Increasing Productivity in a Helpdesk and IT Support Operation

Maria Manuel Teixeira Pinto

Master's Dissertation

Supervisor at FEUP: Prof. José Machado
Co-supervisor at FEUP: Prof Marco Parente
Supervisor at Rangel: Eng. Miguel Cordeiro

U. PORTO

FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

Master in Mechanical Engineering

2023-06-18

Abstract

With the advance of technologies, the digitalization of the industry, and the significant increase in efficiency that its adoption can bring, companies are increasingly betting on creating information systems and departments entirely devoted to technology to remain competitive in the market. Assimilating digital transformation is, therefore, essential. This revolution in the industry creates the need for companies to ensure a good network of information systems and their maintenance. Furthermore, it increases the volume of technology used daily in its operations. In addition to ensuring the quality of information systems, it is crucial to ensure the maintenance and smooth running of all the technologies that support the company's processes, from applications, software, systems and technological devices that can be a simple computer or a production label printer.

This is where the Information Systems Department (ISD) comes in, specifically, the infrastructure team in which this project was developed. It is, therefore, of extreme importance for the business and its prosperity that the performance and efficiency of the infrastructure team are guaranteed because, although it is a team that does not add direct value to the company, it expresses extreme importance since it regulates and prevents situations that may create a loss of value for the company. In this sense, the present project was developed to obtain and implement improvements that increase the performance of the Helpdesk service through continuous improvement techniques and process management, tackling the main problems of the team in question, which, as a result of the lack of standardisation and documentation, among others, were expressed as poor performance and low level of efficiency.

First, the initial situation of the team was studied, and the integration into it was carried out through analysis and study of the processes of the team and the Helpdesk software using lean methodologies; the Gemba Walk and Shadowing were the first ones adopted. Once the As-Is were designed, a deeper analysis using data analysis was performed to obtain quantifiable values of the team, its tasks, and the work volume faced by the them. In addition, a study of the root causes through a methodology of Daily Kaizen, along with the PDCA Cycle, was carried out by understanding the recurrent difficulties of the technicians and the general reasons for the low performance of the service to which they are committed. Finally, the improvements found were implemented, and forecasting techniques were developed to reveal their impact on the team in the long term.

The results obtained and the project's objectives were compared to understand its significance and success. The implementation of the behavioural, procedural and methodological improvements has proved to be a valuable asset to the team, increasing the level of service in 20% and reducing the response time in 27%.

Finally, given that continuous improvement is a constant search for perfection, it was suggested some future works, which were considered to be interesting cases to study, that may be carried out, both in continuing the implementation of the improvements that could not be carried out due to difficulties within the organisation and in new methods to be studied and situations that represent possibilities for improvement.

Resumo

Com o avanço das tecnologias, a digitalização da indústria e o aumento significativo de eficiência que a sua adoção pode trazer, as empresas apostam cada vez mais na criação de sistemas de informação e departamentos inteiramente dedicados à tecnologia para se manterem competitivas no mercado. Garantir a assimilação da transformação digital é, portanto, essencial nos dias de hoje. Esta revolução no sector cria a necessidade das empresas assegurarem uma boa rede de sistemas de informação e a sua manutenção. Além disso, aumenta o volume de tecnologia utilizada diariamente nas suas operações. Para além de garantir a qualidade dos sistemas de informação, é fundamental assegurar a manutenção e o bom funcionamento de todas as tecnologias que suportam os processos da empresa, desde aplicações, software, sistemas e dispositivos tecnológicos que podem ser um simples computador ou, por exemplo, uma impressora de etiquetas de produção.

Aqui entra o Departamento de Sistemas de Informação (DSI), mais concretamente a equipa de infraestruturas na qual este projeto foi desenvolvido. É, por isso, de extrema importância para o negócio e para a sua prosperidade que o desempenho e a eficiência da equipa de infraestruturas sejam garantidos pois, apesar de ser uma equipa que não acrescenta valor direto à empresa, manifesta extrema importância por regular e prevenir situações que possam criar perda de valor para a empresa. Neste sentido, o presente projeto foi desenvolvido com o objetivo de obter e implementar melhorias que aumentem o desempenho do serviço de Helpdesk, através de técnicas de melhoria contínua e gestão de processos, abordando os principais problemas da equipa, que, por falta de standardização e documentação, entre outros, se traduziam num fraco desempenho e baixo nível de eficiência.

Em primeiro lugar, foi feita a integração na equipa e estudada a situação inicial da mesma através da análise dos seus processos, do software de Helpdesk e o funcionamento por tickets que lhe está associado, utilizando metodologias Lean. Gemba Walks e Shadowing foram as técnicas adoptadas para este fim. Uma vez concebido o As-Is, procedeu-se a uma análise aprofundada de análise de dados de forma a obter valores quantificáveis da equipa, das suas tarefas e do volume de trabalho que esta enfrenta. Além disso, efetuou-se um estudo das causas raíz através de uma metodologia de Kaizen Diário, juntamente com o Ciclo PDCA, o qual permitiu compreender as dificuldades recorrentes dos técnicos e as razões gerais para o baixo desempenho do serviço a que se dedicam. Por fim, as melhorias encontradas foram implementadas e desenvolveram-se técnicas de previsão com o intuito de revelar o seu impacto na equipa a longo prazo.

Os resultados obtidos e os objectivos do projeto foram comparados para compreender o seu significado e sucesso. A implementação das melhorias comportamentais, processuais e metodológicas revelou-se uma mais-valia para a equipa.

Por fim, dado que a melhoria contínua é uma procura constante pela perfeição, foram sugeridos alguns trabalhos futuros, que foram considerados casos interessantes a estudar. Estes passam tanto pela continuação da implementação das melhorias que não puderam ser efectuadas devido a dificuldades dentro da organização, como em novos métodos a estudar e situações que representam possibilidades de melhoria.

Acknowledgements

First and foremost, I would want to express my gratitude to my supervisors, Prof. José Machado and Prof. Marco Parente, for all of their assistance throughout the project's development, for always getting the most out of me and for presenting interesting challenges for the project's development. Without a doubt, all the time of interaction was marked by constant learning.

I'd also like to sincerely thank Eng. Miguel Cordeiro for all of his help and support during the project execution and for always integrating me into the team in the best way.

Next, I would like to thank all my colleagues, especially Paulo Neto, Max Johny, Daniel Fernandes, Joana Fernandes, Leandro Cardoso, Daniel Silva and Miguel Lima, for integrating me into the company, making me feel at home and for all the support provided.

I would like to leave a special thanks to Inês Fonseca and Beatriz Araujo, my trainee colleagues, for all the good and hard times spent side by side and the exceptional support, and of course, for the constant good humour which made this experience even better.

I could never forget to thank all of my friends for making these five years so memorable. The ones who have always been a part of my life and those who have integrated my academic experience and made these five years a fantastic adventure. A special thanks to the craziest and most amazing group of friends, Babs, Bábá, Cati, Mulls, Juls, Mary, Sarita, and Teresocas, the pitos that will forever be in my life, who provided unforgettable moments throughout the course and made this period so special.

To Sampii one of the people I most admire for his resilience and commitment, and above all for his heart. Also the person who most put up with me, advised and helped me, and who despite my bad mood never stopped supporting me. And also to my boys Kikiti, Sequi, Zé, Marito, Chico, Zé, Edu and Jorge for being by my side and for nagging me all the time. None of this would be possible without the contribution of each one of you. Last, but not least, I would like to thank my family, for believing in me when no one else does, for putting up with my grumbling, and for holding my hand when I need it. To my mum who has always inspired me by her strength and determination, my brothers who always challenged me to want to be better and supported me in the good and bad moments of life, and finally to my dad who motivates me every day to be a better person and who makes me want to overcome adversities and fight for what I want, and who I hope to be proud of me.

There aren't enough words to thank you all!

"It is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is able to adapt to and to adjust best to the changing environment in which it finds itself."

Charles Darwin

Contents

Acronyms

BPMN	Business Process Model Notation
CCF	Central Composite Face
DOE	Design of Experiments
ISD	Information Systems Department
IT	Information Technology
ITIL	Information Technology Infrastructure Library
JIT	Just in Time
KPI	Key Performance Indicator
PC	Personal Computer
PDCA	Plan-Do-Check-Act
PM	Production Management
RCA	Root Cause Analysis
RSM	Response Surface Modelling
SDCA	Standardize-Do-Check-Act
SLA	Service Level Agreement
TPM	Total Productive Maintenance
TPS	Toyota Production System
VSM	Value Stream Mapping

List of Figures

List of Tables

Chapter 1

Introduction

This project, entitled "Increased Productivity in a Helpdesk and Information Technology (IT) Support Operation", was completed as part of a Master of Mechanical Engineering dissertation at the University of Porto's Faculty of Engineering over the course of five months in an industrial context at Rangel Logistic Solutions, one of largest companies of transport and logistics nationally.

With the global digitalization of the industry and considering the strong growth that the Rangel group is experiencing, it becomes necessary to remain competitive and so, the company must have a developed Tech centre with a wide coverage of information systems. In addition, it is crucial that in all areas of the company, the processes are properly designed and standardized as a way to assist decision-making and eliminate non-value-added activities, increasing operational efficiency.

1.1 Motivation and Aim of the Project

Since Rangel Logistics Solutions is a company with a strong commitment to digitalization, a large part of its workforce uses technology tools and platforms, as well as a wide range of devices, on a daily basis. The high number of employees, 24x7 operations, geographical dispersion, and the reality of remote work poses a set of challenges to the Helpdesk area that seeks to accommodate the growth of the organization with a controlled and sustained increase in costs aiming to extract the maximum value from the available resources by increasing efficiency.

This project was developed by the infrastructure team, a division of the information systems department. This team deals with all the components and services that provide the basis for sustaining the organization's information systems. The major focus of this team is to respond to the Helpdesk tickets with a view of ensuring the proper flow of the whole group operations. The Helpdesk software will be explained in more detail later in this paper.

1.2 Rangel Logistics Solutions Presentation

In 1980 Eduardo Rangel founded a company of customs activity named Rangel. During the 80s and '90s, the company had an accentuated growth in its services, having by 1993 already increased its number of services to four: customs activities, official forwarding agent, transport and logistics. In the 2000s, the need to expand the company geographically was felt, and so Rangel Angola was created. Facing the challenge of growth for other types of industry, in 2009, Rangel extended its transport and logistics services to the pharma industry, having differentiated itself in the market as a pioneer, offering its own temperature-controlled distribution network and innovative traceability systems. The company's detailed history is represented in Figure 1.1.

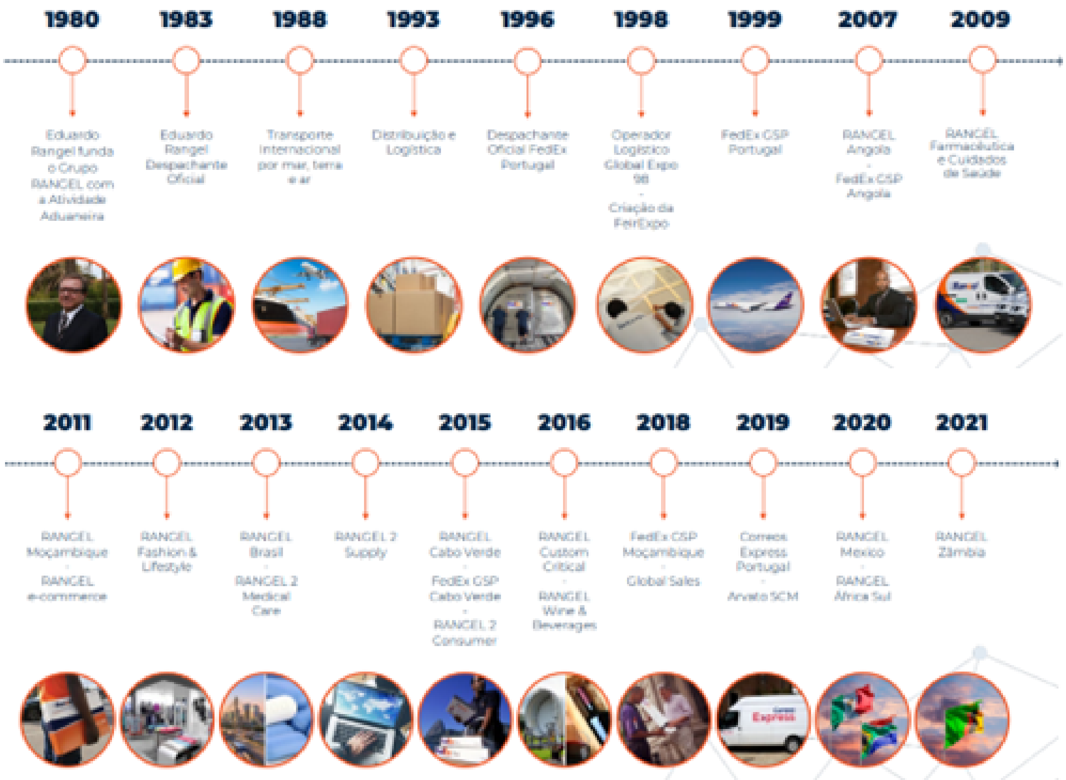


Figure 1.1: Rangel History Timeline, Source: Company Document

Nowadays, 43 years after its beginning as a simple one-service company, the Rangel group reaches a variety of ten industrial sectors with solutions adapted to each one of them, encompassing seven business lines:

1. Customs Broker - The company's first line of business was its customs operation. Any international transaction, whether an import or an export, is based on it.

2. Contract Logistics - Incorporates a diverse experience that enables the implementation of a wide range of integrated supply chain services and solutions. Furthermore, it develops solutions tailored to each industry to optimise the clients' logistics processes.

3. Road Freight - Direct, regular import and export routes to a wide range of destinations and origins, with customized solutions to the situation. From small to large volumes, textile to industrial products, for companies or private individuals.

4. Air & Sea Freight - Creates customized air transport options based on the urgency and kind of cargo. In the area of maritime transport services, it also provides solutions for all items, including hazardous goods and complex logistical processes.

5. Custom Critical - Given the urgency, size, weight, value, risk, or particular design requirements, critical and customized solutions are required for special activities.

6. FeirExpo - Develops the area of logistics and transport for art pieces and trade fairs.

7. Express - Correos Express Portugal is a result of a partnership between Rangel Logistics Solutions and Correos Express Spain. It offers express shipping solutions with global and Iberian coverage, making distances even shorter.

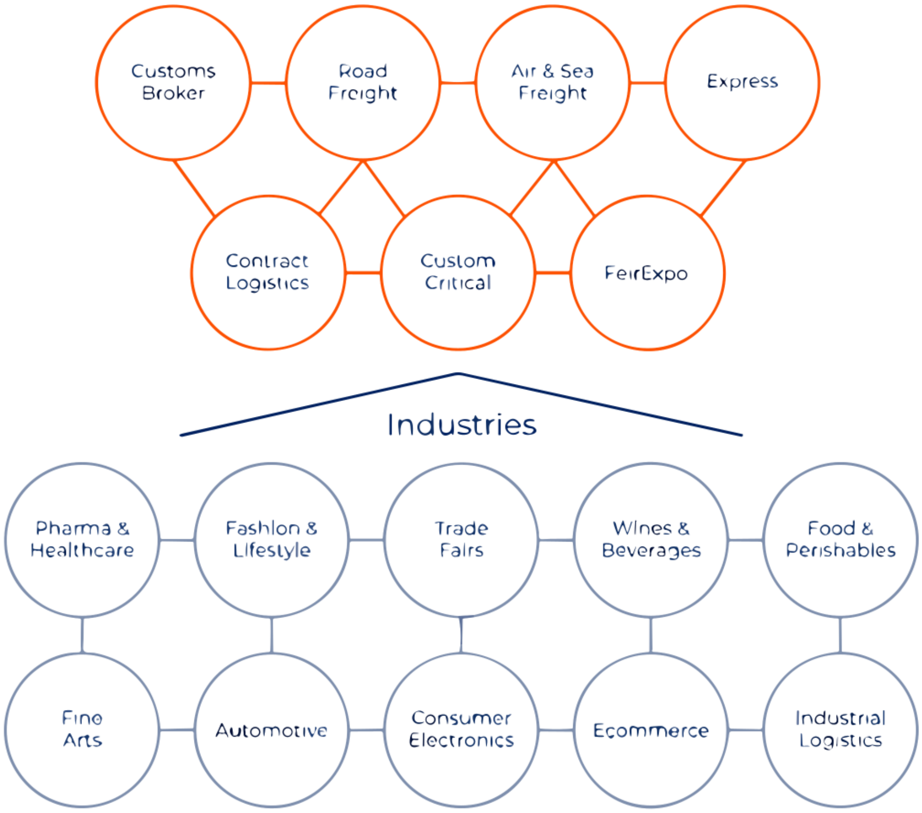


Figure 1.2: Business Lines and Industries, Source: Company Document

Furthermore, Rangel group is present in three continents and, with the help of 2300 collaborators, it moves merchandise between more than 220 countries and territories for 23 thousand clients. Beyond Portugal, it is in Angola, Mozambique, Cape Verde, Brazil, Mexico, South Africa and Zambia. Figure 1.3 shows the locations of the group around the world.

Figure 1.3: Rangel Presence in the world, Source: Company Document

1.3 Project Goals

In order to achieve the previously mentioned aim of the project, some tangible objectives were defined as a gradual way to carry out the increased productivity of the team.

Begin with detecting inefficiencies and non-value-added activities in the process through the definition of methodological approaches. Design and implementation of action plans concerning waste elimination. These led to an improvement of the Helpdesk Key Performance Indicators (KPIs), another goal to accomplish. Furthermore, elaboration of a framework regarding the identified good practices for implementation in other areas.

Following on from the above, and bearing in mind the high request rate this team has to deal with, this project aims to increase the productivity of the Helpdesk and IT support operation. To this end, keeping the focus on increasing the percentage of tickets with a Service-Level Agreement (SLA) in time and reducing incident response time. In other words, improving the team's KPIs. At the beginning of 2023, the team had an SLA of 81% and an average handling time of 258 hours. This project aims to increase the percentage of SLA to 97% and reduce the elapsed time to an average of 204 hours.

1.4 Methodology

All phases of this project and their respective duration times are represented in the Gantt diagram in Figure 1.4 and are explained in detail below.

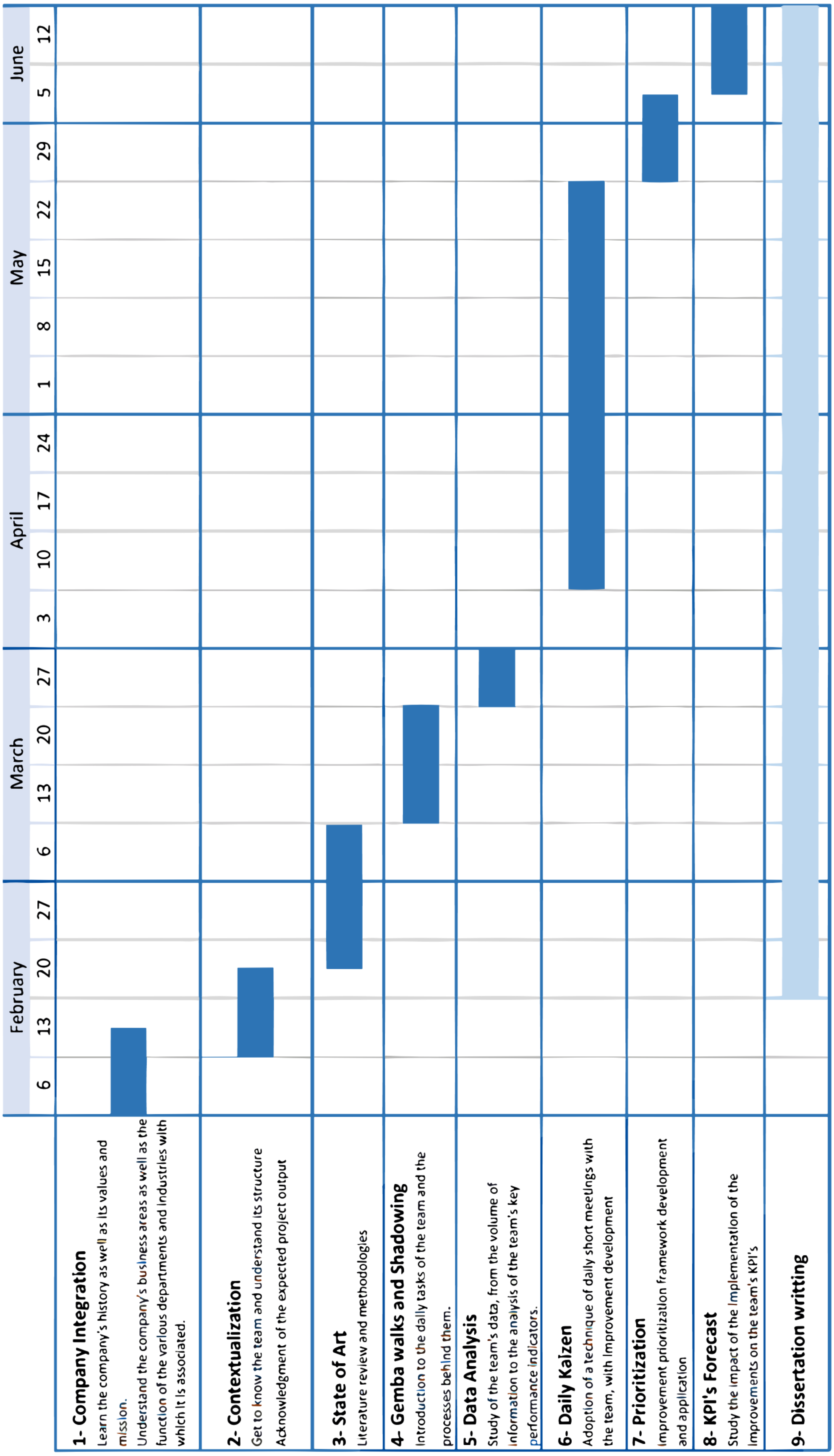


Figure 1.4: Gantt Diagram

The first weeks of this project were dedicated to integrating into the company through a series of training sessions that provided a thorough understanding of its mission and values, as well as its operations and projects. Additionally, as an effort to contextualize the proposed project, a deeper immersion was conducted in the team to be integrated into its procedures.

In the second stage, the Helpdesk, which is the core process of this study, was thoroughly examined, resulting in the design of the As-Is, combined with a research of the most appropriate continuous improvement methodologies and reference frameworks for the activity in question.

Regarding the comprehensive analysis results mentioned above, improvement opportunities were identified.

In order to understand which opportunities would have the biggest impact on the process and on the KPIs that should be improved, qualification and prioritization of the improvements encountered were performed using evaluation techniques.

Passing the decision-making stage, the implementation of the action plan was carried out.

Finally, the benefit tracker was the last stage, which involved tracking whether the Helpdesk KPI's target values were met.

In order to have a clear view of all these stages, a scheme of the methodology is shown in Figure 1.5 with reference to the tools used for each step.

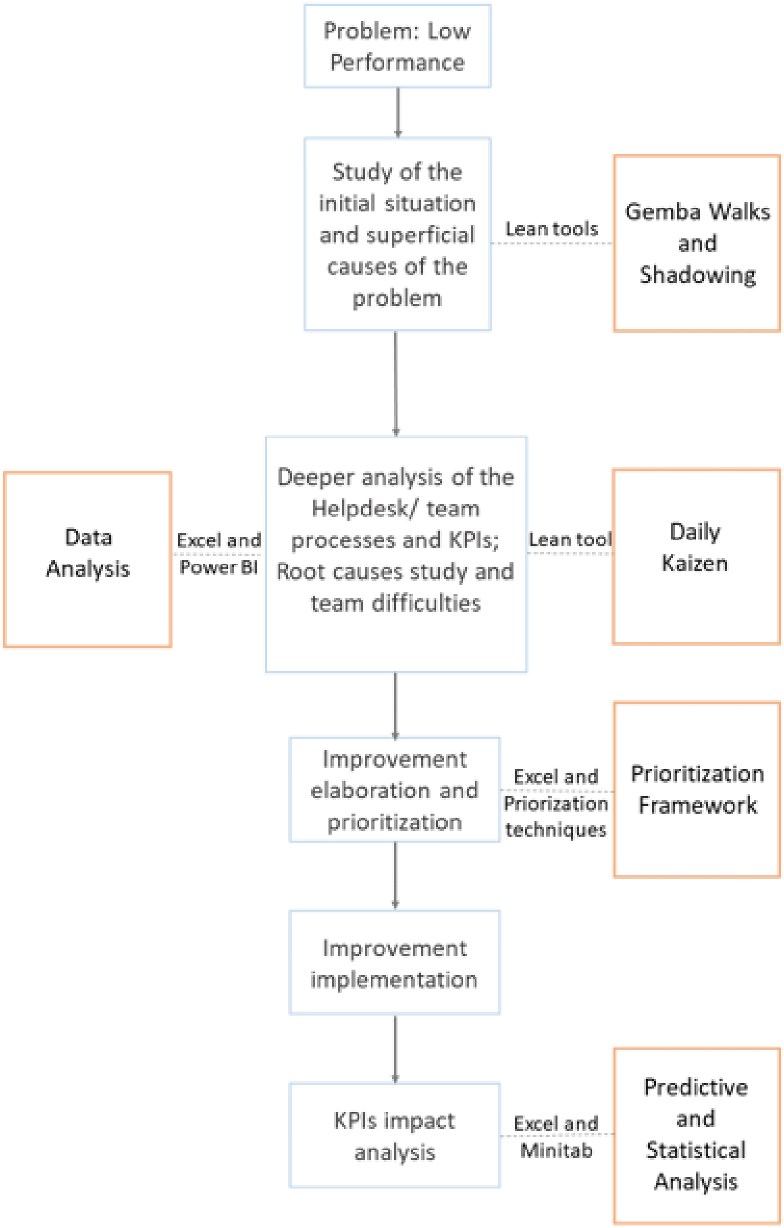


Figure 1.5: Project Methodology Diagram

1.5 Dissertation Structure

The present dissertation is divided into five stages. The current Chapter briefly explains the project's aim and motivation, followed by the company overview. Moreover, the goals to be met are presented, and the methodology to accomplish this is defined.

The literature review is covered in Chapter 2, in which the main topics, methodologies, and techniques adopted throughout the project are made known. It includes the topics: Lean methodologies and tools, business process modelling, data analysis techniques, Design of Experiments

(DOE), Information Technology Infrastructure Library Framework (ITIL), and prioritization methods.

Chapter's 3 primary purpose is to present the project problem and describe the current scenario at Rangel Logistics Solutions with regard to the infrastructures team and the Helpdesk software. In addition, it describes the team's operations and instruments at its disposal.

The methodology used to address the problem and develop the improvements to achieve the project goal are discussed in Chapter 4.

Then, in Chapter 5, all the results coming from the methods provided in the preceding chapter are presented together with a thorough evaluation of the results obtained.

Finally, in Chapter 6, the conclusions provide a brief overview of the project, the work done in this study, and the outcomes. In addition, a synopsis of proposed future work is included.

Chapter 2

Literature Review

2.1 Lean Management

Lean production is just the western designation of the Toyota Production System (TPS). When the TPS was first launched, it had two key distinguishing characteristics: Just-in-time manufacturing and worker empowerment Alves et al. (2011).

TPS sought answers to technical and organizational issues within shop-floor activities while attempting to reduce production costs by eliminating all naturally occurring waste. But the actual essence of TPS goes much further than that, as it benefits from the processes' ongoing, steady improvement. Two prerequisites are necessary for process improvement to be continuous: workers are entrusted and liable for the effectiveness of their work; workers hold appropriate skills, are knowledgeable, and are fully committed to companies' methods and goals. This starkly contrasts standard production control, which is primarily concerned with adhering to production schedules, necessitating inventory buffers to accommodate process failures and unforeseen changes in quantity and product kinds Alves et al. (2011). This is why Lean Production distinguishes itself, in the first place, by how it interacts with the market. In reality, the market drives production, and the lean production system adjusts to this new reality through upstream communications and downstream needs that are drawn in front of the production flow by actual market demands. The workforce is the subject of the second fundamental distinction. Human resources are now considered a resource that naturally wants to work and actually needs to offer more regarding the supply of work rather than a resource that naturally seeks to fight the supply of work. In this model, job responsibilities do not have precise delimitations, and employees are encouraged to participate in production-related decision-making. This encourages acquiring new abilities and assuming responsibility Forza (1996).

Lean manufacturing uses various tools and methods to put its principles into practice. There are over one hundred lean tools that can be implemented; some of the most important lean management tools are 5S, Continuous Flow, Value Stream Mapping (VSM), Daily Kaizen, Kanban (Pull System), Key Performance Indicators (KPIs), Muda (Waste) elimination, Plan-Do-Check-Act analysis (PDCA), Root Cause Analysis (RCA), Total Productive Maintenance (TPM), Gemba walks (The real place). These tools must be adapted carefully for each organizational framework to achieve continuous improvement with a strong local impact Leksic et al. (2020).

Given the project's length, implementing all these tools would be impossible. Therefore it was chosen to use the Kaizen methodology since it is a process improvement technique and enables both the study of inefficiencies and their root causes and the development of improvements to help mitigate these issues while always taking the worker's input into consideration since they are the ones who add value to the process. The following subsections explain the Kaizen technique and specific tools adopted in this project. The sequence of implementation of Lean Production should follow the five lean thinking principles represented in Figure 2.1.

Figure 2.1: Lean Principles, planettogether (2023)

The cyclical application of these principles permits continuous improvement and systematic waste reduction, i.e., eliminating all activities that do not add value from the customer's point of view.

2.1.1 5S - Lean Tool

The 5S tool establishes and maintains an organized, efficient, high-quality workplace. The outcome is the efficient management of the workplace, enhancement of the quality and safety of workers, and avoiding losses associated with failures and breaks Michalska and Szewieczek (2007).

Japan is where the 5S way of thinking first emerged. The name 5S is an abbreviation for five Japanese words that stand for:

- Seiri (Sort) - Refers to the procedure of going through all the equipment, supplies, and others in the workspace and keeping only what is absolutely necessary. Leading to fewer hazards and less clutter to obstruct effective work.

- Seiton (Set in order) - Focuses on keeping the workplace in order; everything should be systematically arranged to guarantee easy and efficient access.
- Seiso (Shine) - Indicates the necessity to maintain a tidy and clean workplace Michalska and Szewieczek (2007).
- Seiketsu (Standardize) - Allows consistency and control by creating a consistent approach to tasks and procedures.
- Shitsuke (Sustain) - Focuses on establishing a new organizational norm and status quo for the workplace, making a habit of properly maintaining correct procedures. The accomplishments of the other pillars would not persist as long without this step EPA (2023).

In this project, the 5S methodology had to be put into a less physical and concrete vision of the workplace to move to a more applied technological and virtual workplace approach, given the area in which the team is inserted.

2.1.2 Kaizen

Kaizen is Japanese for "continuous improvement." The word suggests an improvement that involves everyone and entails little cost. According to the Kaizen principle, our way of life should be centred on constant improvement initiatives. This method produces little, gradual improvements but enormous changes over time. The Kaizen concept explains why businesses cannot stay stagnant for long Imai (2012).

This methodology follows three main principles:

- First Principle - Kaizen is process-oriented. Before results can be improved, processes must be improved.
- Second Principle - Updating and maintaining standards. The only way to create lasting improvements is to combine innovations with continual efforts to maintain and raise standard performance levels. Kaizen focuses on incremental advancements in productivity brought about by continual efforts. If there are no standards, there can be no improvement.
- Third Principle - People-oriented. Everyone in the organization, from top management to employees, should participate in Kaizen. Group-oriented Kaizen is one of the strongest practices harmonizing with this third concept. Kaizen teams prioritize enhancing work processes, routines, and procedures that are often established by management.

2.1.2.1 Daily Kaizen

Daily Kaizen is implemented to influence behaviour in natural teams focused on developing people, problem-solving, and sustained improvements. Any team-based division with a workflow based on processes that generate any kind of output and seek to enhance outcomes, team administration, and the environment can engage in a Daily Kaizen program which is divided into different levels:

- Planning the Daily Kaizen - Analysis of the company to determine whether it is naturally divided into teams organized by value streams, the meeting cascades, and whether the team leaders have an adequate control ratio.
- Daily Management - To involve all staff members in regular, ongoing improvement actions, the team leader should use the Kaizen Leadership principles they have acquired and their team management abilities. Leaders should focus on identifying issues, setting goals, and monitoring Gemba KPIs in daily team meetings and using visual team boards.

  The use of visual team boards is crucial for the success of the Daily KAIZEN Program. It enhances work organization and planning, enables the option of dynamizing the PDCA (Plan, Do, Check, Act) model, and enables the visualization of KPIs to assist in putting up specific countermeasures.
- Standardization - Consists of improving work standards to address the issues previously identified by adopting methods like 5S, Standard Work, and Gemba Walks.
- Training and Coaching - The following sprint will focus on training and coaching, specifically the definition of job instructions, the Improvement Kata, and the Coaching Kata, which are routines to support teams and leaders in acquiring new skills and habits for improvement.
- Problem Solving - Lastly, there is Advanced Problem Solving with tools such as Auto Quality Matrix and Means and sophisticated digital platforms to manage KPIs KaizenInstitute (2023).

2.1.2.2 PDCA cycle

The PDCA cycle ensures the continuation of Kaizen in pursuing a strategy of upholding and raising standards. This cycle of continuous improvement has become a common method in Kaizen and is also used to generate employee improvement habits.

Plan is the term for creating a goal for improvement. Do means to put the plan into action. Checking refers to confirming that the implementation is proceeding as intended and has resulted in the desired improvement. The act involves putting the new procedures into practice and standardizing them in order to stop the original problem from recurring Imai (2012).

This tool will be used in the implementation of certain improvements to the process and of the team itself.

2.1.2.3 Gemba Kaizen

Gemba means “real place”, the place where real action occurs. The Gemba is where value-adding operations that please the client take place in a business. Management can find opportunities to increase the company’s success and profitability by focusing on the Gemba or workplaces.

Effective management of a production site begins with maintaining constant communication and understanding of the Gemba. Some insights for Gemba management are explained below Imai (2012).

- Muda Elimination

  Muda, which in Japanese is translated as "waste," also refers to anything or any activity that does not add value. Value-adding or non-value-adding activities are the only two activities that occur at the Gemba. Since customers do not pay for non-value-adding activities, it is necessary to seek a series of processes in which it is possible to concentrate on each value-adding process and eliminate intervening downtime.

- Gemba Walks

  This concept offers a real opportunity for executives to leave their daily routines, observe where the work happens, and build relationships with employees based on mutual trust. It is a method for gathering information by observing and talking to workers.

  There are three important elements of this lean production tool:

  1. Go and See - The main idea of the Gemba Walk is that managers and leaders at each level should regularly walk the manufacturing floor.
  2. Ask Why - The main goal of a Gemba Walk is to explore the value chain in detail and locate its problematic parts through active communication. The 5W-2H can be used as a means for this end.
  3. Respect people - Remember that a Gemba Walk is not an inspection. The focus should be on identifying process weaknesses rather than employee shortcomings.

- Find the root cause

  Many Gemba-related issues can be resolved immediately and on the spot with a careful examination of the Gembutsu (in the context of the Gemba, the word can refer to a broken-down machine, a reject, a tool that has been destroyed, returned goods, or even a complaining customer) at the problem’s origin and a commitment to pinpointing the underlying causes. Other issues necessitate intensive planning and preparation to address; examples include some engineering challenges or the adoption of new technologies or systems. In these situations, managers need to gather information from all possible directions and may also need to use more complex problem-solving techniques. If managers notice the problem and insist that it be addressed on the spot, about 90% of all problems in the Gemba can be resolved immediately.

Asking "Why?" repeatedly until the root cause is discovered is one of the most effective methods for locating the root cause in the Gemba and then taking a countermeasure.

- Standardize to Prevent

  Management is responsible for finding a solution to each issue as it arises and ensuring that it won't happen again for the same reason. Therefore, the Standardize-Do-Check-Act (SDCA) cycle must be used to standardize the new procedure after resolving a problem. With this being said, every time a problem or irregularity occurs, it is necessary to update the current standards or introduce new ones to stop it from happening again. Standards become a crucial component of Gemba Kaizen and serve as the cornerstone for daily development, and standardization ensures the continuity of the effects of Kaizen Imai (2012).

2.2 Business Process Modelling

The uses of process models are expanding. In addition to their traditional usage in software engineering, process models are increasingly being employed for purely organizational goals. The purpose of process modelling is to provide a tool for managing the complexity of process planning and control.

Process mapping has been adopted in companies as an effective technique to enable organizations to view their business system graphically at any level of detail and complexity. An effective "As-Is" mapping clarifies the PM processes and highlights any inconsistencies, Mura, which is the foundation for a strong "To-Be" model Wil et al. (2003).

2.2.1 Business Process Model Notation

BPMN has evolved into a language for implementation that can be used for business and technical integration procedures. It resolves communication issues between the two worlds by establishing a common notation for IT specialists and business experts. Process diagrams represent what needs to be executed, in what sequence, when, and under what specific conditions Stiehl (2014).

BPMN has five core element categories:

1. Flow objects - These are the main elements of BPMN; they define the process behaviour. It is possible to subdivide the flow objects into three different categories:

   - Event - In order to respond to a wide variety of situations, there are various distinct types. Event types include message, timer, error, compensation, signal, cancel, escalation, link, and others. They are shown by circles containing other symbols based on the event type. There is a visual difference between a start event, which is represented by a circle with a single thin line, an intermediate event by a circle with a double thin line, and an end event by a circle with a thick line, as shown in Figure 2.2.

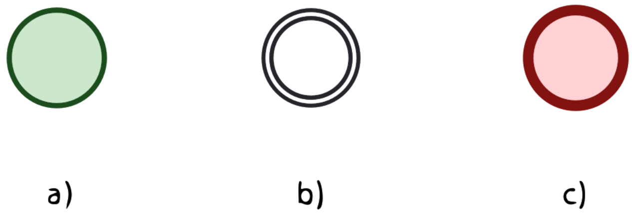


Figure 2.2: Types of events: a) Start event; b) Intermediate event; c) End event. Source: Stiehl (2014)

- Activity - It is possible to divide this element into tasks and sub-processes, both shown by a rectangle with rounded corners. Different markers are used to differentiate tasks in the rectangle upper left corner. The task types used in this project are represented in Figure 2.3 and the sub-process elements in Figure 2.4 Stiehl (2014)

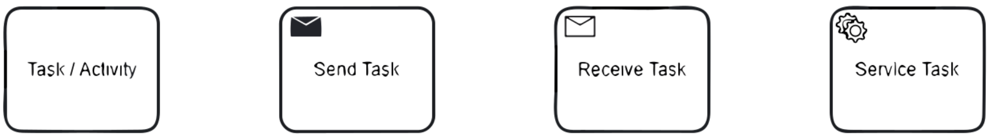


Figure 2.3: Types of tasks. Source: Stiehl (2014)

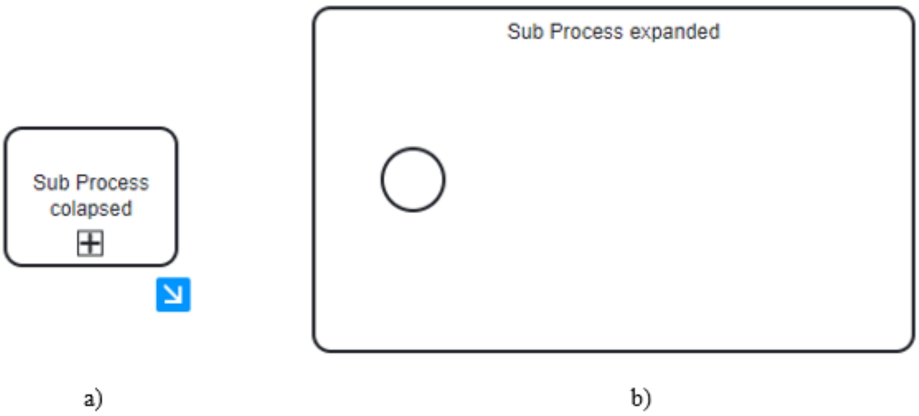


Figure 2.4: Sub process components: a) Sub Process colapsed; b) Sub Process expanded. Source: Stiehl (2014)

- Gateway - Decision point that can adjust the path based on conditions or events. These are used to split and merge process flows and can be exclusive or inclusive. Figure 2.5 exhibits some examples of this element Lucidchart (2023).

Figure 2.5: Types of gateways. Source: Lucidchart (2023)

2. Connecting objects - They link flow objects to one another or supplementary information. These are illustrated in Figure 2.6 Lucidchart (2023).

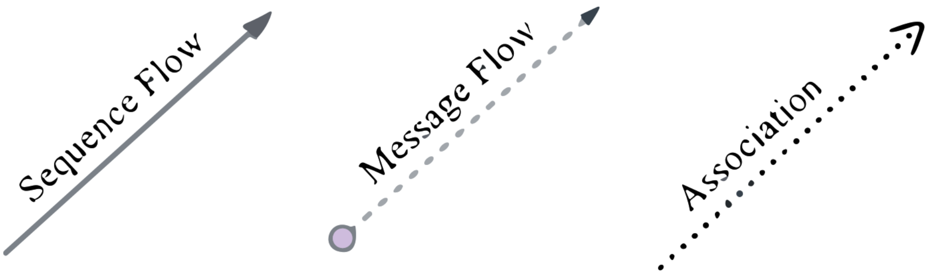
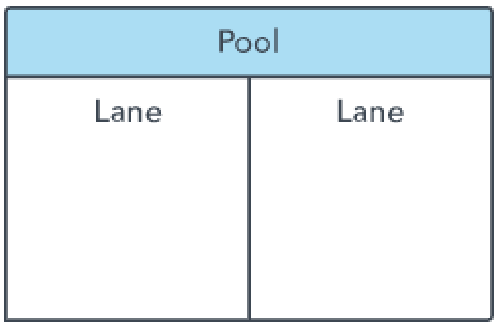


Figure 2.6: Types of connecting objects. Source: Lucidchart (2023)

- Sequence Flow - Illustrates the activities' order.
- Message Flow - Shows messages across pools.
- Association - Connects a text or artefact to a gateway, event, or activity.

3. Pool and Swimlane - These, represented in Figure 2.7, are used to group the above-mentioned key modeling components. A pool depicts the key players in a process. The activities and flow for each participant are displayed in swimlanes within the pool, indicating who is responsible for which steps of the process. Lucidchart (2023)



.

Figure 2.7: Pool and Swimlane. Source:Lucidchart (2023)

4. Artefact - There are three artefact elements, shown in Figure ??. A data object displays which information is needed for a particular activity. The activities are logically gathered in a group without changing the diagram's flow. An annotation provides additional information to a part of the diagram Lucidchart (2023).

Figure 2.8: Types of artefacts. Source: Lucidchart (2023)

2.3 Data Analysis

Data analysis deals with statistics or, more specifically, the science of data collection, analysis, and objective interpretation. Using statistics makes it possible to create predictions and identify patterns and associations. Having data doesn't necessarily mean it's quality data. Occasionally, the data provided does not add meaning or value, or it might have been collected biasedly. The key here is its objectivity which ensures that the outcomes it produces are free from bias and individual motives. It is crucial that the information gathered is thoroughly examined in order to ensure the validity and reliability of the results Turner et al. (2015).

First, it is important to analyze the existing types of data. There are two sorts of data when performing research and data analysis: quantitative and qualitative data.

Quantitative Data - Any information that can be quantified is referred to as quantitative data. It may be measured, counted, or assigned a numerical value.

Qualitative Data - Qualitative data, in contrast to quantitative data, cannot be counted or quantified. It is descriptive and uses language to describe ideas rather than numbers CareerFoundry (2023).

The differences between these two types of data and their properties are resumed in Table 2.1.

Table 2.1: Data Differences. Source: CareerFoundry (2023)

Quantitative Data	Qualitative Data
Countable or measurable; relating to numbers	Descriptive, related to words and text
Answers to how many, how much, how often	Helps in understanding the why or how behind behaviours
Fixed and universal	Dynamic and subjective
Gathered by measuring and counting	Gathered through observations and interviews
Analysed using statistical analyses	Analysed by grouping the data into meaningful themes or categories

2.3.1 Statistical Analysis

- **Descriptive Analysis** - Entails gathering, interpreting, summarizing, and analyzing data in order to portray it as charts, graphs, and tables. It makes the complicated data easier to read and understand rather than offering conclusions.
- **Inferential Analysis** - Focuses on using the data analyzed to draw useful conclusions. It investigates the connections between various factors or makes predictions for the whole population Coursera (2023).

There are five steps when performing a statistical analysis:

1. First Step - Identify and describe the type of data to be analyzed and its nature.
2. Second Step - Build a connection between the sample population to which the data belongs and the studied data.
3. Third Step - Develop a model that concisely explains and presents how the population and the data are related to one another.
4. Fourth Step - Establish the validity of the model.
5. Fifth Step - Predict future patterns and events that will likely occur using predictive analysis Simplilearn (2023).

2.3.2 Qualitative Data Analysis

Also, in qualitative data analysis, five fundamental steps are followed:

1. Get to know the data - Understanding the data is key to performing successful analysis. Reading and rereading the text for qualitative data is necessary for this phase. As going through the data, impressions may be written down.
2. Focus the analysis - Review the evaluation's goals and purpose again. Determine the main inquiries the analysis must address.
3. Categorise information - Identify themes and group them into logical categories.
4. Patterns and connections identification - Patterns and connections will emerge as data and relationships inside and across categories are categorised.
5. Interpretation - Findings explanation using the themes and connections discovered Renner and Taylor-Powell (2003).

2.3.3 Pareto Principle

According to the Pareto principle, 20% of the input or causes lead to 80% of the output or consequences for many phenomena. It is helpful to understand that the majority of results often come from a small number of inputs. This is often applied in management, economics, business, computer science and human activities to increase productivity and make better decisions.

The Pareto Principle is a simplified version of the mathematics behind the Pareto distribution. It is also unimportant if the two numbers do not total up to 100 per cent. The numbers 20 and 80 are general guidelines but are not mathematically set. There are possible variations of 80-20, 90-10, or even 90-20 Dunford et al. (2014).

The classical Pareto distribution is defined in terms of its cumulative distribution function:

where xm is a scale that indicates the necessarily positive minimum value of x and the Pareto index Dunford et al. (2014).

As this principle is applied to various situations and contexts, there are several examples that can help to understand it in real contexts: 80% of the revenue comes from 20% of the customers, 20% of products yield 80% of sales, 20% of society holds 80% of its wealth, and 80% of car accidents are caused by 20% of young people Investopedia (2023).

2.4 Design of Experiments

Design Of Experiments (DOE) is a strategy for methodically using statistics in experimentation. In order to observe and determine the causes of these changes in the output response, it can be more clearly described as a sequence of experiments in which deliberate modifications are made to the input variables of a process or system. DOE is very helpful in identifying the key variables affecting the process-relevant quality parameters Tye (2004).

The steps of this methodology are Tye (2004):

1. Identifying variables that may have an impact on the experiment's outcome and measuring participant responses.
2. Selecting a suitable experimental design for screening or modelling the response surface.
3. Creation of a design matrix specifying the experiments to be run.
4. Conducting the experiments.
5. Fitting the data and generating plots that describe the trends in the results.
6. Drawing conclusions and planning the next step.

There are numerous varieties of experimental designs. The ones based on factorial designs are the most widely used and easiest to comprehend. Consider a series of experiments; for instance, three elements are considered to be important. A low and high value of each factor can be used, generating a two-level factorial design. The design can be thought of as a cube, with the corners representing the possible combinations of the factor levels (low or high). Thus, the cube represents the experimental area under investigation Alagumurthi et al. (2006).

The design chosen is typically a compromise between the amount of data needed and the number of tests to be run. Low-resolution designs will typically be sufficient for easier screening of experimental parameters. These are usually full or fractional factorial designs:

Full Factorial design - Each cube corner represents a combination of the factors used in an experiment. In order to assess reproducibility and find non-linear responses, a centre point is usually included and replicated three times.

Fractional Factorial design - Eliminates two corner points from the full factorial design to reduce the number of experiments Tye (2004).

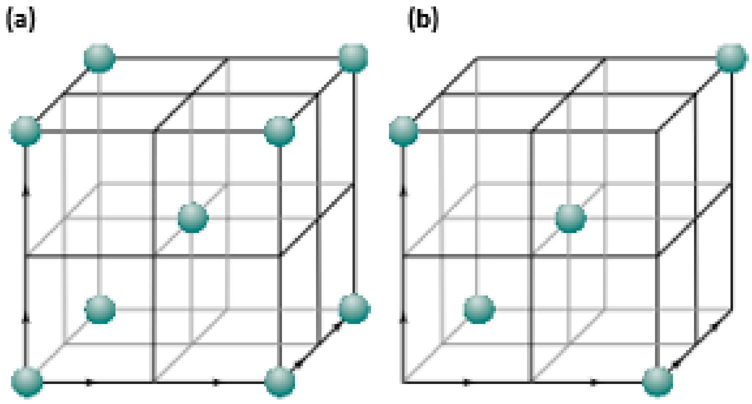


Figure 2.9: Design Regions examples for two-level designs, using three factors. (a) Full Factorial design; (b) Fractional Factorial design. Source: Tye (2004)

For initial sets of trials, factorial designs are helpful for figuring out which of a group of factors is important. The screening designs can only accommodate linear answers. Thus, a more complex design type is needed if a non-linear response is found or a more precise representation of the response surface is needed. Designs like Box-Benhken or Central Composite Face (CCF) are frequently utilized for Response-Surface Modelling (RSM) and optimization applications, and they support non-linear responses:

Central Composite Face design: Derived from the full factorial design, created by adding more points to the face centres to simulate a sphere.

Box-Benhken design - An alternative to the CCF design, which samples the cube's edge centres again to simulate a sphere Tye (2004).

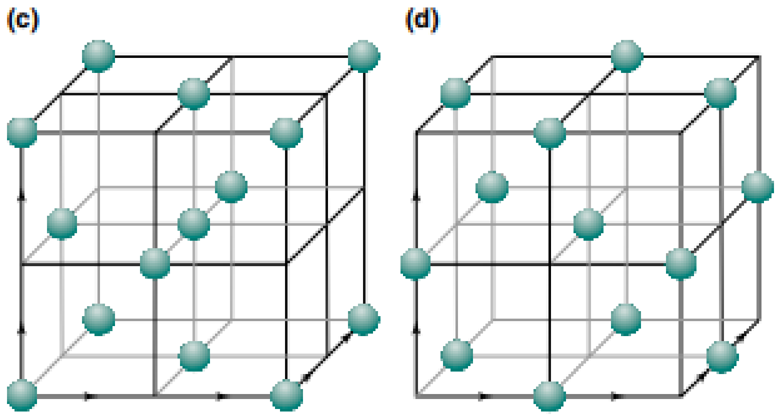


Figure 2.10: Design Regions examples for two-level designs, using three factors. (a) Central Composite Face design; (b) Box-Benhken design. Source: Tye (2004)

It is generally best to conduct an initial screening phase with a larger number of factors using a low-resolution fractional factorial design. Once the key factors have been determined, an RSM design optimisation step can be carried out.

2.5 Information Technology Infrastructure Library Framework - ITIL

This framework offers the best-practice guidance that is applicable to all kinds of businesses that offer services. Organizations all across the world utilize ITIL to create and enhance capabilities in service management. This framework is divided into five approaches Steinberg (2007):

1. Service strategy aims to build up businesses for operational effectiveness and a standout performance by ensuring they can manage the costs and risks connected with their service portfolios.

2. Design ideas and techniques for transforming strategic objectives into service portfolios and service assets are referred to as service design. Service Design is not just for brand-new services.

3. The requirements of Service Strategy embedded in Service Design are efficiently achieved in Service Operations while minimizing the risk of failure and disruption thanks to Service Transition.

4. To ensure value for both the consumer and the service provider, service operations offer advice on achieving effectiveness and efficiency in the delivery and support of services.

5. Continual Service Improvement incorporates the ideas, procedures, and techniques of Capability Improvement, Quality Management, and Change Management. Organizations learn to achieve small-scale and significant gains in operational effectiveness, service quality, and business continuity.

ITIL is not just about straightforward, rote IT skills. It also examines how administrators can use their knowledge to align with business practices within the context of their organization as a whole, which is a significant evolution in the role of IT. As a result, administrators can address every aspect of IT management using more consistent best practices. In light of this, there are six primary, observable advantages of ITIL:

- Improved service timeliness and customer satisfaction.
- Better goal alignment between IT departments and the business.
- Educed operational costs as a result of better resource utilization, digital, physical, and human.
- Increased visibility of IT costs and assets.
- Streamlined service disruption response and management.
- More flexible service environment that can easily adapt to change.

ITIL v3 teaches us that IT tickets can and should be divided into four categories, as explained above:

- Service Request Tickets - Contains an inquiry for information about a product/service or a request, for example, new hardware/software, password resets, and software licenses, to name a few. Some of these may need approval before they can be fulfilled. Example: Request for training to use a projector.
- Incident Tickets - Unplanned interruption or reduction in the service quality of an IT product. This scenario intends to resolve the issue quickly and restore productivity and operational efficiency. Example: A laptop that won't start.
- Problem Tickets - These are the root cause behind incidents. Problems can become major incidents that affect multiple users simultaneously. Problem management involves identifying, understanding, and finding methods to eliminate the root cause of an incident.
- Change Request Tickets - Any change, modification, or replacement in the product/service needs to be managed and supported. Changes can be standard, with pre-approved processes, or they can be non-standard, with higher risks. These are analyzed and approved. Example 1: Moving on-premises services to the cloud.

Separating the requests is a way to really advance the maturity of an IT organization, and by doing this, the Helpdesk is better able to handle incident types that aren't typical low-impact changes since it is easier for the team to organize the tickets. It allows the team to quickly see the number of standard requests received, giving an insight into where to allocate resources. Finally, this practice will keep reports organized and clear. It makes it possible to compare the number of incidents to the number of service requests, figure out the cost of support, and allocate resources appropriately.

2.6 Prioritization Methods

Prioritization techniques are tools used to order a list of tasks or actions in a variety of ways. The idea behind these techniques is to increase your productivity by helping you define and manage priorities. Many models offer distinctive features that can be helpful in different applications. Some of the most common and known ones are explained below:

Cost-Benefit Matrix - This is part of a systematic procedure to determine which options to take. The cost-benefit analysis sums the potential benefits anticipated from a circumstance or course of action and subtracts the overall expenses related to that action Rogers et al. (2009).

MoSCoW - This method is a numerical assignment technique. Four priority groups are created: ”MUST have”, ”SHOULD have”, ”COULD have”, and ”WON’T have”. Requirements are assigned to these groups based on the importance of having them implemented.

Eisenhower Matrix - This method divides priorities into four quadrants to achieve a long-term success project. The chart is separated into importance and urgency.

RICE - This a scoring system that stands for Reach, Impact, Confidence, and Effort. For each of these factors, a score is assigned timeular (2023).

Chapter 3

Problem Description

This chapter will explain the initial situation of the team with emphasis on the software under study, the Helpdesk 4.0, and the key actions it involves. A more detailed study of the team's processes will be carried out to investigate which are the most frequent and important.

The infrastructure team is part of the information systems department, as mentioned in Chapter 1. This team takes care of all the services and processes that support the team's information systems and the assets that keep the organization running smoothly. It deals with both software and hardware issues. Given the broad scope of this team's activities, it is divided into five areas which will be explained below. The main focus of this work will be on the Helpdesk. This team consists of an average of twelve staff members, including a team leader, five technicians, and six specialists, distributed across several locations; seven of them operate in Alfena, two in Montijo, other two in Póvoa de Santa Iria, and finally, there is one specialist in Angola. The size of the team is quite volatile, and most of the team is quite young, as the average length of time the team has been with the company is one year. This is because it is an area that overloads the technicians and often leads to exhaustion.

The Helpdesk software that the team uses to support the whole company works on the basis of tickets created by the customer, in this case, the company's employees. The software forwards these tickets to the appropriate team, depending on the type of problem, i.e., through a code based on the application the user selects.

Important Note: For confidentiality reasons, all figures related to the company in which the project was integrated have been changed and are, therefore, fictitious. However, their relationships remain real so that they can be studied.

3.1 Helpdesk 4.0

Helpdesk serves an important role in the information technology department by providing the primary point of contact for users to contact analysts to help them resolve problems. It can be seen as an information and assistance resource that supports the functionality of an organization by responding to users' requests in a timely manner. It is a core sector through which problems, complaints, and requests, including hardware, software, and networks, are reported, managed, coordinated, and resolved.

The more distributed the information technology, the more support the end users require. As a result, Helpdesk software has experienced an increase in the number of information technologies they must support and an increase in workload.

The team in which this project is integrated handles a large number of requests daily, an average of 64.1 requests daily, and closes an average of 63.5 tickets daily.

This may seem like an excellent ratio between closed and opened tickets. However, considering the tickets in progress created previously that have not yet been resolved and closed, which have a daily average of 51, it is noticeable that there is a constant increase in tickets that remain unresolved. Considering the numbers described above and analysing the results of these values over one month, it is possible to obtain the behaviour represented in Figure 3.1.

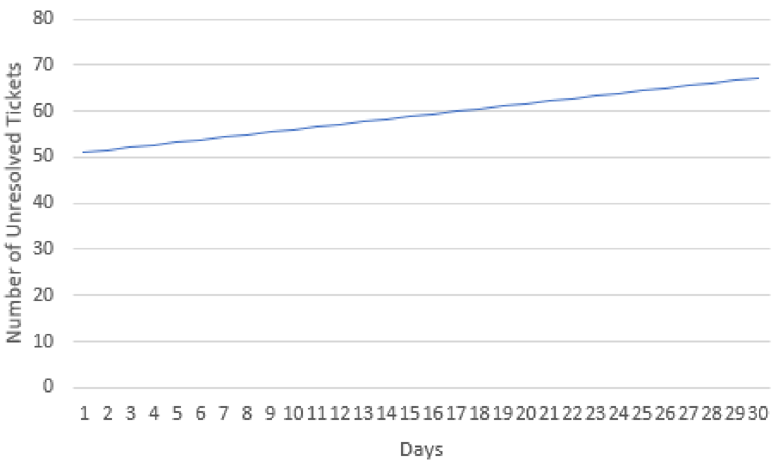


Figure 3.1: Unresolved tickets behaviour

This increase in the number of unresolved tickets arises from the fact that the results depend on the immediately preceding result, creating an accumulation of impact from something that initially appeared to be insignificant.

The Helpdesk software used by the team is bought from the Manage Engine, the IT management division of Zoho Corporation. The team is utilizing the standard edition designed for IT and non-IT teams. This includes multiple services that help in service management:

- Incident management.
- Customizable ticket templates.
- Visual ticket lifecycle builder.
- No-code ticket handling automation.

- Self-service portal.
- Knowledge base.
- SLA management and escalations.
- Reporting and live dashboards.

Although the Helpdesk service offers all these features, many of them have not yet been adopted, and others have only been partially implemented. This will be explained in detail below.

3.2 Current Situation

The whole process, from ticket creation to ticket closure, will be explained in detail in the following subsections to give a clear idea of what the team did at an early stage of the project. All these steps and processes, and even monitoring ticket-related reports, are part of the Helpdesk incident management tool mentioned above.

The current situation was studied using the Gemba walks and Shadowing methodology presented in Chapter 2 Section 2.1.1.2. and explained in detail in Chapter 4 Section 4.1. This study allowed obtaining the first information regarding the team. It made it possible to comprehend the division of the team into its main parts as well as the role of each technician within the team and their individual areas of activity.

The infrastructure team is divided into five major sections: systems, network, facilities, workplace, and Helpdesk. The last two of which can be combined into a single section due to their strong correlation.

Table 3.1 represents a brief explanation of the five existing areas within the team, while table 3.2 presents all the information collected, duly organized, regarding the technicians.

Table 3.1: Team's areas

Team's areas of expertise	Description
Systems	Takes care of the management and maintenance of the computer park, from the organization's computers to the servers; also, it is in charge of ensuring the installation and maintenance of the applications.
Network	Network involves everything from monitoring and troubleshooting your network to making necessary changes and upgrades. It includes the network's physical components, such as routers, switches, and cables, and the network's software, such as networking protocols and networking services.
Facilities	It enables a productive, supportive workplace by managing the physical environment of vital IT infrastructure. Furthermore, it ensures an optimized synergy between digital assets and workplace facilities and cooperates with IT support to install and service IT assets.
Workplace	Refers to everything that involves the workspace, such as equipment, working methods, and contracts with companies that provide the assets (computers, monitors, software, among others).
Helpdesk	Provides technical support to end users, troubleshoots customer and user issues, and/or guides them through specific tasks and actions. A help desk's definitive goal is to resolve user requests as efficiently as possible.

Table 3.2: Worker's Functions and Areas

Worker	Location	Function	Area
1	Alf	IT infrastructure coordinator	–
2	PSI	Senior engineer	Workplace/Helpdesk/Systems
3	Mt	Senior engineer	Network/Facilities
4	Alf	Support technician	Systems/Helpdesk/Workplace
5	Alf	Specialist	Systems
6	Alf	Specialist	Helpdesk/Workplace/Facilities
7	Alf	Support technician	Helpdesk/Workplace
8	Alf	Support technician	Helpdesk/Network/Workplace
9	Alf	Specialist	Network
10	PSI	Support technician	Workplace/Helpdesk
11	Mt	Support technician	Workplace/Helpdesk
12	Angola	Specialist/Support technician (Angola)	

Specialists provide second-line support, while support technicians represent the first line of support. Worker twelve does both the first and second lines of support because, for general problems, he is part of the second line; however, any problem coming from or related to Angola should be solved by him, and therefore, in these cases, he is part of the first line of actuation.

By looking at Table 3.2, it is noticeable that many staff members are dedicated to several areas at the same time, which shows the weak technical speciality and definition of their areas. This creates situations where they don't know who to forward the ticket to or where the ticket is assigned to someone with insufficient know-how. In addition, this analysis gave insights into the main problems within the team that lead to low efficiency, although in a rather general way, since obtained through communication with the team:

- Lack of documented processes.
- Lack of standards, e.g. each technician carries out tasks in his own way without understanding if there is a correct way.
- Weak organization, for example, a technician has a request with priority level 2 and another with priority Level 4, resolves first the priority 4 because it is easier and requires less work.
- Poor communication between the team; for instance, technicians pass tickets without communicating or pass a ticket about to expire without alerting the colleague of this deadline.

Furthermore, this made it possible to map the Helpdesk process from ticket creation to closure. The whole process is represented in the BPMN diagram in Figure 3.2.

- First lane - As the diagram demonstrates, there are numerous ways to contact a technician, but only the Helpdesk platform form creates a ticket. This way, if the contact is made through one of the other ways, it will not be registered in the software. This type of activity can cause inconsistencies in the management of tickets.
- Second lane: Moving on to level one support, if a ticket has been created, it will appear in the Helpdesk interface, in this case, related to the infrastructure team. The technician in charge of sorting then defines the ticket in accordance with its properties and assigns it to a technician with expertise in the relevant area, who will be responsible for its resolution. Ticket assignment at triage is done for first-line support technicians and second-line specialists. The triage moment is no longer part of the process if a ticket has not been created. During the actual resolution, the technician analyses the ticket and, if he does not know how to solve it, questions colleagues with a higher level of know-how. If the solution is found, the ticket is resolved and then closed. Otherwise, the ticket is passed to the level two.
- Third laneGemba - Second-line specialists look at the ticket to understand if it is well-categorized or needs re-categorized. They also go through the ticket analysis phase and check if the ticket that comes directly from triage has been escalated. If they can't resolve

it, similar cases are searched for, or if it's a documented process, they resort to the database. When the solution is found, the issue is reviewed following resolution, and if it was handled correctly and the problem is fixed, it is immediately closed. On the contrary, if, after the resolution, the problem persists, the incident manager is notified.

When the solution is not in the documented processes, or there are no similar cases that can help find the solution to the problem, it may still be necessary to ask for a service from an external supplier, in which case the request is placed On-Hold, pausing the time in which the ticket has to be solved in, the SLA. After it has been resolved externally, the technician is informed, and the ticket is closed.

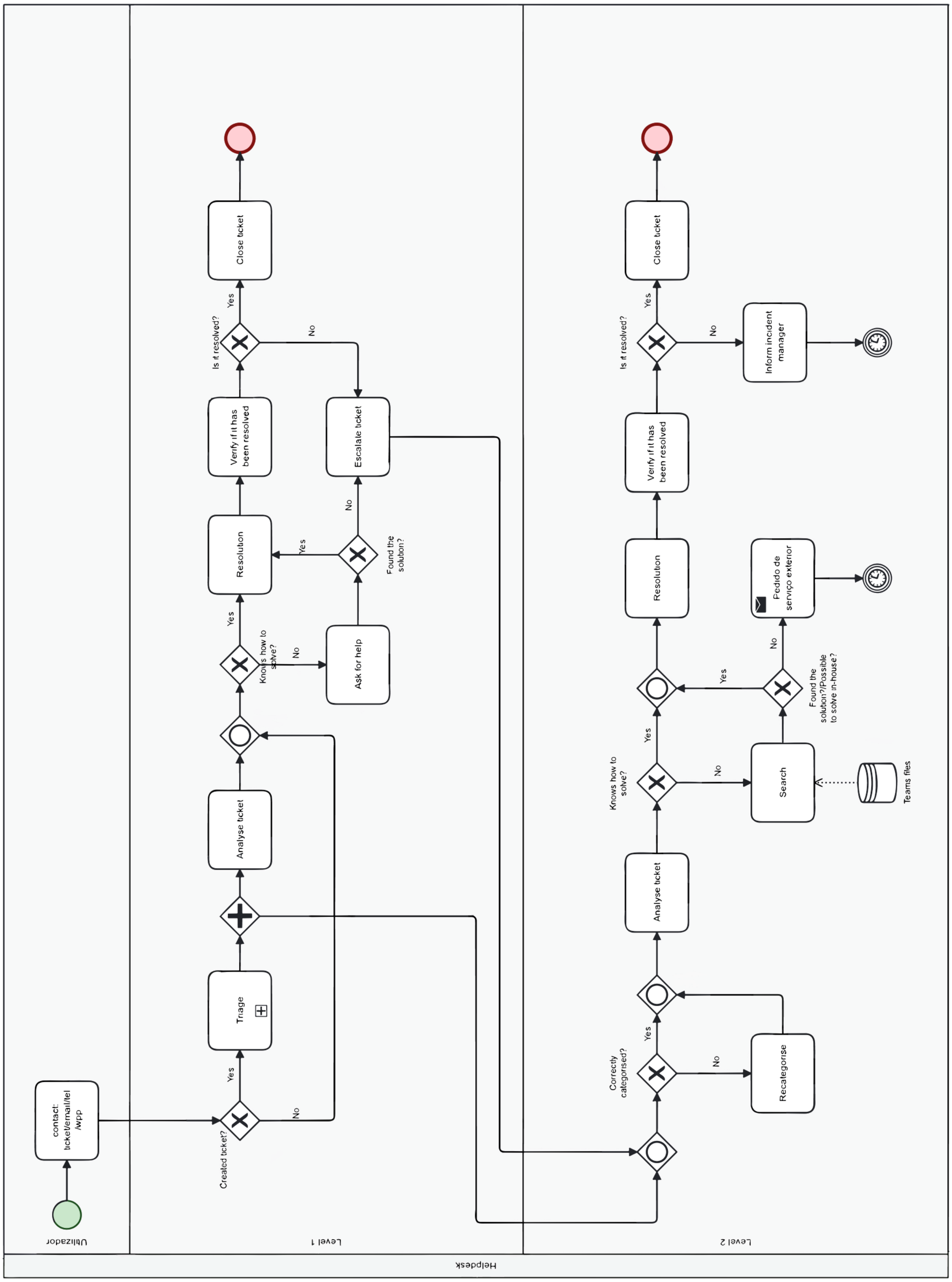


Figure 3.2: As-Is process model

3.2.1 Ticket Creation

The ticket is initially created by the user, preferably via the form in the Helpdesk portal, although contact can be made through another platform, for example, via Teams. The user selects in which application the issue is from a set of existing options that include:

- Angodespa / Gidwin / Trans2004 (Aplicações Despachante).
- Aplicações Trânsitos (Unix, Billflow, RIWare, and ohers).
- Bluejay Air and Sea (TMFF).
- E2Open Road Freight (LSP).
- GCOM / PDAs / Integrações Generix.
- Genero / i-Customs / DigitERDO.
- ICOL / RFs / Pdas / Primavera.
- Permissões de acesso (Pastas partilhadas, VPN).
- Portal MyRangel / WebShipping.
- Posto de trabalho / Impressoras / Comunicações.
- QlikView / Cubos.
- SAP / Portal de despesas / RPA / Sharepoint / Portal id4.

Besides this, a subject must be specified. If necessary, there is an optional field where it is possible to describe the problem or attach documents and figures that might help in the resolution. Figure 3.3 shows the Helpdesk user form for ticket creation.

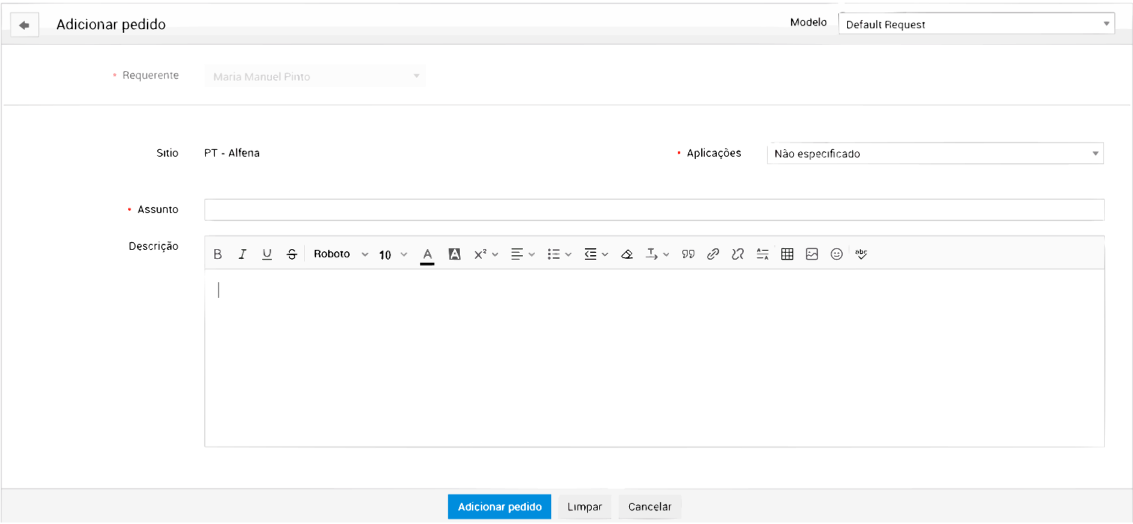


Figure 3.3: Ticket creation form, Source: Helpdesk software

By observing the tickets and communicating with the team, it was noticed that this was an unfavourable aspect of the team's performance since a frequent complaint from the technicians is that the tickets are badly created due to not being directly on the subject parameter or a poor description of the problem. This happens largely, given the poor technical knowledge of the users. With this being said, this will be a point for further study in order to understand how this ticket creation process can be improved, considering the opinion of both the technicians and the user

After creating the tickets, the Helpdesk software forwards them directly to the responsible team. The infrastructure team handles tickets related to "Permissões de acesso" and "Posto de trabalho / Impressoras / Comunicações".

All tickets are gathered into the Helpdesk platform in a datasheet common to all teams. However, it is possible to change the visible tickets in accordance with what is desired. For example, tickets from a specific team and tickets with an expired SLA, among other examples.

3.2.2 Ticket resolution

This process encompasses all the steps from receiving the ticket, or user help request to handling the incident itself and closing the ticket. This is ensured by the Helpdesk and IT support team that splits into two different levels for ticket resolution:

Level 1 - This includes the support technicians; they are the first to have contact with the ticket and analyze it. Most incidents should be resolved immediately at this level.

Level 2 - When the level one support technicians cannot resolve the incident or the ticket involves a high level of know-how, the ticket is assigned to the support specialists representing level two.

3.2.2.1 Triage

This sub-process, represented in Figure 3.4, involves the initial analysis of the ticket, the definition of its properties, and, if necessary, information gathering from the user. Finally, the ticket is assigned to a support technician according to the type of incident.

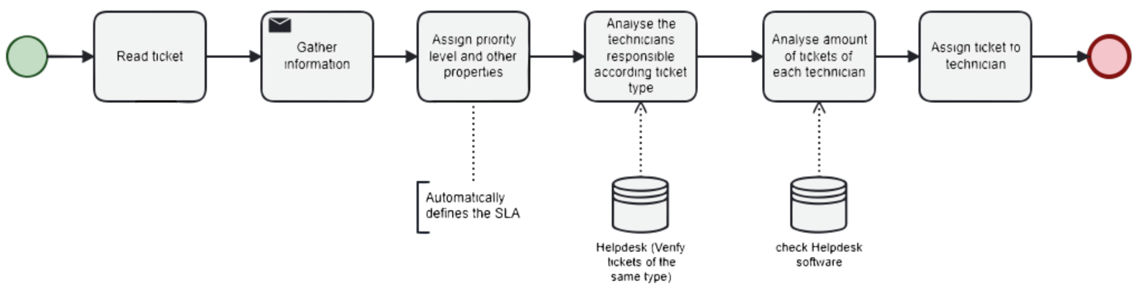


Figure 3.4: Triage sub-process.

To assign a ticket to a technician, at the time of triage, the person responsible for this process makes a brief survey of which technicians typically handle the type of request in question and how many tickets each has to avoid overburdening coworkers. This simple research is performed using the Helpdesk software, which involves searching for requests with the same subject and selecting the technician's name to view the number of pending tickets.

The technician's interface, visible at the time of triage and on which the various properties are assigned, is shown in Figure 3.5.

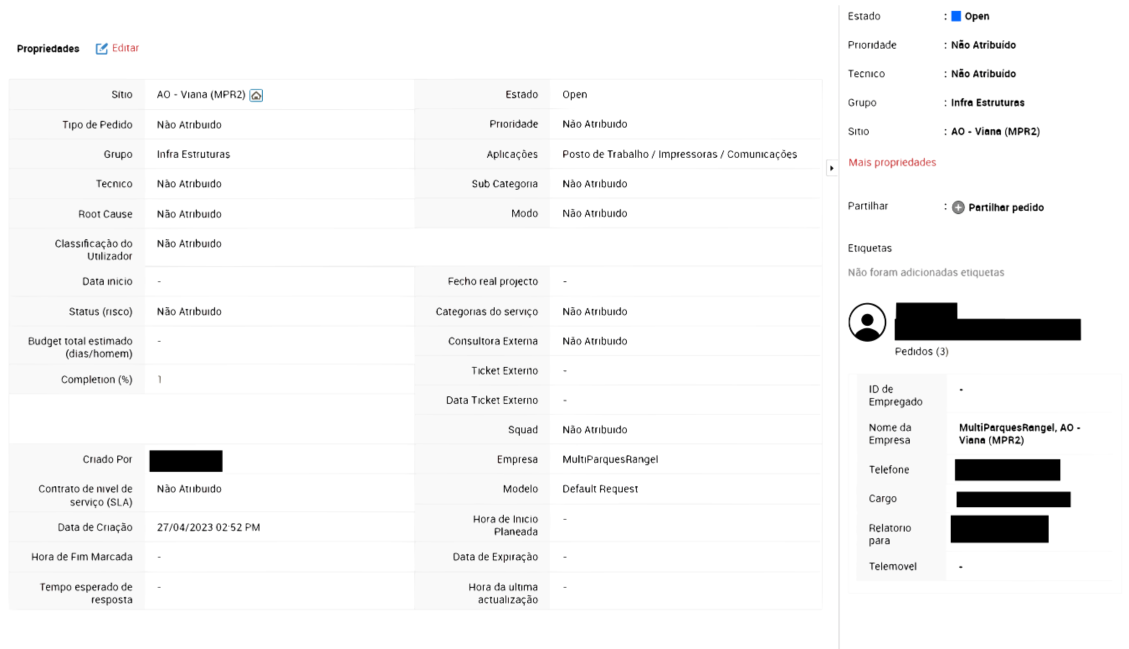


Figure 3.5: Triage interface. Source: Helpdesk software

Each property has a list of possible choices, as shown in Table 3.3.

Table 3.3: Ticket Properties

Ticket type	User classification	Priority level	Ticket creation mode
Development (progressive improvement)	1-Very bad	1-Blocks the operation without workaround	Portal form
Development (Projects)	2-Bad	2-Impacts the operation but exists workaround	SOS call
Error/ Anomaly	3-Medium	3-Makes it difficult to operate	Email
Information request/Support	4-Good	4-Not an anomaly/No impact in the operation	via Teams
Others	5-Very good		In person
			Phone
			Whatsapp

Besides these four properties, the ticket sub-category also depends on the application the ticket is associated with, as seen in Table 3.4.

Table 3.4: Priority level and associated SLA

Application	Sub-category
Work position/ Printers/ Communications	PC
	Internet
	Email
	Printers
	Phones
	Credentials/ Accesses
	PTL-Multiorder
Permissions for accesses	VPN
	Shared Folder

Although these are the applications and their corresponding subcategories that the Helpdesk assumes to be the workspace of the infrastructure team, and thus requests defined by the user with these selected applications are forwarded directly to this team, there are a variety of ticket types that require the intervention of more than one Helpdesk team, e.g. for the same ticket, the intervention of logistics may be required, followed by infrastructure and then corporate IT. Considering this, the team's subcategories are more than three times larger than those originally presented. The team thus has a much broader field of activity than that defined by its applications and subcategories.

3.2.2.2 Priority Attribution

The assignment of priority must meet the criteria described in figure 3.6, according to the degree of impact on the business and the existence of a workaround, which unblocks the user until resolution.

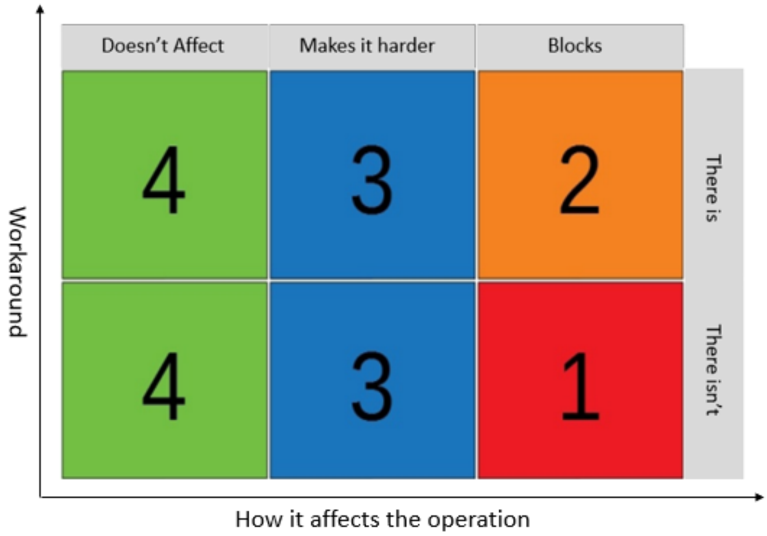


Figure 3.6: Priority Attribution Scheme. Source: Company Document

Each level of priority is associated with an SLA. This is a service level agreement in which the service provider, in this case, the infrastructure team, commits to certain standards in its delivery. SLA attribution and control are part of SLA management.

In the present team, the SLA is defined by the time in which the request should be solved. Only working days count towards the SLA; weekends and holidays do not play a role in it.

The relation is represented in Table 3.5.

Table 3.5: Priority Level and associated SLA time

Priority Level	SLA time
Level 1	Five hours
Level 2	One day
Level 3	Two days
Level 4	Five days

Although these properties are part of the triage, some of them are not defined at that moment or correctly defined. For example, in most cases, the subcategory is only defined at the time of ticket closure, as it is mandatory to define it only at that time. In the ticket type, the technicians only use two of the five possible options since they have no knowledge of when to use the remaining. Finally, the user classification is always, by default, medium level making the field useless.

3.3 Frequently Asked Questions

Frequently asked questions, or FAQs, are one of the simplest and most efficient methods of self-service. This tool aims to offer quick solutions to recurring questions. The following list enumerates the reasons why this tool is so useful and effective:

- FAQs are a terrific approach to enhancing the client experience by addressing their needs.
- The staff will save time since they won't have to respond to frequent questions already answered in the FAQs.
- Enables addressing new customer care issues quickly.
- It increases high-quality and relevant traffic levels if properly updated.

Helpdesk 4.0 offers the user this service and was implemented by the information systems department in 2018. As the team stopped updating it shortly after it was established, the knowledge base currently contains 37 answers, two of which are from 2021 and the rest from 2018. Therefore, it is a tool currently out of use within the team and the company. Figure 3.7 represents the FAQ's interface visible to the user.

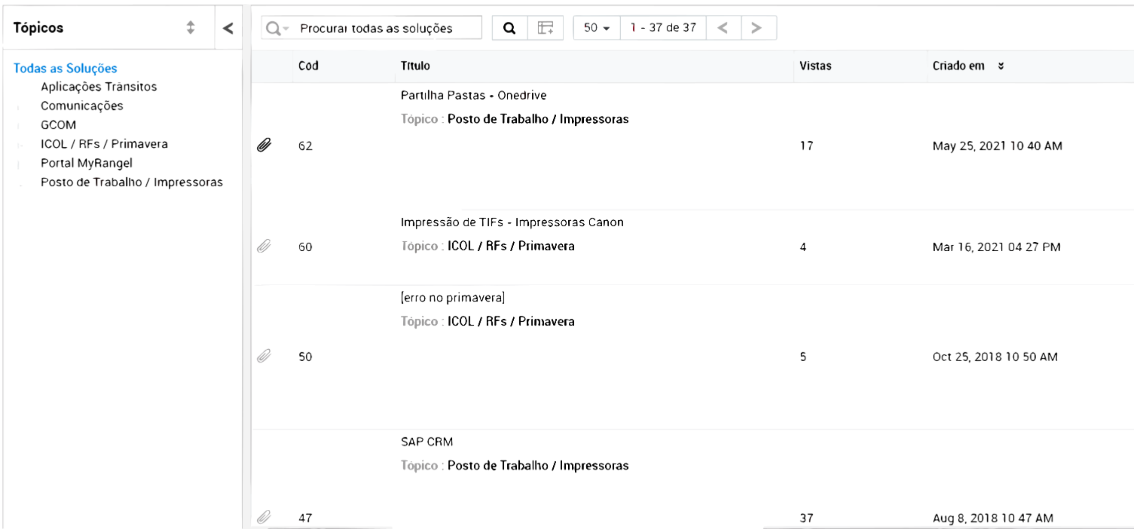


Figure 3.7: Frequently Asked Questions interface. Source: Helpdesk software

Once the benefits of this functionality have been explained and made available by the Helpdesk software used by the team, it is perceptible that creating an updated FAQs section represents an added value for both the team and the user and, therefore, something to be explored.

3.4 Key Performance Indicators

As previously explained, this project aims to increase the team's productivity in the Helpdesk and support process. Certain key performance indicators will be considered to get insight into the team's performance. The best fit for the process in question is fulfilled SLAs, time elapsed, and customer evaluation. The tracking of the team KPIs is one example of the reporting feature offered by the Helpdesk software.

The following figures illustrate the initial situation for these indicators. Figure 3.8 is a graphical representation of the SLA's expiration status for the initial situation. Figures 3.9 and 3.10 represent the time elapsed, in hours:minutes:seconds, and the customer evaluation, on a scale from one to five, respectively.

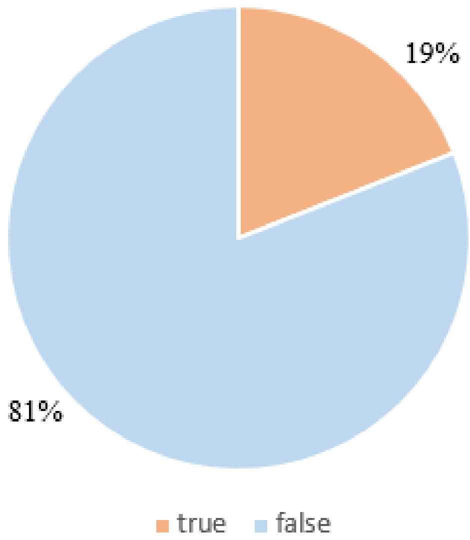


Figure 3.8: SLA's initial situation, SLA expiration status. Source: Helpdesk software

By looking at the graph, it is possible to see that the team has an average capacity to reply to tickets within the SLA of 81%, Which is calculated as shown in Equation 3.1.

$$Average\ SLA\% = \frac{\sum_{i=1}^{D} SLA_i}{D} \tag{3.1}$$

Where i is the day index, D is the total number of days within the study, and SLA_i is the SLA of each day.

	Year		
	2022	2023	Average
	Average	Average	
Infrastructures	272:03:03	188:38:09	259:30:21

Figure 3.9: Time Elapsed initial situation. Source: Helpdesk software

Figure 3.9 shows that the average time elapsed of the infrastructure team in the period considered is, on average, 259.5 hours. This time is calculated from an average between the average time of the year 2022 and the average time of the year 2023 to date. This total average represents a weighted average of the averages of the years considered, calculated as shown in the Equation:

$$Weighted\ Average = \frac{\sum_y t_y * D_y}{D} \tag{3.2}$$

Where y stands for the year, t_y represents the average of the year, D_y the days within that year, and D the total days of the considered years.

	Helpdesk support evaluation (1 to 5)	Average
Infrastructures	4.53	4.53

Figure 3.10: Customer Evaluation initial situation. Source: Helpdesk software

The evaluation performed by the customer/user is done every five closed tickets of the user in question. After five requests are solved for the same user, a satisfaction inquiry is answered to evaluate the level of satisfaction regarding the support on a scale of one to five, where one means very unsatisfied and five means very satisfied.

In an initial situation, the customer's evaluation of the infrastructure team was 4.53 points out of 5. This value represents the arithmetic average of assessments i.e. it is calculated as shown in the following equation:

$$Evaluation\ Average = \frac{\sum_{c=1}^{N} E_c}{N} \tag{3.3}$$

Where c is the index of evaluations, N is the total number of existing evaluations for the considered period, and E_c is the evaluation value from one to five.

The Ishikawa diagram represented in Figure 3.11 summarizes the causes that lead to the main problem.

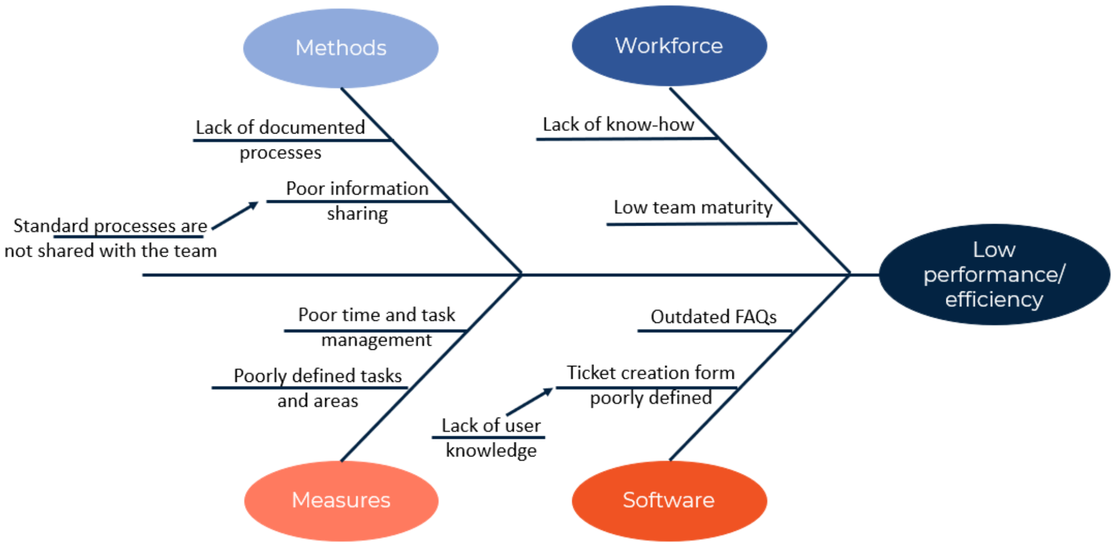


Figure 3.11: Ishikawa Diagram.

Looking at the diagram it is possible to see some of the causes found that converge on the problem of low efficiency. These causes are divided according to the category they fall into: Methods, Workforce, Measures, and Software

Chapter 4

Methodology

This chapter outlines the approach taken throughout the project's development to address the issue raised in Chapter 3, namely the methodologies used to find the improvements to the Helpdesk process will be presented in the application context and how these were implemented in order to achieve the project's main purpose.

The methodology may be divided into three main stages; the first one explains the methodologies adopted to address the problem and deeply study the reasons behind it; the second one is the method used to create the prioritization framework which was applied to the improvements detected in the first stage; and finally, the last one describes the analysis performed to predict the impact of the enhancements made to the process and the team.

4.1 Gemba Walks and Shadowing Application

In an effort to integrate the team and the project and provide first contact with the processes carried out, a strategy of Gemba Walks and shadowing was adopted, which allowed close contact with the technicians and their daily activities.

Although 5S is a method often used in the early stages of a continuous improvement project, in this case, it was decided to conduct a study based on Gemba Walks and Shadowing, as the project was to take place in an environment outside the field. Since IT is a very technical field and the technologies used by the team and even the processes and tasks they were performing were outside my knowledge, it made much more sense to use a method that brought direct contact with these concepts to gain knowledge in the field which would be studied.

The tasks associated with this approach involved observing technicians in processes directly associated with the Helpdesk, such as triage and ticket resolution processes that cover a wide range of areas. In addition to observing, an attempt to comprehend the processes themselves was carried out, as well as the reasoning behind the decisions they make, by asking key questions, for example: "Who is involved? What do you do? How do you know what to do? Why do you do it like that?" in order to understand the method they use in decision phases. No suggestions for change were made during the walks, as Gemba walks good practices say. The three Gemba Walks' guidelines, explained in Chapter 2, were taken into consideration throughout all processes.

This analysis resulted in the working areas of each technician as well as a better understanding of the Helpdesk software that played an important role in the design of the AS-IS helpdesk process and of the whole team's initial state in terms of standards for carrying out tasks and processes.

4.2 Data Analysis Application

The Helpdesk software provides various reports that allow information on all ever existing requests to be analyzed and also keeps performance indicators under observation in order to assess the team's efficiency.

The team itself regularly reviews some of the reports provided by the software: requests with SLA exceeded, all open requests, and requests open for more than five days. Also, some key performance indicators are kept under a close look by the department manager with the aim of improving them, such as: team SLA - the percentage of tickets closed within the associated SLA), the time elapsed - the absolute time from the opening of a ticket until the first closing and customer satisfaction - received via a form to which users reply on the fifth closed request.

In order to understand the initial state of the team and to get a better idea of the issues dealt with and the quantities of tickets they deal with on average, a study was carried out of all closed tickets from January 2023 until the start date of the study, the end of February of the same year. For this end, Excel software was used, the subcategory of each ticket was selected, the duplicates of this column were eliminated, and the number of tickets for each of these sub-categories was counted.

With this analysis, it was possible to extract the most frequent types of tickets through the subcategories associated with them. However, since the sample is relatively small, a more in-depth study of the existing data was performed to analyze better and understand the team's background. With that being said, an analysis was made of all tickets in the year 2022. This study was also performed in order to understand if the results of the first analysis were a pattern or if they were verified only in the year 2023.

In this approach, the main goal was to identify patterns in the tickets. To this end, the Power BI software was employed. Microsoft Power BI is a business analysis and data analysis service; it enables the development of sophisticated, dynamic data visualizations from various data sources. With this in mind, a word cloud was created focusing on the topics of the tickets. A maximum number of seventy words was defined so it wouldn't contain excessive information and would be simple to spot the key terms merely by looking. Repeated words of no interest were eliminated to have a trustworthy and engaging outcome for the project, such as prepositions, greetings, pronouns, and others.

This analysis resulted in the pattern of the most frequent tickets according to their subject. Since the data analysed in this approach was of a qualitative nature and, therefore, retained noise, the results may not be the most reliable. This way, a last analysis was made in order to corroborate one of the two previous analyses and to understand, in fact, the most frequent themes of the tickets solved by the team. This analysis considered all tickets closed from January 2022 until the end of February 2023, the beginning of the study.

The Excel tool was used to complete this. The subcategory column was taken from the data table since it would be the focus of the analysis. Duplicate values were removed to obtain a list of existing subcategories; for each of these, the number of closed tickets was counted using the Excel formula "countif". Having the number of tickets for each subcategory was sought to obtain percentages and the cumulative percentage of those that represented the most frequent tickets.

Understanding the most common issues granted insight into the areas where the team spends the most time and, therefore, the key procedures to consider for potential improvements.

4.3 Daily Kaizen Application

After the data analysis, a different approach was implemented, a continuous improvement methodology that considers the team's voice.

The Daily Kaizen methodology was chosen over other continuous improvement techniques because Rangel had already received intervention from the Kaizen Institute in 2018; in this way, it provided continuity and upheld a particular style of thinking. Also, it is a strategy that focuses on the natural team creating behaviour development, problem-solving, and sustained improvements.

As the IT area and the Helpdesk software were concepts and systems that I had never had experience with, it became crucial to hear the opinions of those on the inside and who deal with the problems every day, the support technicians.

This method aims to create a brief period of communication between the meeting facilitator and the entire team during which everyone has the chance to voice and discuss their opinions with the intention of assessing the processes' current state, organizing the teamwork, identifying deviations, and attempting to respond to these situations with improvements and solutions. All meeting notes and conclusions are recorded in a location that is visible to the entire team (such as a whiteboard).

With this in mind, and in order to meet the Daily Kaizen standards as rigorously as possible, a daily meeting was created with the whole first-line support team plus the team leader. Since the IT team is geographically dispersed, the meeting must be conducted online. These had an average time of twenty minutes. Normally the number of participants was eight, including two Kaizen leaders, one team leader, and five technicians. However, occasionally there were meetings with six technicians due to a change in team members.

At each meeting, the leaders started by asking what each technician had done the previous day, the type of tasks and difficulties encountered in carrying them out, and whether they had managed to overcome those difficulties. Afterwards, a Helpdesk report with the tickets closed the day before was shown to the team, highlighting those that were closed with an outdated SLA. After this, the technician responsible for these tickets would provide an explanation for exceeding the SLA. In front of the whole team, we tried to reach a conclusion of whether the ticket could have been closed on time or not, and the team discussed to understand a solution to the problem in question.

During these Daily Kaizen meetings, the Plan phase of the PDCA cycle was applied to each problem, and difficulty encountered, with the aim of firstly understanding the root cause, then finding possible improvements for the situation in question and planning its implementation. The remaining phases were implemented after the improvements prioritization.

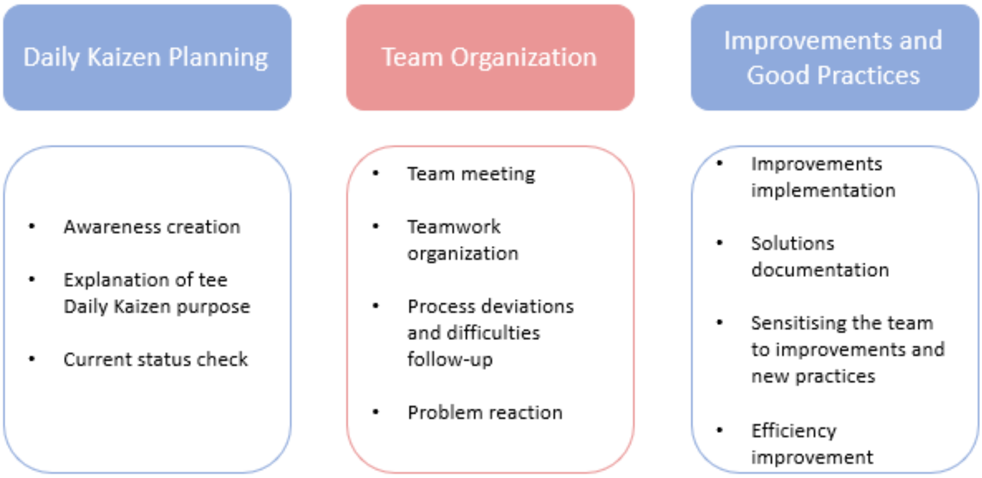


Figure 4.1: Daily Kaizen structure

4.3.1 Daily Kaizen Dashboard

Still on this methodology, and in order to better present and assess its results, a dashboard was created that summarises the information found through the Daily Kaizen methodology. This was created in Excel through pivot tables with the possibility of changing the data represented through slicers, created with this purpose to show only the desired information, so it has the interactive capacity created by the relationship between the tables and slicers. The dashboard represents mainly evolutions concerning team KPIs, SLA, and Time-Elapsed, related to other significant parameters of the study, such as priority levels and ticket subcategories.

4.4 Improvement Prioritization Framework

Following all of the analysis and research previously described, both the integration and perception-gaining achieved in Gemba Walk as well as the information gathering by data analysis and mainly through the discoveries and attempts to react to problems from the Daily Kaizen meetings, concrete and more elaborate ideas of what would be possible improvements to the Helpdesk process began to emerge, as a way to solve problems from scratch and not only react to problems that may appear.

Once such improvements were found and duly structured, and before moving on to implementation, it was necessary to understand which ones would be the most important, those with the greatest impact on efficiency, those with the lowest costs, and others. And therefore, which ones would be the first to be implemented in the team. In other words, the improvements had to be prioritized among them in order to create a chronological plan for implementation.

In order to define a process of improvement prioritization, small research on some existing techniques was done. Several known improvement prioritization methodologies were found, such as the Cost/Benefit matrix, the MoSCoW method - Must Have, Should Have, Could Have, Won't Have, the Eisenhower matrix, the RICE technique, which stands for: Reach, Impact, Confidence and Effort, and so forth.

Despite the existence of these and other various forms of prioritization of extreme quality and significance, it was concluded that none of them responded fully to the parameters considered important in the choice of improvements:

- Associated difficulty recurrence.
- Implementation time.
- Execution time reduction.
- Implementation cost.
- Impact on user satisfaction.
- Is it a quick win?
- Value adding.

Observing the parameters listed above and the prioritization options, it is possible to realize that, for example, the Cost/Benefit matrix has few decision parameters, as does the Eisenhower matrix. The MoSCoW method has parameters of great importance but is more appropriate for a project or in creating a product than it is for assessing improvements. RICE is one method with more parameters aligned to those described, though they are still insufficient. On this basis, a prioritization framework for this situation was created by combining the beneficial aspects of each method.

The framework uses the aforementioned parameters, each with a predetermined weight. The weights were attributed to the parameters according to the importance of each one and according to the contribution to the global objective of the project. These weights have a value of ten for the parameters of extreme importance, five for those that are considered important but not so priority, two for parameters of less importance in the considered situation, and one for the tie-breaker parameters.

Afterwards, and as it happens in the RICE method, a classification for each one of these parameters was attributed with regard to the improvement in question, ranging from one to five or between zero and one if Boolean. Finally, the weighted weight was calculated through the attributed classifications and the weight of the parameters, representing the final classification for implementing the improvement. This process was repeated for each improvement to obtain all the weighted averages for posterior comparison.

$$Final\ Classification = \sum_{p}^{N} C_p w_p \tag{4.1}$$

Having the classifications, a scale was created from the lowest possible classification to the highest, with five intervals represented in Table 4.1.

Table 4.1: Priority Scale

Rating Range	Scale Result
[23-50]	Low Priority
]50-78]	Medium-low Priority
]78-100]	Medium Priority
]100-125	Medium-high Priority
]125-155]	High Priority

The result of the scale was attributed to each improvement, and they were then rearranged by their level of priority.

Once the implementation plan was achieved, the PDCA Cycle continued in the Do phase, the plan was put into practice, and afterwards, verification was carried out in order to understand if this implementation had had a positive effect. Finally, and if the implemented improvement had the expected result, a new step for the standardization of the process was found and documented. If the implementation results were unsatisfactory, the cycle would go back to the starting point, the planning phase, to re-evaluate the problem and create new improvement plans.

4.5 Key Performance Indicators Prediction Method

After applying all the methodologies explained above in this chapter and implementing some of the improvements derived from the study, it was necessary to forecast these impacts on the project objectives. Analytically, this means studying the evolution of the team's KPIs in the long term. This study considered the hypothetical situation of the improvements being implemented to have a stabilized result, so it represents a prediction. If the study were performed with values from the project's end, the reliability of the results would be very low since the KPIs would not be stable yet.

In order to carry out this analysis, two different approaches were carried out, one for the SLA related KPI and the other for the time-elapsed, which are presented in the following subsections.

4.5.1 SLA Prediction Analysis

To analyze the evolution of the percentage of Service Level Agreements (SLAs) met on time, the study utilized the results obtained from the Daily Kaizen methodology. The analysis provided a detailed breakdown of the team's performance in meeting SLAs on a daily basis over a period of seven weeks from ten April to 26 May. For each day during this period, the study recorded the percentage of SLAs the team successfully met on time. The SLA percentage for each day was calculated as shown in Equation 4.2.

$$SLA\% = \frac{1 - \sum_{t=1}^{T} T_{ei}}{T} * 100 \tag{4.2}$$

Where t is the index of tickets, T is the total number of tickets under study, and T_{ei} is the expired ticket.

The initial situation average of SLA was calculated by making an average of the results from Equation 4.2 as shown in Equation :

$$Average\ SLA\% = \frac{\sum_{i=1}^{D} SLA_i}{D} \tag{4.3}$$

Where i is the day index, D is the total number of days within the study, and SLA_i is the SLA of each day calculated by Equation 4.2.

Furthermore, the analysis delved into the reasons behind the violations of each individual ticket, also categorized by the respective days. Each instance where the agreed-upon time for an SLA was exceeded was thoroughly examined to identify if one of the already-found improvements could address the underlying cause.

Upon identifying feasible ways to get around this reason based on the improvements found, the corresponding ticket was removed from the list of violated SLAs, and a new SLA was recalculated based on the new situation. This new SLA was calculated the same way as the previous one, considering the new number of tickets with expired SLA as represented in Equation 4.4.

$$SLA_n\% = \frac{1 - \sum_{i=1}^{T} T_{eni}}{T} * 100 \tag{4.4}$$

The parameters of this Equation are the same as the ones mentioned for Equation 4.2, with the change from T_{ei} to T_{eni}, which is the expired tickets for the new situation.

This comprehensive analysis was performed for each ticket previously analyzed in the Daily Kaizen meetings. Since the new SLAs were daily, an average of them was made to get an overview using Equation 4.5.

$$Average\ SLA_n\% = \frac{\sum_{i=1}^{D} SLA_{ni}}{D} \tag{4.5}$$

Where i is the days' index, D is the total number of days in study, and SLA_{ni} is the new daily percentage of SLA calculated in Equation 4.4.

Obtained the new SLA referring to the impact of the improvements and the SLA for the same sample without this implementation; the evolution suffered by it was calculated using Equation 4.6.

$$Evolution\% = \frac{|Average\ SLA_n - Average\ SLA|}{Average\ SLA} * 100 \tag{4.6}$$

Where, as explained in the above Equations 4.2 and 4.4, Average SLA is the initial average of SLA for the period under study and the Average SLA_n is the new average of the SLA with the impact of the improvements.

This behaviour verified for the sample in question was applied to the sample used to calculate the initial SLA, allowing us to obtain an SLA representing the impact prediction of the improvements in this KPI.

4.5.2 Time-elapsed Prediction Analysis

In order to study the behaviour of KPIs, a study of the current situation was first performed. The report relative to this KPI for the period from January 1st, 2022, to the end of February 2023 was taken from the Helpdesk software. To study the data obtained, Minitab software was used to perform a statistical analysis of the data.

Minitab is a software package that is used for data analysis. It is widely employed in many different fields, including manufacturing, education, and healthcare. This software provides users with tools to perform statistical analysis. Additionally, it provides various graphical tools to help users visualize data. Due to its powerful features and user-friendly layout, Minitab is a well-liked option for statistical analysis. Whether you're trying to enhance your quality control process or carry out in-depth data analysis, it provides a wide range of features that make it suited for various applications. This way, for the study of the team time-elapsed, this software was used in order to have a good vision of the data distribution and to find the fluctuations of the set, one of the main purposes of the study. Resorting to this software, a predictive analysis of the impact of the improvements found on this same set of data, and therefore on the KPI they represent, was also performed.

The Helpdesk software extracted a report on the average time elapsed from one January 2022 to 28 February 2023. In this report, the time was divided by sub-categories in order to have the data properly organized, and it also allowed the study of whether there was any category that was very different from the others and therefore took up a lot of the technicians' time.

The data was in time type format [h]:mm:ss, although since Minitab cannot use this type of format for analysis and graphing, the data was previously formatted in Excel to number with the format n,nn.

Duly organized, the sample with a size of 56, a mean of two-point-eighty-nine, and a sample standard deviation of two-point-sixty-four was inserted into Minitab, where a histogram was created with adjustments in order to see the distribution of the data and those times which were furthest from the average.

The average used for this study does not coincide with the time-elapsed average referred to in Chapter 3, which represents the initial situation of the team since the aforementioned average is the weighted average of the data, i.e., it takes into account the weight of each element. In contrast, the average used in this analysis is the arithmetic average of the data inserted in the Minitab software as represented in Equation 4.7:

$$Average\ Time\ of\ Subcategories = \frac{\sum_{s=1}^{S} t_s}{S} \tag{4.7}$$

Where s is the subcategory index, S is the total number of subcategories, and t_s is the time-elapsed per subcategory.

This is automatically calculated by this software as well as the standard deviation as shown in Equation 4.8:

$$Standard\ Deviation = \sqrt{\frac{\sum(t_s - Average\ t_s)^2}{n}} \tag{4.8}$$

Where, as mentioned in the Equation above, t_s is the time-elapsed for each subcategory, Average t_s is the average resultant from Equation 4.7, and n is the sample size.

Subsequently, the same sample was used to perform an outliers test with a 5% significance level and the following hypothesis:

- Null Hypothesis: All data values are from the same normal population.
- Alternative Hypothesis: The smallest or largest data value is an outlier.

After the test, a graph was obtained with the data distribution and the p-value, which is calculated as Equation 4.9 shows:

$$z = \frac{p - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \tag{4.9}$$

Where p is the p is the sample proportion, p_0 is the hypothesized proportion, and n is the sample size.

If the p-value is lower than the significance level of the test, the null hypothesis should be rejected; that being said, the obtained p-value was compared with the significance level to understand whether this was verified in the present test.

Once the searched values were obtained, these were removed from the sample, and a new test was performed in order to understand if all outliers had already been eliminated. A new histogram was then performed with the new sample to understand the outliers' impact on this.

Once the outliers were studied, we proceeded to the predictive study of the KPI's behaviour regarding the implemented improvements. There is a direct relationship between the implementation of improvements and the decrease in the ticket resolution time since most of them aim to facilitate and shorten the technicians' work. However, no quantifiable relationship can give us certainty about the future evolution of the time-elapsed. Despite this, it is possible to trace a dependency between the improvement of the SLA KPI and the KPI in question in this study.

This way, by decreasing the tickets with expired SLA, it is automatic that the time from opening to closing of these tickets decreases to at least the time within the SLA.

A forecast was made in similar terms to the previous KPI forecast. Data from the Daily Kaizen methodology was used to calculate ticket elapsed times for all tickets analysed over the period of the Daily Kaizen study and the total number of tickets analysed. The outlier found in the previous analysis was not removed from this new sample before starting the study. Equation 4.10 demonstrates how time elapsed is calculated:

$$t_{el} = d_f - d_i \tag{4.10}$$

Where t_{el} is the time-elapsed, d_f is the ticket closure date and d_i is the ticket creation date.

Obtained the times before the improvements, we took each case in which the ticket became within the SLA, explained in the analysis of the SLA KPI, and changed its elapsed time to the time assigned to it by the SLA, ie, the elapsed time of these cases is no longer from when the ticket is created until it is closed to become the time from when the ticket is created until the expiration time. This represents the time in which the ticket must be resolved according to the priority level assigned to it, and it is calculated according to the Equation 4.11:

$$t_{eln} = d_e - d_i \tag{4.11}$$

Where t_{eln} is the new situation time-elapsed, d_e is the ticket expiration date, and d_i is the ticket creation date.

It must be taken into account that this new time represents the maximum elapsed time, so that it may be less than this, and therefore this is a worst-case situation.

Having the times per day, per subcategory and per ticket, and the respective tickets per day per subcategory, both for the initial situation and the situation after the implementation of improvements, as well as the total number of tickets, the overall weighted average per ticket was calculated for both cases, using the equation:

$$Weighted\ Average = \frac{\sum_{d=1;s=1}^{D;S} t_{d,s} * T_{d,s}}{T} \tag{4.12}$$

Where d is the day index. s is the subcategory index, t_{ds} is the time-elapsed for the subcategory s on the day d, T_{ds} is the number of tickets for the subcategory s on the day d, and T is the total number of tickets under study.

Substituting $t_{d,s}$ for $t_{nd,s}$ in Equation 4.12 gives the weighted average for the second case where the improvements already have a concrete impact. With these results, it was possible to study the time evolution between the two cases through the following equation. Obtained the time-elapsed behaviour for the sample in question. As was done previously, this evolution was applied to the KPI that represents the initial state of the project in order to predict the future state of this parameter.

Chapter 5

Results

This chapter's primary purpose is to present and interpret the results obtained from the methodologies adopted explained in Chapter 4. As well as showing the framework that addresses the prioritization of improvements and its results to understand the implementation carried out properly.

The results were duly analyzed, and their significance for achieving the proposed objective was explained.

Still, within this Chapter, the predicted results were compared with those intended to be achieved, representing project objectives.

5.1 Data Analysis

Initially, an analysis was performed of the tickets from 2023 up to the time the study started, having, therefore, a two-month sample. The results obtained are organized in table 5.1.

Table 5.1: Frequent tickets 2023

Sub-category	Number of tickets
Computers	1068
Email	471
Credentials/ Accesses	468
Printers	297
Internet	243
Shared Folder	165

Six sub-categories emerged from the data analysis as the most often occurring ones in the examined tickets. Therefore, it was possible to identify the team's most often handled sub-categories. It was decided to include six sub-categories in the represented table because the category with the fewest tickets, "Shared folder", has five times more tickets than the one after it, which is a significant discrepancy.

In order to understand if these results were a repeating pattern or just an exception due to the small sample, a study was carried out on the tickets of the year 2022. Since the data of this new sample were of text type, a different study was carried out using a Word Cloud created with the Power BI software.

By counting the frequency of words associated with already-existing subcategories, we were able to determine the most popular sub-categories using the Word Cloud, as shown in Figure

Figure 5.1: 2022 Tickets Wordcloud

For instance, it was assumed that whenever the word accesses appeared in the ticket subject, the ticket fell under the subcategory Credentials/ Accesses. These are represented in Table 5.2

With this being said, and given the type of study and the data itself, likely, the results obtained are not the most reliable. Therefore, in case of disparities between the two analyses, another study must be performed to corroborate one of the analyses.

Table 5.2: Frequent Tickets 2022

Sub-category	Word Frequency
Credentials/ Accesses	1368
Email	972
Printers	897
Computers	489
Shared Folder	273
Internet	69

The results were similar in the most frequent themes as is visible in the Word Cloud; however, in this second survey, the ranking of the most common subcategories has changed. Credentials / Accesses became the most frequent subcategory instead of computers. Since the results obtained from the two analyses do not coincide, a more comprehensive and objective analysis of all tickets closed in 2022 and 2023 up to the start of the study was carried out. The results are represented in Table 5.3

Table 5.3: Frequent tickets from 2022 and 2023

Sub-category	Percentage	Cumulative Percentage
Computers	30.85%	–
Email	16.51%	47.36%
Credentials/ Accesses	12.66%	60.02%
Printers	9.49%	69.5%
Internet	6.23%	75.74%
Shared folder	5.63%	81.36%

By observing the table, it can be seen that the results are similar to those obtained in the first analysis, which may reveal that the second analysis had variations, as explained before, due to inconsistencies and noise in the analyzed data. Moreover, by calculating the cumulative percentage of tickets from the sub-categories represented, it was noticed that these represent 80% of all tickets solved by the team and therefore represent the tasks and processes with which the team spends more time. Taking into account the subcategories explained in section 3, these six most frequent subcategories represent about 20% of all subcategories dealt with by the team. Pareto's 80-20 principle applies, according to which 80% of all existing problems that the team solves come from 20% of all the team's action issues. Therefore, in order to address these issues and reduce the number of tickets, it is required to tackle these six often occurring sub-categories.

5.2 Daily Kaizen

The study's findings in this section can be summed up as the challenges faced by technicians on a daily basis and the causes of SLA violations. Finally, in light of these findings, a list of potential improvements to the issues encountered was drawn up.

The information obtained from each meeting is compiled in an Excel sheet; however, as it is in plain text and with IT jargon and certain variations in both the text and the sample of technicians, it has been properly organized in the list below for easier understanding.

- Lack of knowledge - Little documentation and information. Technicians don't know where to get the existing information. They have to question another member of the team, making the process longer for both of them.
- Lack of information sharing - Technicians do not share their know-how in order to help other technicians with a similar problem in the future. If a technician leaves, there is no

documentation of how to perform tasks that only he performs in order to instruct his replacement.

- Lack of user response/feedback - The technician asks the user for extra information in order to understand the request and information necessary for the resolution. Without an answer from the user, the technician is unable to resolve the ticket.
- Poor task management - Difficulty in organizing tasks since technicians work in several types of functions and because the Helpdesk is a priority.
- Poor time management - Excessively long meetings due to lack of definition of topics and rambling.
- Users requesting services without opening a ticket - Users who make requests for resolutions without opening a ticket or calling the SOS number to interfere with the management of ongoing requests and in the ticket resolution order. Additionally, it may stop the technician mid-task, resulting in a ticket violation.
- Poorly created ticket - Poor ticket creation, either by incorrectly indicating the ticket subject or by poorly describing the problem, makes the triage process more difficult and time-consuming, increasing the time elapsed.

The majority of these issues contribute directly or indirectly to ticket violations. This list includes topics that proved to be constant during the Kaizen meetings since the aim was to identify a pattern of recurring problems and difficulties. As explained before, the goal was to combat issues that contributed significantly to inefficiency and poor performance.

For each issue and difficulty, the Plan phase of the PDCA cycle was applied to identify the root cause and discover possible improvements as a team. The three other phases of this cycle are referred to in Section 5.3.1.

Realizing that the creation of tickets poorly defined was a recurring complaint from technicians, it was decided to deepen the study on why this happened in the opinion of technicians. So to this end, a form was created in which technicians could give their opinion on ticket creation, expressing what they thought was wrong and how this process could be improved.

The results obtained are represented in Figure 5.2. The questions above the graphs are the form questions that obtained the answers represented by the graph.

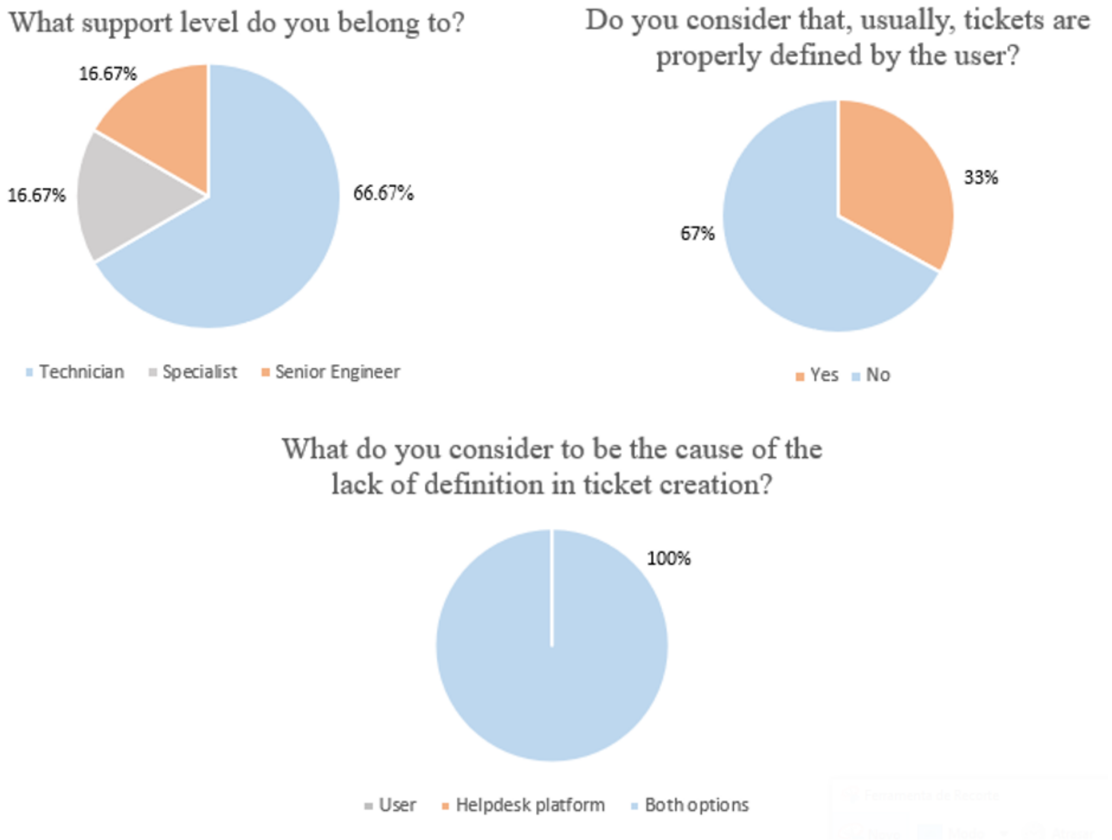


Figure 5.2: Form answers representation

The remaining responses were of the open response type and are therefore listed below: "What are your suggestions for improving ticket creation?".

- Hold a workshop with all users to show how to create tickets and possible information that would be useful to include when creating a ticket.
- Review and update some fields of the software in order to make it easy and intuitive for any user to fill in and add essential information about the problem according to the applications/tools that have emerged.
- Training clients on the Helpdesk platform.
- Addition of extra fields in the software to better characterize the requests and indicate to the user which descriptions would be useful to improve the interpretation of the request.

"Do you think there is anything to improve in the Helpdesk application/service? If yes, what?".

- The software should have a less technical and more simplified layout and/or create a way to help/instruct the user on how to fill in the form.
- The "Application" field is vague; a field of microcomputing should be presented (Hardware, Software, accessory, peripheral, Windows, Microsoft Office, to name a few).

At the end of this methodology, a dashboard was created to dynamically summarise and present the most important data and relationships from this analysis, represented in Figure A.1 from Appendix A.

Looking at the dashboard, it is possible to obtain information about the evolution of the SLA throughout the study without improvements and in case the improvements already have an impact on it. Furthermore, it is possible to see the average resolution times per priority and subcategory, providing insight into the time lost by technicians at each priority level and subcategories that require bigger resolution times. Finally, it is possible to state the number of tickets per priority and perceive that the third level of priority within the data analysed is the most recurring level within the data analyzed.

This interactive dashboard allows the change of parameters such as the date or to choose tickets with a certain priority level, for example, only priority 1 tickets, presenting the results for the desired parameter range, as shown in Figure A.2 from Appendix A.

5.3 Improvements

Based on all the research and analysis done throughout the project, some improvements were identified that seek to address issues facing the team and, in doing so, fulfil the process' primary goal and increase the team's productivity. This increase can be measured through the KPIs the team regularly analyses, as explained in Section 4.

The improvements found were divided into improvements for some of the most frequent tickets found during the data analysis and those discovered through the daily Kaizen methodology.

Once the most frequent sub-categories were found, the ticket description was looked at in detail and asked the technicians about concrete examples of the most frequent tickets within each sub-category to understand possible improvements. This led to the following list:

Table 5.4: Frequent tickets improvements

Sub-category	Ticket	Improvement
Computer	Full Disk	Ticket creation instruction, for the user to indicate already at the time of ticket creation which programs and files should not be deleted. Saves time in which the technician would have to ask the user and wait for an answer.
Printer	Install printer	User must identify if it is a company or personal printer; in case it is personal, require its IP, thus reducing the execution time of the process.
Accesses	Access card error	Often associated with printer login. Creation of a user-help instruction manual, available on the computer itself and at printer locations.
Email	Empty Outlook box	Raise awareness of the user that it should be them to manage their emails themselves. It is not the technician's responsibility. Create a FAQ explaining how to proceed for the user to consult in case of need

The improvements found for frequent tickets represent small procedures that help in performing the tasks to resolve the ticket or tasks that should and can be done by the user in order to save service time for technicians.

As the project and the studies were carried out, new improvements were found, this time related to daily Kaizen:

1. Lack of knowledge - Create documentation with process mapping and working indications. Create an organized database that is easy to access and available for the team's documents and important information.

2. Lack of information sharing - Awareness-raising of technicians to resort to existing documentation when they do not know how to solve a problem/ticket. Indicate resolution when closing a ticket in order to create information to be later validated and inserted in the process documentation database.

3. Lack of response from the user - Create an "On Hold" instruction which must define how much time the ticket should remain "On Hold" and in which situations the ticket status must be changed to this. Make users aware of these rules, indicating the response time limit.

4. Poor task management - Daily scheduling and task planning. Create a calendar where each technician should define the daily tasks to be carried out by himself, with associated time intervals for easier orientation. Redefine tasks/areas of action of each technician according to know-how in order to specialise the team in the respective areas.

5. Poor time management - Planning the topics to be discussed at each meeting, with time associated with each topic, according to its importance. If more time is needed, schedule specific meetings for the topic.

6. Users requesting services without opening a ticket - Inform users that they must open a ticket and provide the team's contact information and SOS phone number in case they are unable to access the Helpdesk.

7. Poorly created ticket - Change the way of creating a ticket by changing or adding fields to the ticket creation form. For example, select the subject field instead of an open reply.

Other improvements found during the project not directly related to the Data Analysis and Daily Kaizen methodologies:

1. Update FAQs with simple and frequent processes. - Found when studying the initial situation.

2. Correctly evaluate the user at the time of triage in relation to the ticket created in order to understand later if the number of users with difficulties creating tickets is significant and analyse which fields are the most problematic. - Found when studying the initial situation.

3. Technicians responsible for triage must analyse tickets with expired SLA or about to be expired.

5.3.1 Improvement Prioritisation

The prioritization framework was created in Excel according to the parameters previously explained in Chapter 4. All improvements discovered and their corresponding final classifications, determined by the evaluation technique previously indicated, are reflected in this framework as shown in figure B.1 from Appendix B.

The framework includes a space for introducing additional improvements, continuous enhancement of the project, and possible development of future studies.

Illustrated in Figure 5.3, a prioritization scale of five levels was created according to the possible ratings of the improvements, from the lowest to the highest. This scale assigns a prioritization level to each improvement based on its ranking from the framework.

[23 ; 50]	]50 ; 78]	]78 ; 100]	]100 ; 125]	]125 ; 155]
Low priority	Medium-low priority	Medium priority	Medium-high priority	High priority

Figure 5.3: Prioritisation Scale

The obtained scale ranges from 23 to 155, and the levels defined by this are Low priority; Medium-low priority; Medium priority; Medium-high priority and High priority.

Based on this scale, a table was created with the levels associated with each improvement, represented in the figure 5.4.

Improvement name	Final classification	Prioritisation level
Documentation and Process Mapping	105	Medium-high priority
Indication of the resolution when closing a ticket with subsequent evaluation and insertion in the database	110	Medium-high priority
Update FAQ'S with simple and frequent processes	88	Medium priority
Instruction for ticket creation	127	High priority
Create printer instruction and interactive user support manual	95	Medium priority
Definition of area of operation + specification of each technician's tasks for the day	79	Medium priority
Definition of the topics to be addressed at meetings with associated times	93	Medium priority
Technician responsible for triage must analyse tickets with SLA violated or about to be violated	119	Medium-high priority
Form about the ticket creation for the user	101	Medium-high priority
Create an organized database to include all documents and processes of the team	128	High priority
Instruction for tickets On-Hold	143	High priority
Correctly evaluate the user at the time of triage in relation to the ticket created	112	Medium-high priority

Figure 5.4: Prioritisation Classification

Finally, after the improvements had been properly categorized and given levels of priority, they were arranged in positions from one to nine according to the priority of execution. Figure 5.5 represents the final outcomes of the prioritization of improvements.

Position	Improvement name	Final Classification
#1	Instruction for tickets On-Hold	143
#2	Create an organized database to include all documents and processes of the team	128
#3	Instruction for ticket creation	127
#4	Technician responsible for triage must analyse tickets with SLA violated or about to be violated	119
#5	Correctly evaluate the user at the time of triage in relation to the ticket created	112
#6	Indication of the resolution when closing a ticket with subsequent evaluation and insertion in the database	110
#7	Documentation and Process Mapping	105
#8	Form about the ticket creation for the user	101
#9	Create printer instruction and interactive user support manual	95
#10	Definition of the topics to be addressed at meetings with associated times	93
#11	Update FAQ'S with simple and frequent processes	88
#12	Definition of area of operation + specification of each technician's tasks for the day	79

Figure 5.5: Prioritisation Position

With the improvements duly prioritized, implementation began. Although all suggestions for improvement are implementable in the team, not all of them can be implemented immediately. Below are listed the factors that prevent this action and the respective improvements to which they correspond.

- Must be done in partnership with the marketing department because these documents or files will be available to all the company's employees.
  1. Instruction for ticket creation.
  2. Printer Instruction and User Interactive support manual.
  3. Ticket creation form for the user.
- Requires management approval since it requires investment.
  1. Change/addition of fields in ticket creation and triage for a better definition of the ticket.

Having said this, the remaining improvements were implemented, taking into account the priority. After its implementation, these improvements were submitted to the PDCA Cycle; it was verified if it was having the intended results in the team and subsequently became standardized processes.

The improvements corresponding to the documentation and mapping of processes and the update of FAQs are improvements that do not have an immediate implementation and result since it is a continuous and lengthy process. However, they are already in action with the help of the improvement that aims to put the resolution when closing a ticket. With the information from this action, it is possible to update the two improvements mentioned above.

The improvements found that represent behavioural improvements and technical improvements were implemented by the technicians. The remaining were developed and then provided to the team:

- The On-Hold tickets instruction was created according to the structure normally used by the company; it contains all the steps of placing the tickets On-Hold, the situations in which it must be done, and the time span for each situation. This instruction was provided to the team in order to help them understand the purpose of On-Hold and decrease the number of tickets violated by lack of response from the user. This is represented in Figure C.1 from Appendix C.
- A storage file was created for all the team's documents and information to be kept in a simple and organised way, taking into consideration the first S's of the 5s methodology. This folder was internally divided by team area, and each section was further divided into the corresponding subcategories. This way, there is now a common information base for all technicians, and the process of searching for documentation has been simplified.
- Although the ticket creation form is an improvement that cannot be directly applied, as explained earlier in this section, a template was created to serve as an example for its future creation. This form is shown in Annex W and aims to get the users' opinions on what is wrong with this process and what can be improved.

5.3.2 To-Be Helpdesk model

Considering the improvements discovered for the Helpdesk process, which are also represented in the framework of Figure B.1, some adjustments were made to the mapped process model giving rise to the To-Be process, shown in Figure

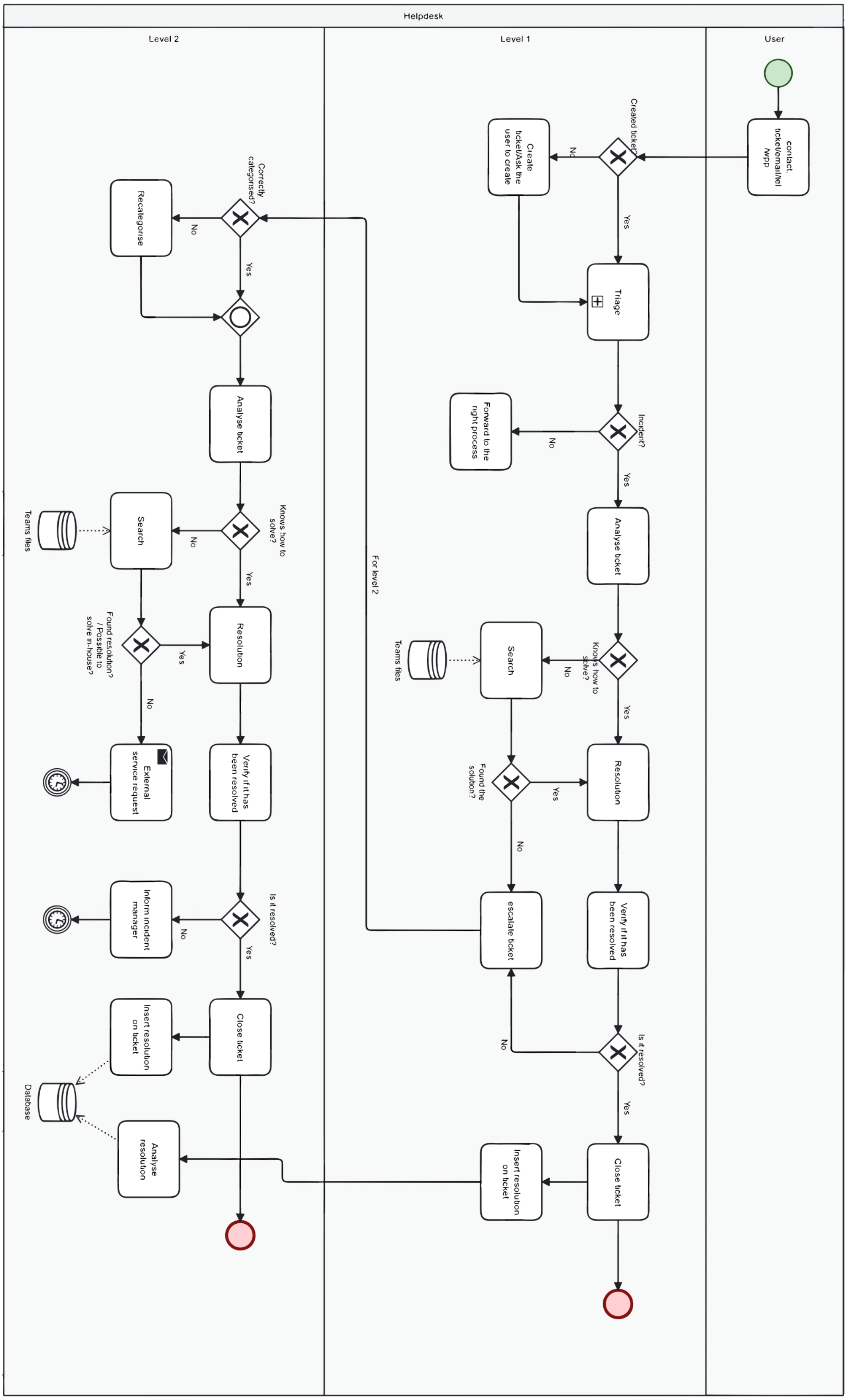


Figure 5.6: To-be process model

As a result, to the process previously presented in Chapter 3 in subsection 3.2, some steps were added.

Starting by looking at Level 1 of the Helpdesk, creating a ticket for any type of existing incident is now mandatory. If the user contacts the service by means other than the Helpdesk portal form, the technician must inform the user to open a ticket so that the problem can be addressed correctly. Suppose the user cannot do it because the error affects that type of service, for example. In that case, the computer does not turn on, and the responsibility for creating the ticket becomes the responsibility of the technician.

Within the triage subprocess, there were also some modifications; a new subprocess inside the triage was created, in which the technician responsible for triage verifies the existing tickets with the purpose of finding expired ones or about to expire and proceeds to alert the technician responsible for it to resolve it, or alternatively resolve it right away. This subprocess is represented in Figure 5.7.

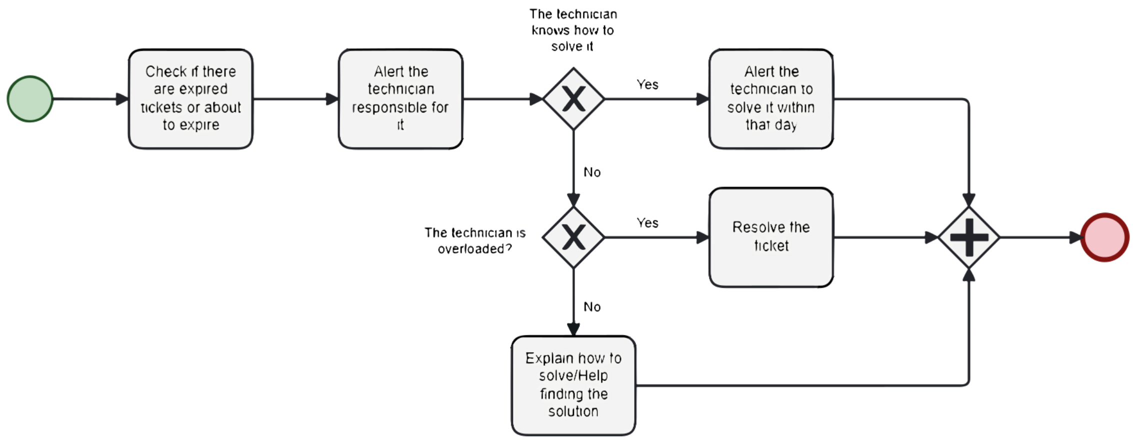


Figure 5.7: SLA subprocess

The ticket then proceeds normally, just as it did in the initial process, with the exception that incidents are now distinguished from other kinds of requests. If it is not an incident, it should be forwarded to the appropriate process, as the analyzed process focuses primarily on resolving incidents.

Improvements have also been made in the ticket resolution phase. In case of not know how to resolve the ticket or part of it, the technician will first consult the created documentation to avoid unnecessarily interrupting and disturbing coworkers.

From here, there are two possible directions for the ticket. The first occurs if the technician knows how to solve the request according to the defined process or if he discovers the solution after researching the existing documentation. In this case, the ticket is resolved and proceeds to verification, where the technician verifies whether the problem has been resolved with the user. If applicable, the issue is closed with the obligation to specify the resolution to be later validated by a second-line expert and integrated into the database containing the process documentation. Otherwise, it is escalated to the next level of assistance, level two.

The second possible route for the ticket is if the technician doesn't know how to solve it at first or if, after searching the documentation, the technician still doesn't know how to proceed. In this case, the ticket will be escalated.

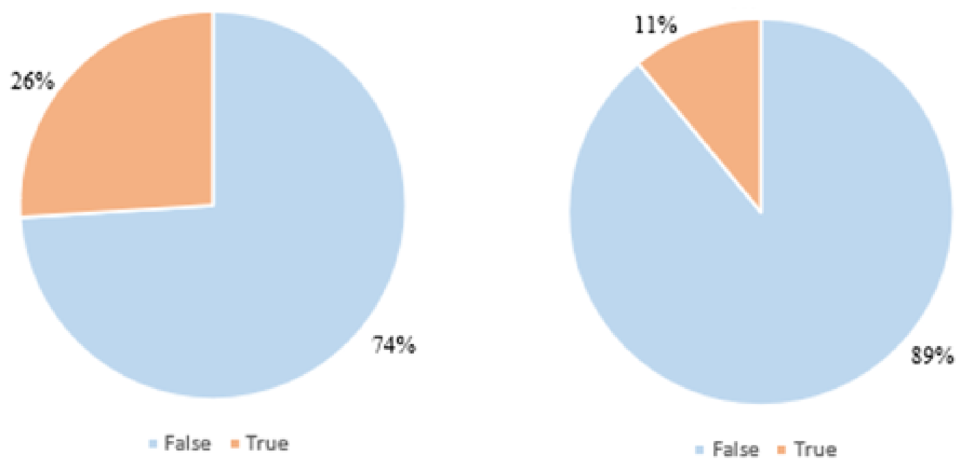
The ticket is examined as it moves through the second line to determine if the first support line correctly categorised it during triage. If it is accurate, it moves on to the next stage; if not, it is re-categorized before moving on. The following steps are the same as the process described for the first level up to the decisive moment, which follows the documentation search. At this point, there are two viable questions to ask, has a solution been found? or is it possible to solve it in-house?

If the answer to these questions is negative, it is necessary to make an external service request, for example, to a supplier; by doing this, the ticket is put on hold, stopping the time count for the SLA. On the other hand, if it is affirmative, the ticket goes to resolution. After the resolution, the ticket is checked with the user as in the process of the first level described earlier, and if the issue has been resolved, the ticket is closed with the resolution details. If, after the resolution, the problem persists, the incident manager is notified, and the ticket is placed on hold, stopping the SLA.

5.4 Key Performance Indicator Prediction

5.4.1 SLA Prediction

Through the predictive analysis described in chapter 4 in section 4.5.1. it was obtained prediction of what the SLA would be if the improvements implemented/being implemented already had long-term results and, therefore, stable results could have a real meaning regarding the behaviour and performance of the team under study. The results from this analysis are represented in Figure **??**



a) b)

Figure 5.8: Daily Kaizen SLA Prediction, SLA expiration status: a) Without improvements; b) With improvements

As explained before, the SLA without improvements implemented was calculated, that is, the real state during the daily Kaizen methodology, for the same sample in order to better compare the result of the new SLA. Both SLAs are shown in Figure 5.8.

Looking at the results obtained, it is possible to state that there was a significant improvement, of 20%, before and after the implementation of the improvements, and we can conclude that these have a positive effect on this KPI as expected.

Since the results obtained in this study come from a different sample from that used to define the initial SLA of the team in Chapter 3, they cannot be directly compared. Therefore, the results of the study were applied to the initial SLA, considering a 20% increase. So the evolution of the SLA of the initial situation was calculated taking into account these improvements. The results obtained are illustrated in Figure 5.9

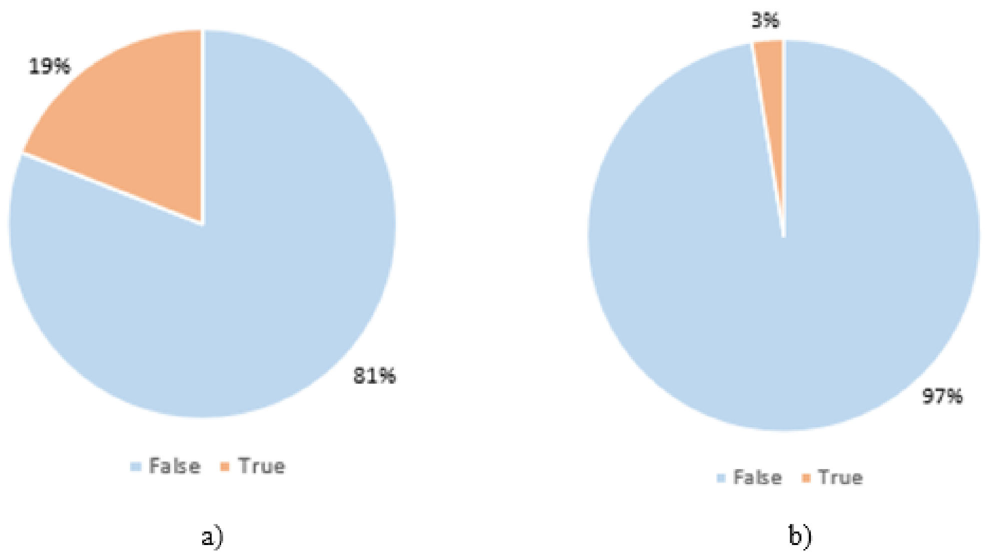


Figure 5.9: Global SLA Prediction, SLA expiration status: a) Without improvements; b) With improvements

In Figure 5.9, the study showcases the initial Service Level Agreement (SLA). It provides a forecast of the SLA's performance if the impact of the identified improvements is already steady. The analysis reveals that with a 20% increase applied to the initial SLA, the corresponding KPI saw a significant improvement, rising from 81% to 97.2%.

This outcome aligns with one of the key objectives outlined in Chapter 1 of the project. The success achieved in this aspect demonstrates the project's effectiveness in enhancing SLA adherence. It is important to note that these results were obtained without implementing all the identified improvements. Thus, it can be predicted that once all these improvements are put into action, the KPI will experience an even more substantial increase. The projected increase in the KPI is a promising indicator of the positive impact that the full implementation of the identified improvements will have on the team's performance; it is anticipated that the team will achieve an even higher level of SLA compliance, further improving operational efficiency and customer satisfaction.

5.4.2 Time-elapsed

Taking now into consideration the second KPI of interest to the project, the time elapsed, the results of the statistical study carried out before the forecast itself are first presented.

The analysis represented in Figure 5.10 was made for a sample mean of 2.89 and a standard deviation of 2.64 with a significance level of 5% had the following hypotheses: Null Hypothesis - All data values are from the same normal population. Alternative Hypothesis - The smallest or largest data value is an outlier.

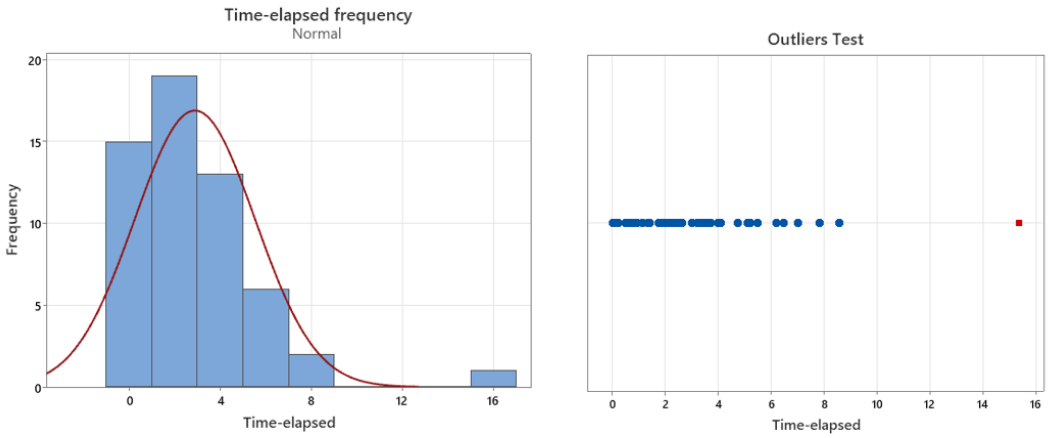


Figure 5.10: Minitab Analysis

The histogram gives us a view of how the data is distributed and its frequencies, and from this graph, we can see that there is an element which does not fit into the adjustment added to the graph, represented by the red line; this may represent a possible outlier. Anyway, considering the other test more directed to the purpose of the study, the outliers test, having obtained a p-value of 0.0 and by direct observation of the chart, the null hypothesis is rejected. Therefore, it is verified that one outlier corresponds to the last data set with a value of fifteen-point-thirty-eight, which refers to the subcategory PDAs.

The outlier found was removed from the sample, and the same analysis was performed for the new sample shown in Figure 5.11. This new distribution has an average of

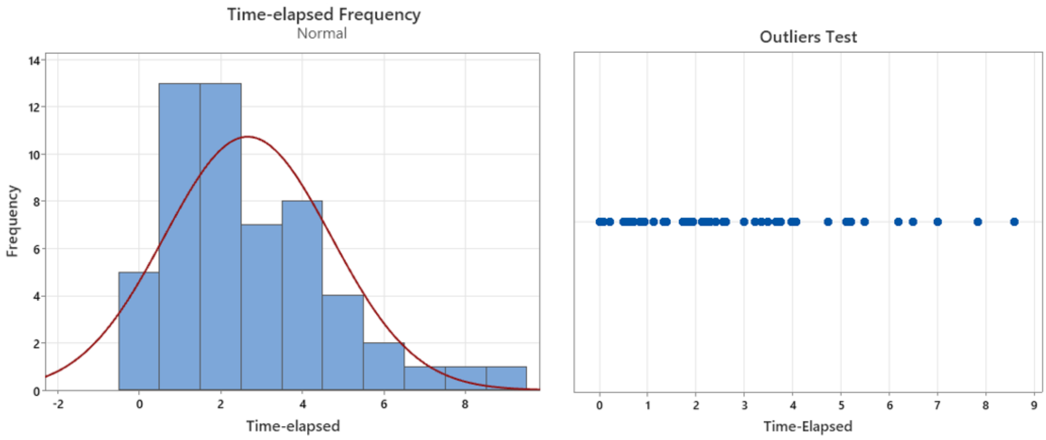


Figure 5.11: Minitab Analysis after removing the outliers

As expected, the data distribution now fits the adjustment distribution, and by redoing the outlier test, a p-value of 0.144 is obtained, which is higher than the significance level. With that being said, the null hypothesis is not rejected, concluding that there are no outliers in the new sample.

Once the outliers were identified and removed, we proceeded to the study to predict the evolution of this KPI as explained in Chapter 4. Considering the analysis made for the time elapsed of the Daily Kaizen period, the results obtained in Table 5.6.

Table 5.5: Time-Elapsed Prediction

Time-elapsed ([h]:mm:ss)	Time-elapsed with Improvements ([h]:mm:ss)
283:37:51	205:52:06

Looking at the table, it is visible that there has been a decrease in time-elapsed, which can be quantified at 27.4%. Figure 5.12 represents this evolution.

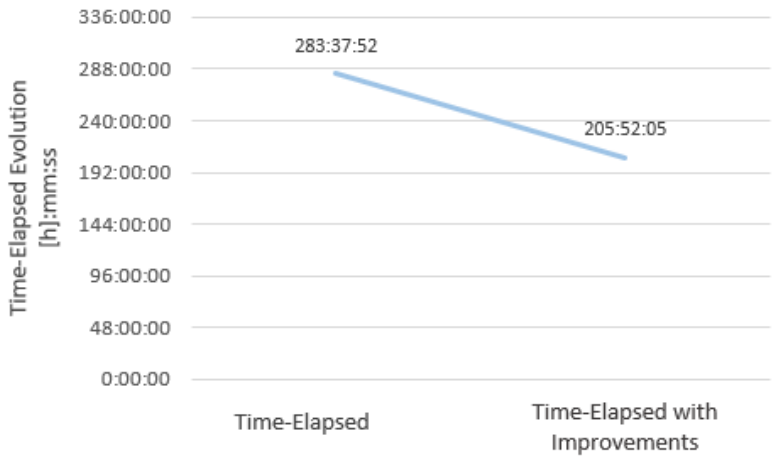


Figure 5.12: Time-Elapsed Evolution

Applying this evolution to the KPI of the initial situation, which was situated at 259.5 hours, the result of the forecast intended with this study was obtained, shown in the Table.

Table 5.6: Time-Elapsed Prediction

Time-elapsed ([h]:mm:ss)	Time-elapsed with Improvements ([h]:mm:ss)
259:30:21	188:21:27

It is concluded that there was a significant decrease in the KPI under study caused by the improvements implemented in the team. In this case, the team takes approximately 188 hours per ticket, proving the project's success.

5.4.3 Costumer Evaluation

The KPI concerning customer evaluation of the Helpdesk service cannot be predicted as previously done since there is no data to understand its evolution and because it does not have a linear relationship with any of the other KPIs. However, it is expected that by increasing the relative KPI and decreasing the average time elapsed of tickets, the user will improve their perception of the service provided and consequently evaluate it in a more positive way, raising the KPI in question. This is because these parameters are the ones that best define the service in the eyes of the customer, the time they wait to have their problem resolved and if this problem was treated within the established time.

It is concluded that to understand this project's success in this KPI, a new evaluation of this parameter will have to be carried out when the impacts resulting from the implementation of the improvements stagnate.

Chapter 6

Conclusion and Future Work

6.1 Conclusion

The thesis's objective at Rangel Logistics Solutions was to increase the productivity of the Helpdesk and IT support team. This project required the detection of inefficiencies in the team and the projection of improvements that would combat the causes of the lack of efficiency to achieve this challenge's main objective. To identify these inefficiencies, it was intended to adopt methodologies to analyze the initial situation and then apply methodologies for continuous improvement and process management in order to obtain the future situation.

A Gemba Kaizen methodology was adopted in order to study the Helpdesk team and process. The processes that make up this service were studied to immediately understand the team's way of acting, low-value behaviour, and the standardization of these processes. Furthermore, a brief analysis was made of the remaining areas of activity of the technicians since they are all linked to the Helpdesk process.

This methodology consisted of performing Gemba Walks and Shadowing, maintaining a critical view but without making any changes to the situation of the team during this analysis. From the outset, this methodology revealed significant problems in the team at the behavioural, process, and management levels. It was found that the support team under study had low levels of process and task standardization due to a major gap in process documentation. The fact of being a team of low maturity both within the company and in many cases in professional experience, in general, presupposes insufficient know-how in large part of the situations that cannot be countered due to the aforementioned lack of documentation. This low level of maturity of the team also creates weak management of responsibilities and tasks that leads to more valuable tasks being put in second place.

Data analysis methodologies were used in the second stage of the study to find recurring tasks and tickets and quantify the team in terms of workload and efficiency. This provided quantitative insights into the efficiency of the team in terms of average response times and quality of service. Also, they quantified the recurrence of processes that proved to be frequent and, therefore, important in the support context.

The Daily Kaizen methodology was also adopted, which revealed patterns of difficulties in the team and root causes of inefficiency, allowing, with the help of the PDCA cycle, to discover improvements to combat these problems.

From the results of the prioritization of the improvements found, it is clear that improvements that combat problems of know-how, organization/management, and responsibility are pillars for the good functioning of the Helpdesk process and increased efficiency of the team, so the first positions in this prioritization give way to tasks that create documentation and standardization or help with this, operations that aim to improve the organization of the team and its joint responsibility in order to achieve the common objective.

Looking at the results obtained from the predictive analysis of the team's KPIs resulting from the implementation of the improvements, it can be concluded that there was an increase in the level of service provided by the team revealed by the 20% increase in the percentage of the SLA KPIs and a consequent decrease in the Helpdesk service response time, expressed by the 27% decrease in the KPI referring to Time-Elapsed. With these results, it was also possible to conclude that, since these KPIs are two of the most important factors considered by the customer when evaluating the service, an improvement is expected in the KPI referring to the user satisfaction level.

When comparing the forecast results with the quantifiable objectives of the project, it is possible to conclude that these were achieved, having raised the level of service of the team from 81% to 97%, which represents precisely what was the goal for this KPI and in terms of time-elapsed, expectations were exceeded, which were to reduce the time-elapsed from 258 hours to 204 hours, since according to the forecast it will be 186 hours. It is therefore verified the success obtained in this project. Finally, it is concluded that the realization of this project in the team of infrastructures of the information systems department has proved to be an asset in the team's efficiency and performance to support the company's operations.

6.2 Future Work

As future work, it is initially proposed to implement the remaining improvements found in this study, which were not integrated into the team due to either the project's duration or because they required the collaboration of other departments. Such as the study of customer opinion regarding ticket creation, through collaboration with the marketing department to create a form that can be made available to the whole company, as well as the other improvements mentioned above that could not be carried out. An example of the user satisfaction form is presented in Appendix D. Another interesting study that comes from the improvement of correctly evaluating the customer would be to study the type of tickets in which it is more difficult for the user to define them, as well as the most problematic fields to fill in. This would also allow us to understand if holding a workshop or user training action would be significant for this process. In addition to this, it would be relevant to conduct a KPIs forecast using Autoregressive Integrated Moving Average Models (ARIMA) and compare the results with the ones obtained in this project. This technique captures the data's patterns, trends, and seasonality using a combination of past values, differences, and errors to predict future values; it uses time series data to predict future trends. This widely used model is applied in various industries; for example, to predict stock prices.

Following this, it will be crucial to examine the real impact of the improvements implemented in the team's KPIs, once they have stabilized, to assess the team's performance and the project's success and compare these results with the predictions made in this project. Still, within the infrastructure team, it would be beneficial to apply the 5S Lean philosophy to the workspace it uses in order to reduce waste and foster a productive environment.

Screening is a process done daily by the technicians, which, despite being extremely important, does not add value because it is not a resolution in itself. So if it were possible to free the technicians from this task, they would have more time to solve tickets, tasks that really help the company not to lose value. Therefore, It would be worth studying the possibility of sorting automatically through machine learning techniques.

It would also be valuable to the team, to find out which parameters have the greatest influence on the process through a design of experiments (DOE) analysis.

In addition to the infrastructure team, eight additional teams with varying specialities use the Helpdesk software to assist the business. In this way, extending the improvements and procedures found during the project to the remaining Helpdesk teams would increase the productivity of all the company's Helpdesk support, ensuring a better flow of operations and processes that bring value to the company.

Bibliography

Alagumurthi, N., Palaniradja, K., and Soundararajan, V. (2006). Optimization of grinding process through design of experiment (doe)—a comparative study. *Materials and manufacturing processes*, 21(1):19–21.

Alves, A. C., Sousa, R. M., Carvalho, D., Moreira, F., and Lima, R. M. (2011). Benefits of lean management: results from some industrial cases in portugal.

CareerFoundry (2023). Quantitative vs qualitative data: What's the difference?

Coursera (2023). What is statistical analysis? definition, types, and jobs.

Dunford, R., Su, Q., and Tamang, E. (2014). The pareto principle.

EPA (2023). Lean thinking and methods - 5s.

Forza, C. (1996). Work organization in lean production and traditional plants: what are the differences? *International Journal of Operations & Production Management*.

Imai, M. (2012). *Gemba Kaizen, A Commonsense Approach to a Continuous Improvement Strategy.*, volume 2.

Investopedia (2023). The 80-20 rule (aka pareto principle): What it is, how it works.

KaizenInstitute (2023). What is the importance of adopting daily kaizen to create a kaizen culture.

Leksic, I., Stefanic, N., and Veza, I. (2020). The impact of using different lean manufacturing tools on waste reduction. *Advances in Production Engineering & Management*, 15(1).

Lucidchart (2023). Bpmn 2.0 diagram elements and symbols.

Michalska, J. and Szewieczek, D. (2007). The 5s methodology as a tool for improving the organization. *Journal of achievements in materials and manufacturing engineering*, 24(2):211–214.

planettogether (2023). Five principles of lean manufacturing.

Renner, M. and Taylor-Powell, E. (2003). Analyzing qualitative data. *Programme Development & Evaluation, University of Wisconsin-Extension Cooperative Extension*, pages 1–10.

Rogers, P. J., Stevens, K., and Boymal, J. (2009). Qualitative cost–benefit evaluation of complex, emergent programs. *Evaluation and Program Planning*, 32(1):83–90.

Simplilearn (2023). What is statistical analysis? types, methods and examples.

Steinberg, R. A. (2007). *ITIL Version 3 Service Operation*, volume 2.

Stiehl, V. (2014). *Process-driven applications with BPMN*. Springer.

timeular (2023). The 10 best prioritization techniques.

Turner, A., Brazier, J., Bishop, C., Chavda, S., Cree, J., and Read, P. (2015). Data analysis for strength and conditioning coaches: Using excel to analyze reliability, differences, and relationships. *Strength & Conditioning Journal*, 37(1):76–83.

Tye, H. (2004). Application of statistical 'design of experiments' methods in drug discovery. *Drug discovery today*, 9(11):485–491.

Wil, v. d. A., Desel, J., and Oberweis, A. (2003). *Business process management: Models, techniques, and empirical studies*. Springer.

Appendix A

Daily Kaizen Dashboard

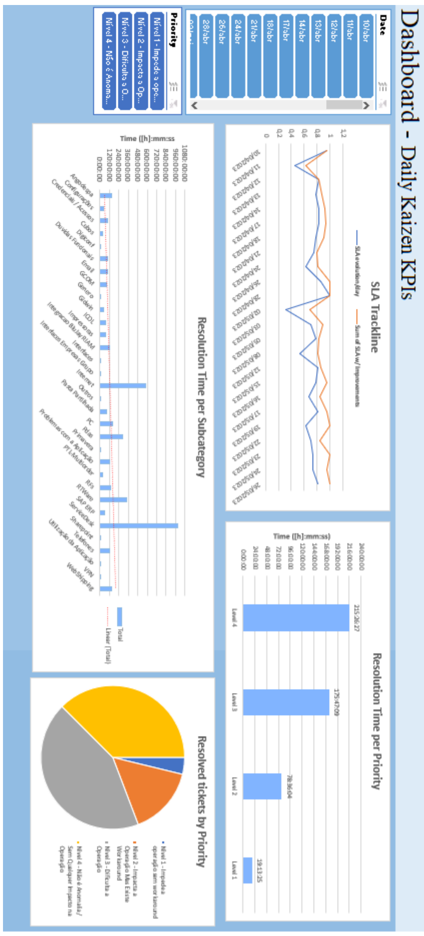


Figure A.1: Daily Kaizen Dashboardl

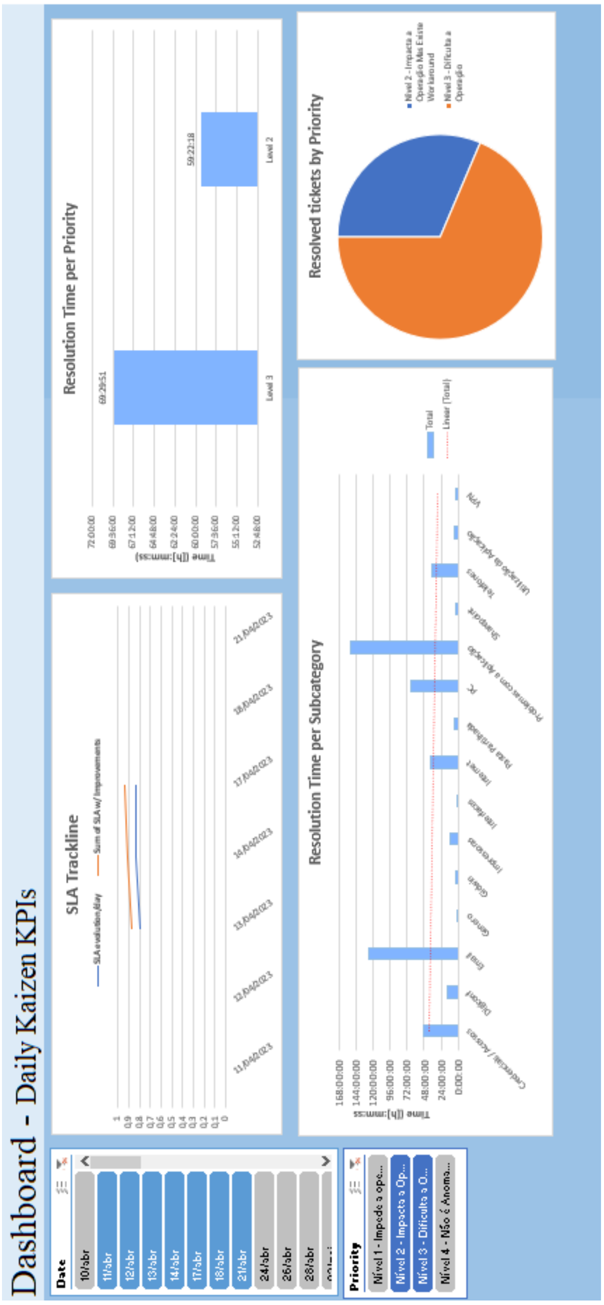


Figure A.2: Daily Kaizen Dashboard

Appendix B

Prioritization Framework

Category	Weight	Classification											
		Documentation and Process Mapping	Indication of the resolution when closing a ticket with subsequent evaluation and insertion in the	Update FAQ'S with simple and frequent processes	Instruction for ticket creation	Create printer instruction and interactive user support manual	Definition of area of operation + specification of each technician's tasks for the day	Definition of the topics to be addressed at meetings with associated times	Technician responsible for triage must analyse tickets with SLA violated or about	Form about the ticket creation for the user	Create an organized database to include all documents and processes of the	Instruction for tickets On-Hold	Correctly evaluate the user at the time of triage in relation to the ticket created
Recurrent dificulty	10	5	3	2	4	3	3	4	4	3	5	5	3
Implementation time	10	2	4	3	4	3	3	3	5	4	4	5	5
Reduces execution time	10	1	1	0	1	0	0	0	0	0	1	1	0
Implementation cost	2	5	5	5	5	4	5	5	5	5	5	5	5
Impact on user satisfaction	5	2	2	5	4	5	1	1	2	4	2	3	4
Quick win	5	0	1	0	1	0	0	1	1	0	1	1	0
Value adding	1	5	5	3	2	2	4	3	4	1	3	3	2
Final Classification (weighted classification)		105	110	88	127	95	79	93	119	101	128	143	112

Figure B.1: Prioritization Framework

Appendix C

Instruction for tickets On-Hold

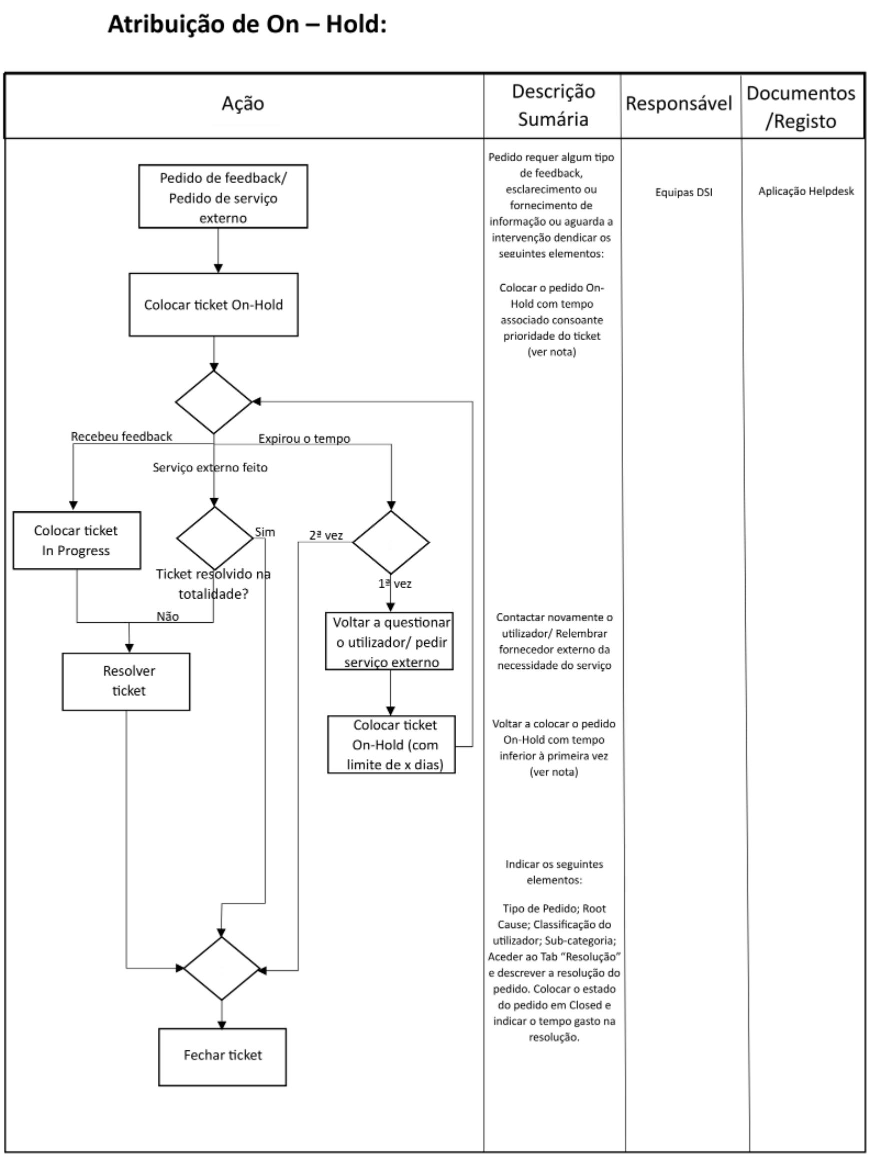


Figure C.1: On-Hold Instruction

Appendix D

User Form Example

Service Desk na Rangel - Grau de satisfação

(En) Service Desk - Satisfaction level

O presente formulário foi desenvolvido a fim de apoiar o estudo dos processos associados ao ***service desk***. Tem como objetivo perceber o **grau de satisfação** dos usuários, bem como **oportunidades de melhoria** e problemas a serem resolvidos.

This form was developed in order to support the study of the processes related to **service desk**. It aims to understand the degree of **user satisfaction**, as well as **opportunities for improvement** and problems to be solved.

* Obrigatória

* Este formulário irá registar o seu nome, por favor preencha seu nome.

Figure D.1: Form initial page

1. Sabe como utilizar o serviço de ***helpdesk***?

   (En) Do you know how to use **helpdesk**? *

   ◯ Sim / Yes

   ◯ Não / No

2. Já criou um ***ticket*** no *helpdesk*?

   (En) Have you ever created a **ticket** in helpdesk? *

   ◯ Sim / Yes

   ◯ Não / No

Figure D.2: Form first and second questions

Guia de criação

(En) Creation guide

3. Gostaria de ter um **guia** de ajuda à criação de um *ticket*? (para qualificação e descrição do problema)

   (En) Would you like to have a **guideline** to help you create a ticket? (for problem qualification and desciption) *

   ◯ Sim / Yes

   ◯ Não / No

Figure D.3: Form third question

Grau de satisfação

(En) Satisfaction level

Nesta secção pretende-se perceber qual o seu grau de satisfação em relação ao *service desk*.

(En) In this section we aim to understand your service desk satisfaction level.

4. Gostaria de ter um **guia** de ajuda à criação de um *ticket*? (para qualificação e descrição do problema)

   (En) Would you like to have a **guideline** to help you create a ticket? (for problem qualification and desciption) *

   ◯ Sim / Yes

   ◯ Não / No

5. Gostaria de, no momento de criação do *ticket*, poder definir o **nível de prioridade** a ele associado? (Sabendo que poderia ser alterado pelo técnico mediante uma justificação)

   (En) Would you like, when creating a ticket, to be able to define the **priority level** associated with it? (Knowing that it could be changed by the technician with a justification)

   Nível 1: máxima prioridade / Level 1: top priority
   Nível 4: mínima prioridade / Level 4: lowest priority *

   ◯ Sim / Yes

   ◯ Não / No

Figure D.4: Form fourth and fifth questions

6. Considera que, na criação de um *ticket*, é possível **especificar/descrever corretamente o problema** com os campos existentes, i.e. aplicações, assunto e descrição? (De forma a facilitar a identificação do problema por parte do técnico)

   (En) Do you consider that, when creating a ticket, it is possible to **correctly specify/describe the problem** with the existing fields, i.e. applications, subject and description? (In order to make it easier for the technician to identify the problem) *

   ( ) Sim / Yes

   ( ) Não / No

7. Quais dos seguintes considera ser uma **mais valia** para a correta especificação/descrição do problema, na criação de um *ticket*?

   (En) Which of the following do you consider to be an **asset** for the correct specification/description of the problem, when creating a ticket? *

   - [ ] *Behavior Driven Development* - Utilização de um padrão de escrita com um guia/exemplos / Usage of a writing pattern with a guide/examples
   - [ ] Adicionar campos de definição do *ticket* (p.ex. subcategoria) / Add ticket definition fields (e.g. subcategory)
   - [ ] Utilização de palavras-chave / Usage of keywords
   - [ ] Campos com opções predefinidas / Predefined fields
   - [ ] Outro

Figure D.5: Form sixth and seventh questions

8. Gostaria de ter ***feedback*** mais detalhado e recorrente ao longo da resolução do *ticket*?

   (En) Would you like more detailed and recurring **feedback** throughout the ticket resolution? *

   Sim / Yes

   Não / No

9. Estaria interessad@ em ter acesso a ***self-service*** de *helpdesk* atualizado, para pedidos de simples resolução e recorrentes?

   (En) Would you be interested in having access to up-to-date **self-service** helpdesk for simple resolution and recurring requests? *

   Sim / Yes

   Não / No

10. Qual o seu **grau de satisfação** quanto ao serviço do *helpdesk*?

    (En) How **satisfied** are you with helpdesk? *

Figure D.6: Form eighth, ninth and tenth questions

Recomendações

(En) Recommendations

11. Gostaria de partilhar alguma recomendação?

    (En) Would you like to share any recommendations?

Figure D.7: Form eleventh question