Automation of Equipment Control and Regularisation Processes in a Telecommunication Company

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Master's Dissertation

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Abstract

This dissertation project was carried out as part of an automation initiative in the Fixed Planning unit of the telecommunications company NOS.

Given the amount of equipment managed by NOS, whether in its own facilities or the warehouses of service providers, it is important to have processes in place for equipment control and regularisation. This enables the resolution of any inconsistencies without disrupting the processes.

In the current global scenario, there is a growing emphasis on eliminating non-value-adding process steps. This ensures that labour is used efficiently and that any redundant steps are replaced by technology.

The organization employs various IT platforms and systems to manage the complexity and extensive information associated with each piece of equipment. As a consequence, when inconsistencies arise, the process of collecting and analysing information takes a prolonged duration.

Furthermore, all processes were executed manually. This manual approach adversely affects the outcomes, resulting in prolonged execution times and diminished operational efficiency for the team.

In view of the situation described, this project focused on automating the equipment control and regularisation processes, specifically the SAP Inconsistencies and Ticketing processes.

An intensive study was conducted into the processes in question. This included detailed mapping of each process and analysing the opportunities for improvement needed to remedy the shortcomings identified.

Therefore, a decision-support platform was created in Excel to automatically handle both processes using programmed buttons with VBA scripts. The platform allows for the centralisation of information and prior analysis of the data available to formulate coherent feedback in the case of tickets, reducing the time dedicated to analysis.

With the platform implemented, it was possible to reduce the time spent on equipment control and regularisation processes by 14 hours and 50 minutes per month. This resulted in annual savings totalling 3 138,62 €.

Resumo

Este projeto de dissertação foi realizado como parte de uma iniciativa de automação na unidade de Planeamento Fixo da empresa de telecomunicações NOS.

Dada a quantidade de equipamentos geridos pela NOS, tanto nas suas próprias instalações como nos armazéns dos prestadores de serviços, é importante ter processos estabelecidos para o controlo e regularização dos equipamentos. Isto permite a resolução de quaisquer inconsistências sem interromper os processos.

No cenário global atual, há uma crescente ênfase na eliminação de etapas de processos que não acrescentam valor, garantindo que o trabalho seja utilizado de forma eficiente e que qualquer etapa redundante seja substituída.

A organização utiliza várias plataformas e sistemas de TI para gerir a complexidade e a vasta quantidade de informações associadas a cada equipamento. Como consequência, quando surgem inconsistências, o processo de recolha e análise de informações revela ser moroso e complexo

Além disso, todos os processos eram executados manualmente. Esta abordagem manual refletia negativamente nos indicadores de performance, culminando em tempos de execução prolongados e numa eficiência operacional reduzida para a equipa.

Face à situação descrita, este projeto concentrou-se na automação dos processos de controlo e regularização de equipamentos, especificamente nos processos de Inconsistências SAP e de Ticketing.

Foi realizado um estudo intensivo sobre os processos em questão, desde o mapeamento detalhado de cada processo à análise das oportunidades de melhoria necessárias para remediar as deficiências identificadas.

Assim, foi criada uma plataforma de suporte à decisão em Excel que permite a resolução automática de ambos os processos, utilizando botões programados com scripts VBA. Esta plataforma permite a centralização da informação e a análise prévia da informação disponível para formular feedback coerente no caso de tickets, reduzindo o tempo dedicado à análise.

Com a plataforma implementada, foi possível reduzir o tempo despendido nos processos de controlo e regularização de equipamentos em 14 horas e 50 minutos por mês, resultando numa poupança anual total de 3 138,62 € .

Acknowledgements

These last six years, which are now coming to an end, have undoubtedly been an adventure marked by great personal growth. I must thank those who have tirelessly stood by my side.

Firstly, I would like to thank my parents for their love and endless dedication and for showing me the importance of resilience from an early age. I would like to thank my mum for being the best person I know, my best friend, the one who fights my battles and spares no effort to see me happy. If I finish my degree today, it's thanks to her commitment and tireless sacrifice. To my father, thank you for your example of determination and perseverance in life, your unwavering strength and for ensuring the well-being of everyone around you. This wouldn't be possible without you. Thank you from the bottom of my heart.

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To my Thursday group for helping me every week to be the best version of myself, showing me that there is room for failure and that life is what we make of it, with no need for hurry or desperation. We're on the right path together. You all have a very special place in my heart. Thank you for everything.

Last but certainly not least, I would like to thank my supervisors Professor Ricardo Filipe Soares and Ana Machado Rocha for all their dedication, availability and guidance throughout this project.

"A vida é o que fazemos dela. As viagens são os viajantes. O que vemos não é o que vemos, senão o que somos."

Fernando Pessoa

Contents

Acronyms and Symbols

3PP	Third-Party Providers
BI	Business Intelligence
BPM	Business Process Management
BPMN	Business Process Model and Notation
CE	Circular Economy
CI	Continuous Improvement
CLSC	Closed Loop Supply Chain
CRM	Customer Management Relations
EoL	End of Life
ERP	Enterprise Resource Planning
ICCID	Integrated Circuit Card Identifier
IT	Information Technology
KPI	Key Performance Indicators
RL	Reverse Logistics
SLA	Service Level Agreement
SNs	Serial Numbers
SP	Service Providers
VBA	Visual Basic for Applications

List of Figures

List of Tables

Chapter 1

Introduction

1.1 The Company

NOS is a Portuguese group in the telecommunications and entertainment sector. Founded in 2014, the NOS group resulted from a merger between the telecommunications company OPTIMUS and the multimedia company ZON. The merger between the two companies allowed for the integration of operational synergies as well as the sharing of technological patents considered fundamental for the development of internet and mobile telephony services throughout the country, making it possible to increase operational efficiency and satisfaction with the service provided, thus boosting technology and investment in the telecommunications sector in Portugal.

The company offers cable and satellite television, as well as mobile and fixed telephony services, broadband, and mobile internet services. These are considered the company's best sellers and provide a complete range of services tailored to meet the diverse needs of its customers. More recently, the group has also started providing security services in the form of alarms. These services are available for individual, residential, and corporate market segments.

The NOS group consists of multiple companies that operate in various communication sectors, including film distribution and production, premium channels, and IT innovation. They place a strong emphasis on developing 5G technology solutions. The group is composed of the following companies: NOS Comunicações, NOS Wholesales, NOS Corporate Centre, NOS Mediação de Seguros, NOS Lusomundo Audiovisual, NOS Lusomundo Cinemas, NOS AUDIO-Sales and Distribution, NOS Açores Comunicações, NOS Madeira Comunicações, DREAMIA, ZAP, SPORT TV, NOS Technology, NOS Sistemas, NOS Inovação and Ten Twenty-One.

The company's dominance in Portugal's telecommunications industry is evident from the following market indicators. The company has a 37% share in the subscription TV service, 34% share in the fixed broadband service, 34% share in the fixed voice service, and a 29% share in the national mobile network service. NOS continues to strengthen its presence in the market, committed to offering the latest generation of services and always endeavouring to keep ahead of innovations in an increasingly AI-driven sector. (NOSSGPS, 2024)

1.2 Project Background and Motivations

NOS has a well-defined organisational structure, with one of the most prominent departments being Procurement and Supply Chain, which guarantees all logistics operations associated with NOS equipment, including purchase, storage, and transport. NOS' Procurement and Supply Chain unit is divided into the following sectors: Purchases; Network Materials, Sims and Alarms; Partnership; Fixed Reverse Logistics; Purchases of Telecommunication systems; Supplier and Contract Management; General Services and Network Materials; Logistics Centre Operations; Mobile Planning; Fixed Planning.

Figure 1.1 illustrates the hierarchical structure of NOS' Procurement and supply chain department.

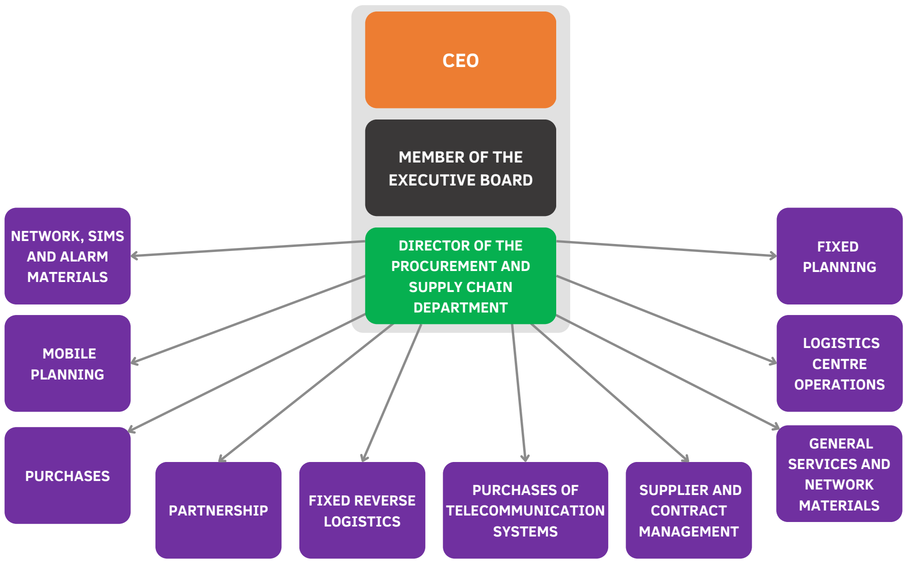


Figure 1.1: Hierarchy of the NOS Procurement and supply chain department

NOS uses third-party companies called Service Providers (SPs) to provide customer services. These service providers are situated nationwide and are accountable for providing installation and maintenance services at customers' residences as well as installing network units across the country. To ensure the quality of the services provided, technicians at each of the SPs undergo training provided by NOS, as well as periodic tests. This guarantees equal access to new technologies and standardises the quality of the service.

Every service provider (SP) has its own warehouse containing NOS products. Even though the equipment is located outside the company's immediate vicinity, it is still in its possession. To maintain the integrity of the NOS equipment stock, each serial number (SN) is monitored using Enterprise Resource Planning Software (ERP).

Several processes are executed to ensure the company's stock is accurately maintained. The Business Intelligence (BI) team issues a weekly report that gives an overview of the equipment that has been subject to stock removal operations but continues to be listed as in stock on the ERP platform. Regularising such equipment is known as the SAP Inconsistency process and is carried out by a member of the Fixed Planning team weekly.

Another method used for stock control is a Ticket. If the SPs encounter any issue, such as an order not progressing through the system or incorrect charging, they can raise a dispute using a Ticket, which is then handled by a member of the Fixed Planning unit.

Having a Ticket enables the correction of stocks and facilitates the management of equipment distributed between NOS warehouses and SPs. However, each ticket can include a large number of devices, which must go through several regularisation stages. This is because the information required for the final analysis is spread across four IT platforms. As a result, the process of resolving the ticket is lengthy and must be carried out separately for each of the devices mentioned in the ticket.

With the advent of new technologies, it has become increasingly important to establish streamlined and efficient work processes that require minimal human intervention. These processes should allow optimal resource utilisation and reduce unnecessary time spent on non-value-added tasks (Rosa Aisa a, 2023).

1.3 Automation of stock inconsistencies processes

The work of this dissertation was carried out within the scope of the Fixed Planning unit. The Fixed Planning unit carries out various operations related to purchasing residential and commercial equipment, such as boxes, routers, Wi-Fi devices, remotes, and network antennas. In addition, the unit is responsible for procuring necessary installation and packaging components, including cables, boxes, and labels. Fixed Planning manages receipts, processes orders, maintains stock control, and ensures inventory integrity. Additionally, it is responsible for purchasing the components required for the refurbishing process, which involves treating returned or collected equipment from customers, making it possible for it to be used again within the company's quality standards. Figure 1.2 illustrates the scheme of how the unit is organised:

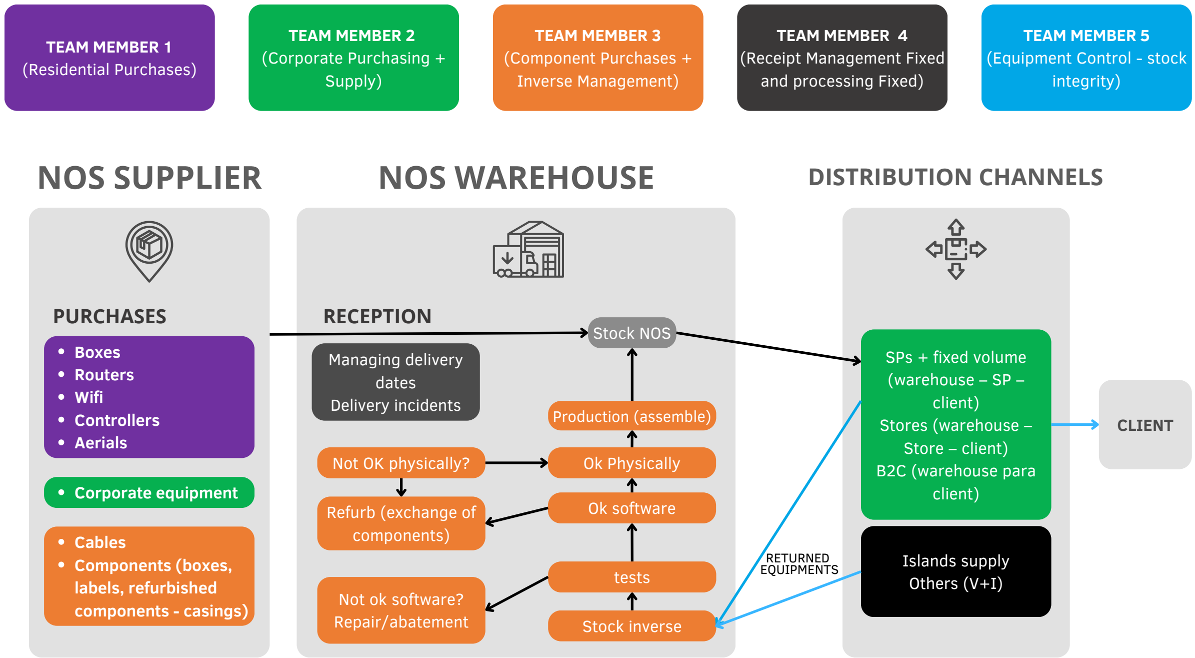


Figure 1.2: Scheme of the organisation in the Fixed Planning Team

Stock control and regularisation processes are crucial to guaranteeing the accuracy of a company's inventory. However, the current manual and time-consuming approach, which involves only one person, can lead to various problems in terms of operational efficiency and transparency of operation.

Some examples are as follows:

- Inefficiency: The regularisation process is often delayed, leading to operational bottlenecks and dissatisfaction among partners (SPs).
- Lack of process transparency: The team's ability to keep abreast of the workflow is significantly hampered by the exclusive execution of the process by a single individual, which jeopardises overall accountability. In addition, the lack of a process flow diagram for the SAP Inconsistencies processes and the various ticket types are also obstacles to process transparency.
- Human error: the resolution process is entirely manual and requires consulting various sources of information, making it more prone to errors.
- Personnel dependency: Relying solely on a single individual to complete a task could lead to embarrassment in the event of the person's absence or termination from the company.
- Lack of data: Many serial numbers that are dealt within the SAP inconsistency process are reported again in tickets. In addition, many serial numbers are repeatedly reported in tickets, even after they have already been treated. The lack of a data base to check and flag

serial numbers that have already been addressed before starting to analyse the equipment in a ticket is a shortcoming in the process.

The issues identified motivated the work presented in this dissertation. This project focused on developing a decision-support tool that enables more efficient resolution of stock correction processes, specifically Tickets and SAP inconsistencies. The tool provides a simple, efficient, and transparent flow that centralises all the necessary sources of information for an accurate analysis.

1.4 Project Objective

The objective of this project was to enhance the efficiency of the ticket resolution process and address SAP inconsistencies. The primary focus was on developing a decision-support platform using VBA (Visual Basic for Applications) in Microsoft Excel. The platform aimed to facilitate data integration between the two processes, centralise information and enhance performance indicators (KPIs) for both processes.

In addition to the objectives listed, the goal was to create a system that would reduce the time spent analysing the individual cases contested in each ticket, the potential causes, and suggestions for corrective action.

1.5 Methodology

An execution plan, which can be found in Appendix A, was drawn up at the start of the project to guarantee the fulfilment of all the objectives outlined.

The first task was to understand each equipment control and regularisation process and their respective shortcomings. This was followed by the elaboration of the respective process mapping using the Business Process Model and Notation.

The second task consisted of studying the opportunities for improvement and the possibilities for optimising the processes based on the study of the process mapping.

A third task consisted of designing a decision support platform and parallel tasks to ensure the automation of the process as a whole.

The fourth task consisted of testing the platform created, gathering user feedback, and correcting shortcomings.

The fifth task consisted of collecting results and comparing the KPIs achieved with the new platform to the as-is model.

The sixth task consisted of analysing opportunities for future work.

Finally, the seventh task consisted of continuously writing the dissertation throughout the project.

1.6 Dissertation Structure

This dissertation is organised into six separate chapters.

Chapter 1 presents the company as well as an introduction to the present work, clarifying the background of the project, motivations and objectives, and the methodology adopted in the execution of the project. **Chapter 2** performs a literature review to obtain a scientific understanding and justification for the decisions made throughout the project. **Chapter 3** comprises a description of the problem in which an overview of the current situation and identification of opportunities for improvement were carried out. **Chapter 4** covers the methodology used to create the decision support platform. This chapter describes the approach used to implement the platform and the priorities established to ensure process cohesion. **Chapter 5** resumes the final results of the platform's implementation, namely the impact on lead times and average resolution times per equipment, as well as the monetary savings achieved by using the platform. Finally **Chapter 6** includes the conclusions about the project and suggestions for Future Work.

Chapter 2

Literature Review

A very important aspect of the NOS logistics supply chain is the use of reverse logistics.

Reverse logistics allows the company to mitigate the high costs inherent in purchasing new equipment in order to be able to respond to market demands, as well as being an ecological solution that reduces the environmental impact caused by the production of equipment. There are many benefits inherent in the practice of reverse logistics, but there are also many challenges, such as processing the equipment in ERP software and difficulty in guaranteeing the return of equipment, for example.

2.1 Reverse Logistics

The transportation, storage, and inventory management involved in logistics are major contributors to pollution that leads to the greenhouse effect. Due to the deterioration of the global environmental situation, various legislative measures have been implemented to control industrial emissions. These regulations aim to restrict the usage of raw materials and greenhouse gas emissions while limiting the amount of energy consumed during production processes, (Anika et al., 2022). To address the pressing need to prevent further damage caused by rising temperatures, the ambitious goal of achieving net-zero Carbon emissions by 2050 has been established, (Forkan et al., 2022). To attain higher levels of environmental responsibility, it is imperative to restructure all sectors. This entails the establishment of a planet-friendly supply chain with minimal environmental impact, commonly called the "Green supply chain." Reverse logistics (RL) has emerged as a prominent approach among the strategies employed in the green supply chain due to its environmental and economic efficiency, (Srivastava, 2007).

The concept of reverse logistics is defined as "The process of planning, implementing, and controlling the efficient and cost-effective flow of raw materials, in-process inventory, finished products, and related information, from the point of consumption to the point of origin, to recapture value or eliminate it appropriately" (Dale S. Rogers, 1999). By implementing refurbishing and eco-design operations, it is possible to provide a new life to equipment that has reached its end-of-life (EOL) stage. This, in turn, enables companies to keep up with market demands (Alexandre Labelle, 2023).

The combination of the classic supply-chain model, i.e., direct logistics, with the concept of reverse logistics is known as the Closed-Loop Supply Chain (CLSC) (Daria Battini, 2017) is exemplified in Figure 2.1:

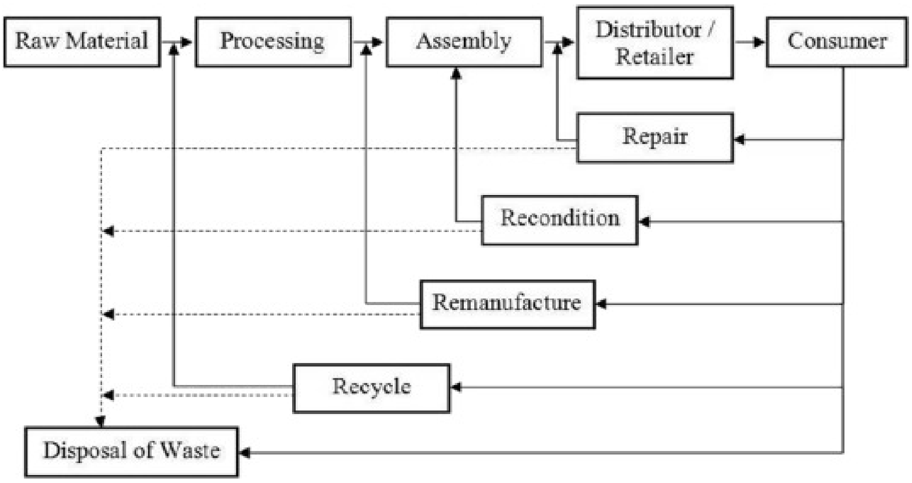


Figure 2.1: Diagram of a Closed-Loop Supply Chain Source: Kuan Siew Khor (2012)

It is essential to consider the cost implications of a supply chain model when analysing its feasibility for a company. Research indicates that an RL process costs, on average, 4% of the total value of a company's logistics structure. This is because setting up an RL process only requires two channels, one dedicated to collecting the devices and the other to performing refurbishing operations such as cleaning, polishing, and technical interventions in the equipment (Vaishali Sharma, 2016). Companies can realize significant savings in logistics costs, up to 10%, by outsourcing the task of RL to third-party providers (3PP). This approach results in a take-back model whereby the 3PP assumes responsibility for the task (Vaishali Sharma, 2016).

One of the biggest challenges to the success of Reverse Logistics (RL) is its direct dependence on customers' voluntary return of equipment. Several mathematical models have been developed to predict consumer behaviour regarding equipment returns. These models consider factors such as collection point location, socio-demographic information, sustainable attitudes, and consumer profiles (Alexandre Labelle, 2023). Another challenge is the mentality of consumers since many still consider reconditioned equipment to be of lower quality (José Carlos Curvelo Santana, 2021), which is further reinforced by significant technological advances that end up putting equipment into idle status at an unprecedented speed.

Processing the data associated with RL poses a significant challenge for companies like NOS. Tracing all the allegedly returned equipment is difficult, as it is distributed among various SPs warehouses throughout the country. In response to this issue, the company has instituted a policy of automatically deducting the Service Provider (SP) if the returned equipment remains in the SP's warehouse for more than 45 days prior to being returned to NOS for the required refurbishment procedures. Equipment can also be automatically inserted into an SP's reverse cycle if the information on the NOS IT platforms justifies it, with these devices being subject to the previously mentioned 45-day limit before the debit is issued. However, the SP can contest both the debit and the entry of equipment it considers inappropriate in the inverse cycle by opening a ticket, which triggers a long and extensive analysis cycle.

Currently, the RL landscape is predominantly occupied by electronic products. Other products, such as car components, personal IT equipment, printer toner, and glass, also comprise a significant part of the reverse flow (Chi Kin Chan, 2020). It is important to note that the range of equipment subject to refurbishment operations has increased exponentially with technological developments.

The idea of a circular economy has become crucial nowadays as large companies aim to create a more sustainable future. However, implementing sustainable practices from a bureaucratic and functional point of view presents many challenges. The RL strategy, for example, is a fundamental pillar in establishing a circular economy in the telecommunications and electronic devices market.

2.2 Circular Economy

The concept of the circular economy (CE) consists of a new model of production and consumption, the theoretical formulation of which dates back to the 1990s with the recognition of the worrying environmental situation and the scarcity of natural resources for future generations (Nancy M. P. Bockena, 2016). The CE seeks to reduce waste to a minimum by investing in recycling, refurbishing, and repairing operations, thus extending the product's proper life cycle. Therefore, when a product reaches EoL status, its materials and components continue circulating in the economy thanks to recycling operations, adding future value (Frank Figge, 2023).

CE is grounded on reducing pollution, increasing the longevity of products, and regenerating natural systems (Murray, 2017). To effectively achieve the goals of this model, it is crucial to restructure the paradigms of manufacturing concessions by critically reviewing the parameters utilised in product design. A high-priority action item is to develop products that are durable, easy to repair or improve, and readily comprehensively into Closed-Loop Supply Chains (CLSCs) to ensure that CE's principles are met (CA Bakker, 2014). Figure 2.2 illustrate the scheme of circular economy, also known as Butterfly Diagram:

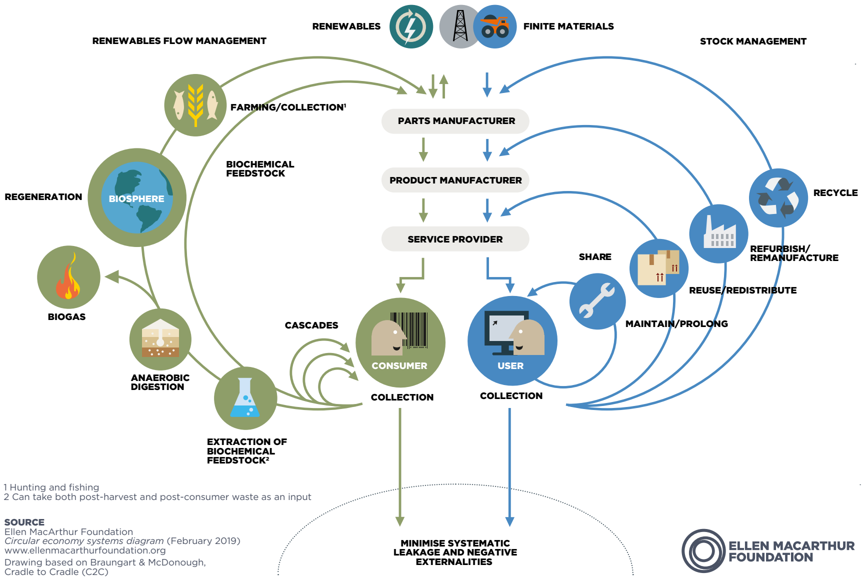


Figure 2.2: Butterfly Diagram Source: Foundation (2019)

Implementing the circular economy has various obstacles. The first is the need to modify customer behaviour. To survive in a circular economy, consumers must be prepared to buy recycled goods and engage in behaviours such as repair and reuse. This behaviour necessitates raising awareness, offering incentives, and overcoming obstacles such as convenience and quality perceptions (Martin Geissdoerfer, 2017).

Another problem is the requirement to invest in new technologies and infrastructure. Transitioning to a circular economy involves innovation in material design, product life extension, and waste management systems. The change might be especially difficult for small and medium-sized businesses that require enough financial resources or technological competence (Martin Geissdoerfer, 2017).

Extensive work has been carried out at NOS to enable the implementation of a circular economy (CE) in its logistics chain. The logistics center has set up refurbishment and testing units to ensure the quality of reconditioned products before they are reintroduced into the market. Furthermore, the company has invested in environmentally friendly packaging for the products. The supply chain unit has set up teams to ensure the smooth flow of reverse logistics activities. However, the process has flaws, as customers find it challenging to return their equipment, often choosing not to do so. This leads to many pieces of equipment being reported as lost, which represents a loss of assets for the company since the equipment's whereabouts depend solely on the information updated in the ERP software and other IT platforms.

In conclusion, a circular economy is a concept that holds considerable promise for accomplishing both environmental and economic goals. It confronts substantial implementation hurdles, particularly in terms of changing consumer behaviour and investing in new technologies and infrastructure. Despite these challenges, the circular economy could be a key driver of long-term development and resource efficiency.

2.3 Business Process Management

The principal objective of this project is to optimise equipment regularisation processes by eliminating tasks and procedures that do not contribute to the overall value. Business Process Management (BPM) is a critical methodology that aids in comprehending the process and generating flowcharts using the Business Process Model and Notation (BPMN) to identify potential areas for improvement.

Business Process Management (BPM) refers to an organizational model that aims to streamline processes to achieve established goals efficiently. As one of the oldest holistic approaches in industrial engineering (Iovanella, 2024), BPM aims to eliminate unnecessary costs and tasks that do not add value while improving customer satisfaction. Various tools are employed in the BPM, including IT solutions, data analysis, and, most importantly, the development of business process models (Gažová et al., 2022).

The concept of Business process models entails the capacity to delineate how an enterprise produces and delivers value to its clientele. The process models reduce activities into processes, rendering them visualisable and comprehending the interactions and stages necessary to execute them, thereby synthesising relationships and networks, generating a comprehensive overview of the organisation (Gažová et al., 2022). The primary objective of this activity is to analyse the current ("as is") process and improve it in the future ("to be"). Business analysts and managers typically undertake Business Process Modeling to enhance process efficiency and quality (Muehlen, 2008).

Several process modelling languages can be employed, namely flowcharts, Unified Modelling Language (UML), Event-Driven Process Chains (EPCs), data-flow diagrams, and the most widely used of them all, Business Process Model and Notation (BPMN).

2.4 Business Process Model and Notation

Based on conventional flowcharting methods, the Business Process Model and Notation (BPMN) is a standard for business process modelling that offers graphical notation for describing business processes in a Business Process Diagram (BPD). BPMN's goal is to facilitate business process modelling for both technical and business users by offering business users-friendly syntax that can capture intricate process semantics (Skouradaki et al., 2015). The language used for BPMN modelling comprises an assortment of flow objects, connecting objects, swimlanes, and artefacts, which serve as tools for accurately describing the process at hand.

2.4.1 Flow objects

There are three types of flow objects and they are classified as events, activities, and gateways.

An event is an initiating factor that starts, modifies, or concludes a process. It has a circular shape and can have symbols inside to help distinguish between different causes or results. The

Start, Middle, and End events are the three distinct moments affecting the flow (Object Management Group, 2013). Figure 2.3 provides a few examples of the symbols used to represent events.

Figure 2.3: Types of events in the BPMN Source: BPMN.IO (2022)

A task is a set of actions performed by a system or person. It is represented by a rectangle with rounded corners and can include multiple instances, loops, compensations, and sub-processes (Object Management Group, 2013). Figure 2.4 illustrates some examples of tasks/action types.

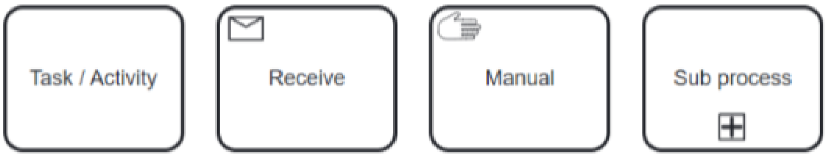


Figure 2.4: Types of actions in the BPMN Source: BPMN.IO (2022)

A gateway is a point selected to set conditions for the process's flow. It might be parallel, inclusive, exclusive, or based on information or events. A diamond symbolises it. Figure 2.5 illustrates a few examples of a gateway.

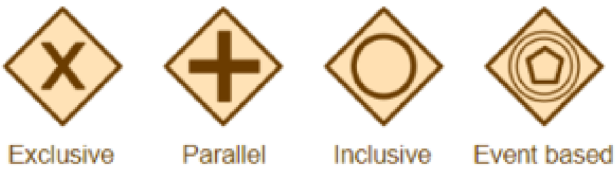


Figure 2.5: Types of gateway in the BPMN Source: BPMN.IO (2022)

2.4.2 Connecting Objects

In the context of flowcharts, various types of arrows are used to connect objects, including message flow, association, and sequence flow.

The sequence flow, in particular, plays a crucial role in determining the order in which tasks must be executed. Sequences can be either default or conditional, and they are depicted by a straight-line arrow. A default flow is indicated by a dash at the beginning of the arrow, whereas a diamond symbol represents a conditional flow. Figure 2.6 illustrates a sequence flow.

Figure 2.6: Sequence Flow BPMN.IO (2022)

A message flow illustrates how messages move between teams and departments within a company. It is shown in Figure 2.7 as an arrow with a starting circle and a dashed line.

Figure 2.7: Message Flow BPMN.IO (2022)

An association flow is a dotted line symbol used to link an artifact or text to an action, event, or gateway. Figure 2.8 illustrates an association flow.

Figure 2.8: Association Flow BPMN.IO (2022)

2.4.3 Swimlane

Swimlanes are sections of lanes and pools where the critical steps of the process are organised. Usually, each lane represents a department that is in charge of carrying out a specific process step. On the other hand, pools represent more expansive organisational units and offer a high-level perspective of the interactions among several stakeholders or company divisions. Within an organisation, lanes exist within pools. Figure 2.9 illustrates an example of a swimlane.

Figure 2.9: Swimlane Source: BPMN.IO (2022)

2.4.3.1 Artifact

Artifacts provide more data about the process, making it easier to understand and analyse. Some examples of artifacts are Groups and text annotations. Groups allow activities to be grouped throughout the workflow diagram, and text annotations enable the addition of relevant information to understand the process. Figure 2.10 illustrates the existing types of arctifacts.

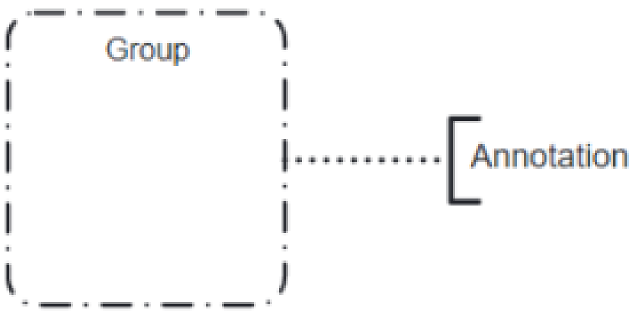


Figure 2.10: Types of Artifacts Source: BPMN.IO (2022)

2.5 Continuous Improvement

Continuous improvement is one of the main motivators for automating processes. The use of methodologies such as Gemba walks, Lean, Kaizen, and data analysis is crucial to ensuring the resolution of any shortcomings that arise during the project's implementation and success.

Continuous improvement has become a significant focus of discussion since the industrial world began to face stiff global competition (Harwinder Singh, 2015). It is a crucial aspect of the quality management process and involves measuring essential process indicators across all areas and taking action to enhance them (Berk and Berk, 2000).

CI is centered on identifying deficiencies and variability in administrative, manufacturing, and service processes that can detract from a quality result. It aims to change the process to eliminate unwanted outputs, explicitly focusing on processes. The overall objective is to continually improve the quality of the process (Berk and Berk, 2000).

Organisations use CI methodologies to achieve large-scale improvements. These methodologies aim to reduce waste, simplify production lines, and improve efficiency. Examples of CI methodologies include Lean Manufacturing, Six Sigma, and Kaizen (Amit Baghel, 2005).

2.5.1 Lean

Lean is a philosophy based on the Total Quality model, the Toyota Production System. It was developed at Toyota by Taichii Ohno and focused on eliminating all types of waste associated with a production process (Harwinder Singh, 2015). This makes it possible to establish processes that use minimal resources for maximum output while guaranteeing maximum product quality (Amit Baghel, 2005).

The Lean methodology is marked by its emphasis on minimal inventories, reduced waiting times, and a production pace based on a pull system. This means that the customer decides the amounts to be produced, which helps avoid the accumulation of large stocks. Additionally, lean production systems use just-in-time supplier delivery and systematic techniques to minimise scrap and inventory. Doing so minimises all forms of waste while quality and productivity are maximised, ultimately decreasing costs (Putnik and Avila, 2015),(Sunder M and Prashar, 2024).

The Lean philosophy is not limited to production processes but can also be applied in various other areas, like management. This gives rise to Lean Management, where managerial practices are centered on systems thinking and aimed at the user. The approach emphasises collaboration and empowerment of employees, as well as improving processes to reduce bureaucracy and hierarchy (Oliveira-Dias et al., 2021). The application of Lean Management tools is not restricted to any particular sector and is transversal to different sectors of the economy.

2.5.2 Six Sigma

Six Sigma is a quality management methodology developed by Motorola Inc. in the US in 1986 (Linderman et al., 2003). Its main objective is to measure the quality of a process using statistical process control to reduce defect rates by minimising nonconformance to near zero while also reducing process variation Amit Baghel (2005).

Six Sigma uses the DMAIC model, which stands for Define, Measure, Analyze, Improve, and Control (Sundram et al., 2023).

This approach in real life corresponds to:

- Defining the problem and the main goal of the project;
- Measuring the process and identifying the problems related to each stage of the manufacturing process;

- Analyzing the collected data to define the root cause;
- Improving the process by redesigning or modifying the existing process;
- Controlling the improved process by following a continuous improvement mindset;

Six Sigma offers quality measures that can be implemented across the organisation in manufacturing, design, administration, and service areas.

2.5.3 Kaizen

Kaizen is a Japanese philosophy that emphasises the continuous improvement of processes across various sectors of economic activity. The word translates to "change for the better," highlighting the importance of constant change to achieve maximum resource efficiency (kir, 2022), (Kiran, 2020). This philosophy is famously associated with the production model developed by Toyota, which utilised it as one of the core tools responsible for its success (Harwinder Singh, 2015).

Kaizen, whose motto is "Doing 100 things 1% better than doing one thing 100% better", does not involve substantial investment to promote increased efficiency on the shop floor, as it focuses on maximising human power and making full use of its potential, facilitating the creation of a more dedicated and independent workforce (Kiran, 2020).

2.5.3.1 Gemba

In Japanese, Gemba means "real place" and is often referred to as the place where value-added activities occur in companies (Imai, 2012). Based on the concept of "Go and see", the aim of a Gemba walk is to give leaders and managers direct contact with processes, enabling them to obtain information by interacting with workers (Jansson, 2024).

The Gemba is the source of all information and the key to all problems. Therefore, understanding the information obtained from the Gemba walks is the first step towards understanding the impact of the decisions made on the business unit (Imai, 2012).

To achieve the objectives set out in a Gemba walk and make it possible to implement continuous improvement measures with Kaizen, certain principles must be strictly adhered to (Imai, 2012). These principles include the following: Drawing up a prior plan, clarifying the purpose of the walk, reinforcing with KPI-related concerns; Always following the Value Stream mapping of the process; Focus on the process and not on the people. This is not the time to blame anyone; Document observations; Go in with an open mind; Ask questions about the process and the team's perception of it (de Sousa Barros Basto, 2021), (Jansson, 2024).

The most widely used tool for finding root causes in Gemba is the "5 Whys" principle. As the name suggests, the principle consists of repeatedly asking why until the root cause of the problem being analysed is discovered, enabling a decision to contain it (Imai, 2012). The "5 whys" include the following questions: **Who** – "Who are the people involved in the processes that you observe?" **What** – "What are the inputs and outputs of the process?" **Where** – "Does the space where the work is performed conform to 5S?" **When** – "Are process inputs available when needed?" **Why**

- "Why this work? What value does this work add for the customer?" (de Sousa Barros Basto, 2021).

2.5.3.2 Daily Kaizen

Daily Kaizen is a practice that aims to improve the workforce's culture and behaviour by promoting personal development, critical thinking, and motivation.

The implementation of Daily Kaizen is mapped out in levels. **Level 1-Planning**: consists of analysing the composition of the organisation and teams, checking whether it is divided into natural teams organised by value streams, what the meeting cascades are and analysing the level of team control; **Level 2-Daily Management**: Team leaders must apply Kaizen Leadership concepts and team management skills to involve all team members in continuous improvement efforts. Leaders should focus on recognising problems and setting goals. The implementation of models such as dynamic PDCA (Plan, Do, Check, Act) and the visualisation of key performance indicators (KPIs) contribute to the development of specific countermeasures. **Level 3- Standardisation**: The implementation of methodologies such as 5S, Standard Work and Gemba Walks to resolve previously identified problems; **Level 4- Training and Coaching**: Consists of helping the teams and the leaders develop new improvement habits and skills; **Level 5-Advanced Problem Solving**: Using specific tools such as Auto Quality Matrix and Means, A3 Problem Solving, and sophisticated digital platforms to manage KPIs, the problems are resolved (Institute, 2024).

2.5.3.3 Data Analysis

To properly understand and address a problem, it must first be identified, and then relevant data must be obtained and analysed. Collecting data on current status allows for understanding which areas are more critical, providing a starting point for progress (Imai, 2012).

There are two types of data: Quantitative and Qualitative. Quantitative data refers to any data that can be counted or measured with a numerical value. To analyse quantitative data, statistical methods must be used. On the other hand, Qualitative data refers to all types of data that cannot be counted and is usually expressed using written language. Qualitative data is obtained through observation and interviews and is usually analysed by grouping information into categories and themes (Stevens, 2023).

Data analysis is a key component in resolving existing problems and implementing continuous improvement measures, making it an essential tool for Kaizen.

2.6 Visual Basic for Applications

Visual Basic for Applications (VBA) is a programming language specifically developed for Microsoft Office, particularly Excel. VBA has various features that enable users to create scripts and routines, record macros, and program pop-up warning messages. These features make VBA a powerful and versatile tool that can be used for various purposes (Alex Jerabek, 2023).

One significant advantage of VBA programming is the ability to automate repetitive tasks and centralise information from various sources. These functionalities enable the optimisation of processes considered time-consuming or carried out manually, improving performance indicators (KPIs) and team efficiency.

The VBA language has a wide range of usability and can be implemented in any area or project that requires its functionalities. Some of the possible applications are:

- Inputting algorithms to predict the values of parameters and initial variables (Takayanagi, 2023);
- Utilizing VBA programming as a decision support tool Ramezanianpour et al. (2023);
- Automating the calculating of a Local Singularity Analysis (LSA) (Zhang et al., 2016) ;
- Creation of a cost-effectiveness frontier (CE) and for Probabilistic Sensitivity Analysis (PSA) (Poirrier and Bergemann, 2023) ;
- Various calculations using macro (Li et al., 2020);

VBA's relevance to this project is essentially based on the development of the decision support platform using this programming language.

Chapter 3

Current Situation

This chapter provides an overview of NOS's equipment control and regularisation processes' current performance indices and a detailed description of the processes from an "as is" perspective. It also addresses the challenges encountered during the development of the dissertation project.

Each regularisation process has a dedicated section that explains it in detail. In the case of Tickets, different types of Tickets, their reasons for opening, and their objectives are highlighted. A section has also been created to emphasise the IT platforms used to consult/extract information, in order to enlighten the reader about their functionalities and relevance.

Additionally, the process mapping of both processes, Tickets and SAP inconsistencies, is presented using the Business Process Model and Notation (BPMN), highlighting the unique characteristics of each procedure. Finally, the chapter identifies potential opportunities for improvement and their possible impact on the respective processes, which will be explored in depth in Chapter 4.

All the information presented in this chapter was collected using Gemba and Shadowing methodologies.

3.1 IT Plataforms

As a company whose mainstay is technology, NOS develops and uses many IT platforms to facilitate access and manipulation of the large volumes of information associated with each of the services provided and equipment.

This section will present in detail the platforms used in the equipment control and regularisation process and their functionalities. The IT platforms in question are SAP ERP, Portal de Reporting, Siebel, ITSM, Procura de Equipamentos, and Click.

3.1.1 SAP ERP

An enterprise resource planning (ERP) system is an IT tool used in the business context that facilitates information sharing. It can integrate the flow of materials, stock, and financial reports, allowing different business applications to share the same database. The best-known ERP systems are SAP ERP, Oracle, and PeopleSoft Shen et al. (2016).

NOS uses SAP ERP, which allows visibility into the location and financial status of equipment distributed among the partners' warehouses. It's important to note that the SAP interface available to SPs is called Portal 360. In the context of the stock control and regularisation process, the most noteworthy transactions are:

- **IQ09**: Allows consultation of the equipment status in the system, i.e. whether it is in transit, in a dismantled state, installed or in stock. It is a query carried out in any equipment regularisation process and can be made individually for each piece of equipment or in bulk.

- **Financial Reports**: Enables consultation regarding whether a debit or credit note has already been issued for a particular piece of equipment, depending on the case in question. This query can be run individually for each piece of equipment or in bulk and is only carried out for certain types of tickets, particularly for Deadline Control- inverse and Dispute inventories, which will be explored in detail later in this document.

3.1.2 Portal de Reporting

The Portal de Reporting platform is an IT tool created by NOS itself to enable the extraction of reports in Excel file format. The reports typically include important information about the actions taken on work orders, comments written by the technician, and activation messages for each device. Examples of such reports are "Quadro de recolhas Click", "Comentário de todas as Ots" and "Incoerência Serial vs Items."

The "RPA Regularização de Equipamento" report is in a different report category. It provides information about the regularisation process conducted by the Robot Process Automation (RPA) mechanism. The report includes messages obtained from the process, which allows to determine if any errors have occurred.

The reports mentioned above are used in the regularisation and equipment control processes. However, they are limited in allowing information to be extracted individually for each SN and work order number, making the process very time-consuming.

3.1.3 Siebel

Siebel Software is a reference in customer relationship management (CRM) software owned by Oracle. NOS uses Siebel software to store all the information associated with a given service account number.

Each NOS customer has a service account number associated with them, which is linked to all the services they have subscribed to and the active equipment they have in their portfolio. Siebel also records all the work orders carried out and is a complementary tool for consulting information. However, it only allows the user to consult the information contained in a single service account.

3.1.4 ITSM

The IBM ITSM platform manages the reception and processing of tickets opened by partners.

The platform enables communication between NOS and partners, as well as changes to ticket status and requests for information. When a ticket is assigned to a particular staff member, they receive a notification, and the ticket is given the status 'Assigned'. As soon as the ticket begins to be processed, its status is changed to 'In progress'. If further clarification is required from the SP, or if the information submitted is incomplete, the ticket's status is changed to 'Pending' until it has been processed. Once the elements present in the ticket have been processed, they are given the status 'Resolved'.

3.1.5 Procura de Equipamentos

The Procura de Equipamentos is a platform developed by NOS that allows users to check whether a piece of equipment is active or not. This enquiry is made in bulk and is only used in cases where the consultation of the equipment's activation status is relevant. It is used both to resolve tickets and SAP inconsistencies.

3.1.6 Click

The Click portal is an IT platform where equipment activation is carried out.

For a device to become active for a customer, it has to be registered and activated in Click, which documents the activated devices and their respective work orders. The platform is used to verify what has been activated and to confirm work completed on a specific piece of equipment if it is involved in any equipment regularisation and control processes.

3.2 Tickets

3.2.1 Ticket's Typifications

Realising the situations in which each type of ticket is used is an extremely important step in understanding the resolution process of each ticket category. The reason for opening each ticket varies according to its category and can also be influenced by external factors such as technical unavailability or supply problems.

Each ticket category will be presented below, along with their importance and purpose in the equipment control process.

- **Dispute Inventories:** As the name suggests, this ticket is used to contest inventory actions. The SP can only open this type of ticket six months after the inventory is created, i.e. when a cycle is closed. This ticket aims to enable debits arising from inventory breaks to be contested. Some caution is required when opening this type of ticket to avoid disputing equipment that has already been treated in previous tickets;

- **Deadline Control - Inverse:** Tickets for inverse deadline control are used to dispute the improper entry or debit of equipment into the reverse cycle of the service provider in question. The debit occurs when the equipment remains in the SP's warehouse for more than 45 days without being returned to NOS. Dispute tickets can lead to the equipment being removed from the inverse cycle, the charge being maintained, or credit notes being issued if the SP's argument is justified. These tickets have the most extended resolution lead times and require a more extensive analysis;

- **Stock Dispute:** Stock dispute tickets are used in cases where equipment is still listed in the SP's stock on the SAP platform but is no longer physically in stock. Thus, by opening the ticket, the equipment can be regularised to its correct state based on information from work orders held on the Portal de Reporting platform. It is important to note that this type of ticket can only be opened 15 days after the work order in question has been carried out;

- **Portal Support:** Portal support tickets are used to report errors in accessing the 360 portal. The 360 portal is the SAP ERP interface that partners can access to carry out equipment entry and exit operations. Therefore, whenever a ticket of this type arises, it is given top priority for resolution since an error in the 360 portal significantly impacts the SP's transactions.

3.2.2 Current Performance of Ticket Resolution

The ticket resolution process lacked a visualisation tool for a long time, hindering improvements and making it difficult for managers and team members to understand the process.

A dashboard was created on the Power BI platform in 2023 to ensure transparency throughout the process. This dashboard is accessible to all team members and keeps track of all activities via the ITSM platform. A wide range of metrics can be visualised, including Key Performance Indicators (KPIs) to track each team member's performance in meeting Service Level Agreements (SLAs). This involves the number of tickets with the status "Pending" and "Resolved", as well as the average response time for each team member in the current and previous week, along with their progress over the last ten weeks.

Table 3.1 displays the number of equipment control tickets closed between September 2023 and March 2024, the average lead time of each classification, the percentage of tickets resolved within and outside of the Service Level Agreement, and the number of days established for SLA for each category.

Table 3.1: Ticket Metrics Comparison

Ticket Typification	Average Lead Time [Days]	Quantity	Out of SLA [%]	Within SLA [%]	SLA [Days]
Dispute inventories	90,84	1	100%	0%	7
Deadline Control-Inverse	25,57	3	100%	0%	3
Stock Dispute	15,68	27	63%	37%	3
Portal Support	0,05	26	0%	100%	1

After analysing the presented data, the tickets that stand out the most in terms of the proportion of open tickets versus average lead time are stock dispute and portal support. These ticket types have had more than 20 open tickets during the period under analysis, with an average resolution time varying between 16 and 0.05 days, respectively.

The tickets considered most critical regarding average lead times are the inventory dispute ticket and the inverse deadline control ticket. The large number of devices associated with the same ticket, which requires more time in the analysis phase, is a factor responsible for the high processing time.

On the other hand, portal support tickets, as already mentioned, have the shortest resolution times despite being the second most opened ticket type in ITSM. This can be explained by the speed with which they are resolved/forwarded to other teams.

Another important metric for ticket resolution performance is the average resolution time per piece of contested equipment. Over the course of a month, all the tickets resolved were timed, particularly the information gathering and analysis phases, considered critical to operational performance. Figure 3.1 illustrates the average resolution time per device calculated for the tickets timed over a month between March and April of 2024.

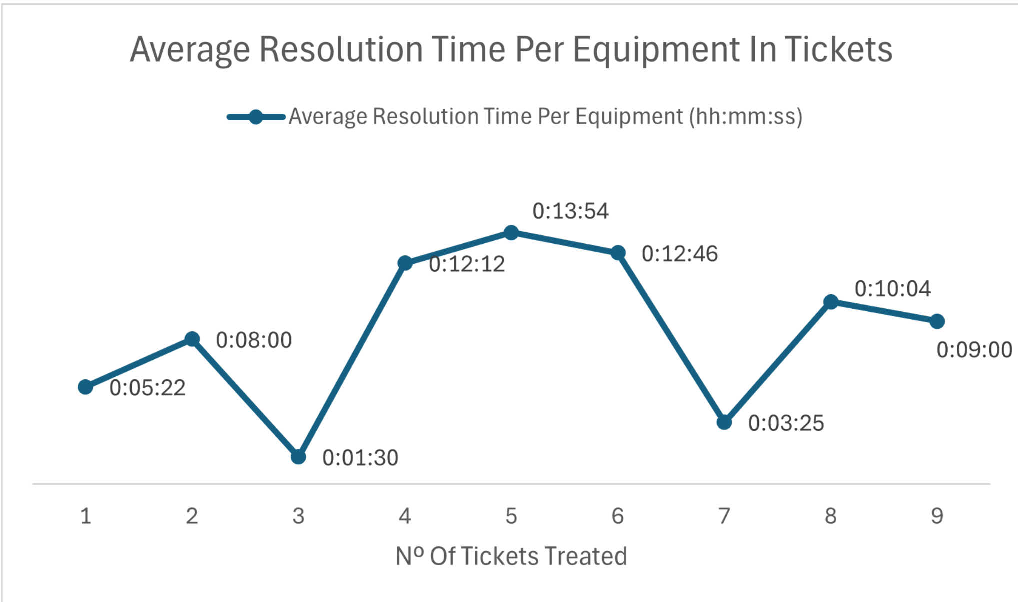


Figure 3.1: Average resolution time per device calculated for the tickets treated over a month, between March and April of 2024

The average resolution time per piece of equipment was 9 minutes, which is considered relatively high. This could potentially lead to prolonged lead times, especially in cases involving multiple pieces of equipment. Therefore, it was crucial to prioritise reducing the average resolution time per piece of equipment throughout the execution of this project.

A KPI accounts for the capacity to respond to tickets within the specified SLA, which is presented in the "Within SLA" column of Table 3.1. At the end of March 2024, the KPI stood at 73%, although the target set by management is 95%. This implies that the current performance of the ticketing solution does not fulfil the expected parameters. Improvements and procedural changes must be implemented to better utilise human resources and reduce delivery times.

3.2.3 Tickets Resolution Process Mapping

To document and better understand the processes, each of the previously mentioned ticket typifications was mapped using the BPMN methodology.

The data needed for this mapping was collected through the shadowing approach during the first month of the internship, in which a member of the fixed planning team was closely followed.

As mentioned previously, ticket resolution is handled by a single member of the Fixed Planning team, with most of the tasks carried out manually. To emphasise the percentage of automated and non-automated tasks throughout the process, the following symbology, illustrated in Figure 3.2, was used:

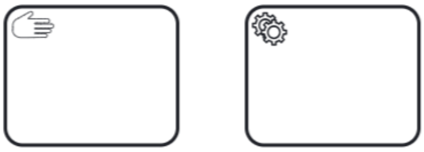


Figure 3.2: Symbology used to discriminate between manual (left) and automated (right) tasks in the BPMN diagram

The ticket resolution process is not straightforward for all types of tickets and varies depending on the classification of the incident.

The opening of the Ticket is the only stage of the process considered to be transversal to all the typifications mentioned.

The SP must open the Ticket on the ITSM platform. To ensure that the Ticket is treated, the information must be sent using the template available on ITSM. The template is intended to make it easier to import and analyse the information. If it is found that the information attached to a ticket does not use the template, a request is made via ITSM for the SP to re-send the information under the established standards. The ticket will remain unresolved until the SP re-sends the information in the correct format. Once the information is in the correct format, the ticket can begin to be processed.

This section will detail the processes for each ticket category, accompanied by the corresponding BPMN diagram.

3.2.4 Dispute Inventories Tickets

The dispute inventory ticket is essential to ensure the regularisation of SP's Stocks. Figure 3.3 illustrates the BPMN of the Dispute Inventories ticket resolution process.

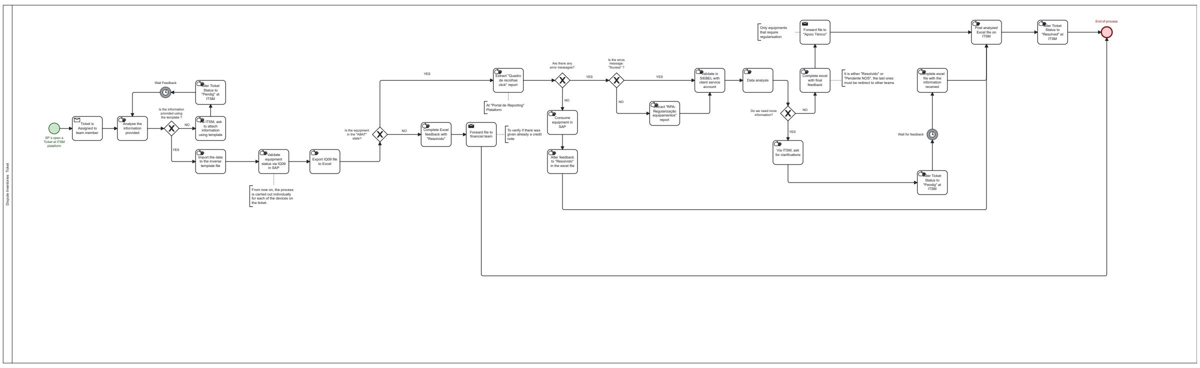


Figure 3.3: Process Modelling of Dispute Inventories Ticket

In an inventory dispute ticket, the first step is to import the information submitted via ITSM into an Excel file. Next, the status of the equipment in the ticket must be checked using the IQ09 transaction in SAP. This transaction will provide the current status of the equipment, i.e., whether it is installed or collected, for example. The information from IQ09 will then be imported into the Excel file.

Please ensure that any equipment not in the "ABAT" status, i.e. in the abated state, is labelled as "Resolvido." Additionally, the corresponding serial number should be forwarded to the finance department to verify whether the partner has received credit for the equipment. The analysis for this equipment is now complete.

When the equipment is in "ABAT" status, the "Quadro de Recolhas Click" report should be extracted from the Portal de Reporting platform for each serial number separately for the purpose of collecting information submitted when the work order was placed. Next, the analysis should determine if any error messages were reported at the time of activation. If no error messages were reported, the equipment must have its status corrected in SAP, and the final feedback in the Excel file should be changed to "Resolvido," concluding the analysis for this equipment.

In cases where error messages are verified, a distinction must be made between two cases.

If the message reported is "Success," the customer's service account must be used to validate the status of the equipment on the Siebel platform. Regarding other error messages, the "RPA-Regularização de equipamento" report should be extracted from the Portal de Reporting and the

SN validated via Siebel. Once the information has been collected, a member of the Fixed Planning Team must analyse the data.

If further information is required, the SP's are asked for clarification via ITSM and the ticket status is changed to "Pending". If no further clarification is deemed necessary, the next stage is to complete the Excel file with the final feedback. The final feedback options available are "Resolvido" or "Pendente NOS". For the latter, the equipment must be sent to the technical support teams for regularisation.

The analysed file should then be published in ITSM for the partners, and the Ticket Status should be changed to "Resolved", thus ending the inventory dispute ticket process.

3.2.5 Deadline Control-Inverse Ticket

The Deadline Control-Inverse Ticket allows the debiting of inverse logistics equipment to be contested. Figure 3.4 illustrates the BPMN of the Deadline Control-Inverse Ticket resolution process.

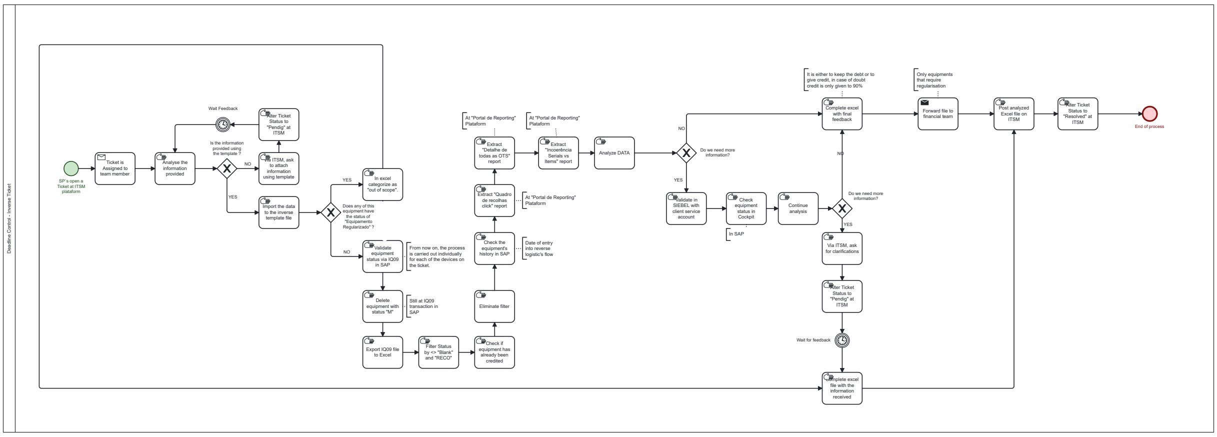


Figure 3.4: Process Modelling of Deadline Control - Inverse Ticket

The serial numbers contained in the tickets should be filtered in the Excel file. Equipment with the status "Equipamento Regularizado" in the "Observações" field must have its feedback filled in with "Fora de âmbito", and its analysis is given as completed.

The remaining equipment must have its status validated through transaction IQ09 in SAP. The result obtained in IQ09 must be filtered before being exported to Excel, and the "M" typification equipment must be eliminated from the list once mobile equipment is not dealt with in this Ticket. The IQ09 information must then be imported into the Excel file.

In the Excel file, the equipment with an IQ09 status other than 'RECO', i.e., collected equipment, and 'Blanks', with no status assigned in SAP, must then be filtered out and checked in SAP to verify whether the corresponding credit notes have already been issued. The Excel file should then be updated accordingly. The next step is to remove the filters and collect the information needed to analyse serial numbers with a blank and "RECO" status.

In the case of a Deadline Control-Inverse Ticket, the collection of information is made up of the following steps: first, the date on which the equipment entered the inverse flow must be checked using the "Equipment History" tab in SAP. Then the following reports, "Quadro de Recolhas Click", "Detalhe de todas as OTs", and "Incoerência Serial Vs Itens" must be extracted from the Reporting Portal. Once the information has been collected, the data analysis must be carried out by a member of the Fixer Planning Team.

If more information is needed, the Siebel platform and the equipment status field in 'Cockpit' in SAP should be consulted. If more information is still needed, the SPs are invited to provide clarification via ITSM, and the ticket's status is changed to 'Pending'.

The Excel file must then be completed with the final feedback: 'Resolvido' with regularisation actions of 'Manter débito' or 'Dar Crédito'. The next step is to send the finalised file to the finance team to issue the credit and debit notes. The analysed file should then be published in ITSM for the partners, and the Ticket Status should be changed to "Resolvido", thus ending the Deadline Control-Inverse Ticket process.

3.2.6 Stock Dispute Ticket

The purpose of stock dispute tickets is to regularise equipment that has not been consumed in SAP. Figure 3.5 illustrates the BPMN of the stock dispute ticket.

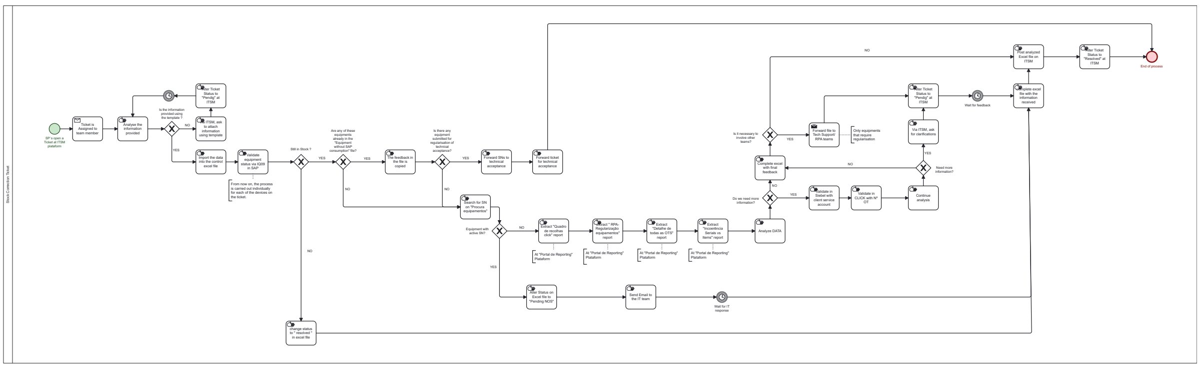


Figure 3.5: Process Modelling of Stock Dispute Ticket

After importing the information in the template submitted via ITSM into the Excel file, the first step will be to collect the updated statuses of the contested equipment via IQ09 transaction in SAP and then import the information into the Excel file.

The next step will be to filter the equipment in stock and check whether its serial number has already been dealt with in the SAP inconsistency process. To do this, a search is performed on the last SAP inconsistency file processed. If the equipment is in the 'Equipment without SAP consumption' file, the already assigned feedback is copied and checked whether the equipment has been forwarded to the technical acceptance team. If so, the ticket should be forwarded to Technical Acceptance for processing. Otherwise, it must follow the recommended procedure for equipment that is no longer in stock, i.e. check the serial number status in the Portal Procura de Equipamentos.

The search result in the Procura de Equipamentos portal can be "Active" or "Inactive/Not Found".

Suppose the serial number is classified as "Active." In that case, the feedback should be changed in the Excel file to "Pendente NOS". The SN should be forwarded to the respective team responsible for correcting the status of the equipment in the system and await a response. In these cases, the ticket's status is changed to "pending" until the feedback is received.

If the serial number is classified as "inactive/not found" at Procura de Equipamentos, the extraction of the reports "Quadro de Recolhas Click", "Detalhe de todas as OTs", and "Incoerência Serial Vs Items" and "RPA—Regularização de equipamentos", should be carried and the information obtained analysed by a member of the Fixed Planning Team.

If additional information is required, validation should be carried out in Siebel with the customer's service account and then in CLICK with the work order number to obtain more information. In the event that further clarification is needed, a request for details should be made to the SP via ITSM, and the ticket's status is changed to "pending" until there is a response.

For the remaining cases in which the information collected in the Portal de Reporting is sufficient, the Excel should be filled in with the final feedback and then forwarded to the technical support teams and RPAs, if applicable. In the event that the involvement of other teams is necessary, the ticket's status should be changed to "pending" while awaiting feedback.

After receiving the feedback, the file must be finalised and made public in ITSM for the partner. The ticket status should be changed to "Resolved" and the process is complete.

3.2.7 Portal Support Ticket

The portal's support tickets are the simplest, compared to the tickets seen so far. Figure 3.6 illustrates the BPMN of the Portal Support ticket resolution process.

The first thing to check is whether the information submitted via ITSM is sufficient to start the analysis. If not, the missing information must be requested to the SP via ITSM.

The next step involves analysing the reported error and checking whether it can be resolved or if it needs to be forwarded to another team.

If the member of the Fixed Planning Team cannot resolve it, a ticket will have to be opened on the Ineed support platform, specifically under the heading "Suporte SAP". While waiting for the feedback from Ineed, it is necessary to change the ticket's status to "Pending". The moment it has been resolved, the ticket is given the status "Resolved" thus concluding the process of the portal support tickets.

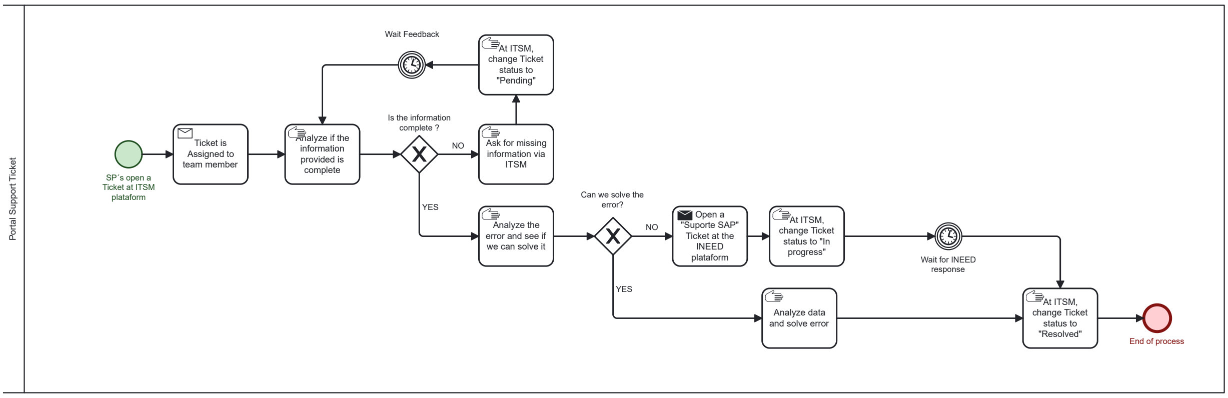


Figure 3.6: Process Modelling of Portal Support Ticket

3.3 SAP Inconsistencies

In addition to resolving tickets, SAP inconsistencies is another process that constitutes the regularisation and control of equipment at NOS.

As already mentioned in Chapter 1, the BI team provides a weekly report containing a list of SNs that have not progressed in the SAP system, i.e. equipment that has been subject to stock removal actions but remains in stock in the system. There are approximately 800 pieces of equipment on this list each week.

This report is compiled by verifying whether the specified equipment has been officially removed from stock and by seeking further clarification from relevant teams to enable the completion of regular procedures.

Once the report has been treated, it is forwarded to the BI team for updating, ensuring that the processed SNs do not reappear in the following week's report.

One of the process's biggest limitations is the lack of transparency with the SPs about the SNs dealt within SAP Inconsistencies. Since it is an internal process carried out in conjunction with the BI and fixed planning teams, many of the SNs dealt with in the SAP inconsistency process are subsequently reported by the SP via a Stock Dispute Ticket, forcing a repeated analysis of equipment that has already been treated, as there is no automatic verification mechanism.

3.3.1 SAP Inconsistencies Resolution Process Mapping

SAP inconsistencies are a fairly simple regularisation process compared to tickets since this process doesn't require as many individual analyses as tickets do and is mainly focused on dealing with the information in the report. Figure 3.7 illustrates the BPMN for the SAP inconsistency resolution process.

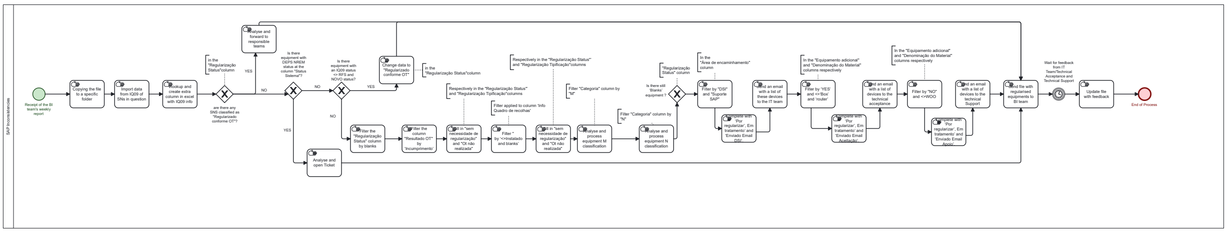


Figure 3.7: Process Modelling of SAP Inconsistencies

After saving a copy of the report file sent by the BI team in the correct directory, the file processing begins. The first step is to import the equipment statuses via the IQ09 operation in SAP. This information is imported in Excel file format and then inserted into the processing file via a manual lookup action, resulting in the creation of a column with the respective information.

The first action is to filter the 'Regularização status' column by 'Regularizado conforme OT' values. If any equipment has this status, it is important to flag it and forward the list of the respective serial numbers to the teams in charge. The status 'Regularizado conforme OT' must not exist in this file before processing.

Next, the 'Status Sistema' column must be filtered by DEPS NREM, a status associated with equipment in transit. If equipment falls under this classification, the 'Regularização status' column is updated to 'Por regularizar' and a ticket will be raised to report its presence.

The next step in processing the file will be to check whether any equipment has a status other than 'RFS' and 'NOVO', statuses which indicate that the equipment is still in stock. This selection will include all equipment that is already out of stock and will be classified as 'Regularizado conforme OT' in the 'Regularização status' column.

For the remaining equipment with 'NOVO' and 'RFS' statuses and blank entries in the 'Regularização status' columns, the 'Resultado OT' column must be filtered by 'Incumprimento'. After applying the filter, the entries in the 'Regularização status' columns should be updated to 'Sem necessidade de regularização' and the entries in the 'Regularização Tipificação' column to 'OT não realizada'.

Next, all the applied filters are removed except for the one that equals blanks in the 'Regularização Status' column. The next step involves categorizing the equipment. First, the mobile equipment, categorized as 'M', is treated, and then the fixed equipment, categorized as 'N'. Each analysis consists of a series of checks on the equipment types and their activation status.

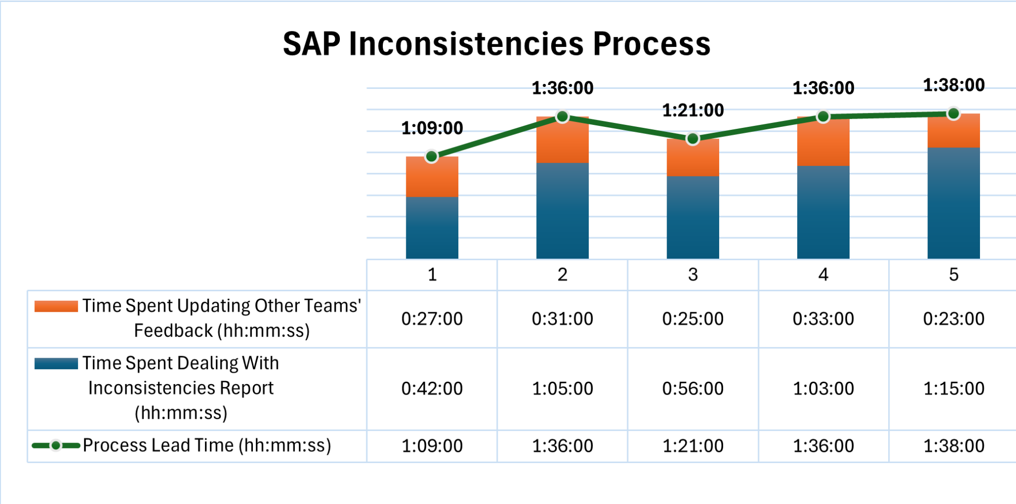
If the "Regularização Status" column for equipment in the 'N' category is blank, the equipment will be forwarded to the IT or technical acceptance or technical support teams, depending on its description, whether it's an additional item, and whether it has a typified routing area.

The list of treated equipment is then forwarded to the BI teams, and the process is finalised.

3.3.2 Process Performance

In order to quantify the time spent resolving SAP inconsistencies, the process was timed over five weeks.

Figure 3.8 illustrates the processing time for the inconsistency file, the duration for updating the feedback received from other teams, and the total lead time for the process, encompassing the combined duration of the two aforementioned steps.



	1	2	3	4	5
Time Spent Updating Other Teams' Feedback (hh:mm:ss)	0:27:00	0:31:00	0:25:00	0:33:00	0:23:00
Time Spent Dealing With Inconsistencies Report (hh:mm:ss)	0:42:00	1:05:00	0:56:00	1:03:00	1:15:00
Process Lead Time (hh:mm:ss)	1:09:00	1:36:00	1:21:00	1:36:00	1:38:00

Figure 3.8: Time Dedicated To The Resolution of SAP Inconsistencies

The average lead time to resolve SAP inconsistencies was determined to be 1 hour and 30 minutes. According to the process's BPMN, handling the file involves applying and removing filters, which has significant potential for automation. Implementing this automation would greatly impact the lead time of the equipment control and regularisation process.

3.4 Improvement opportunities

In addition to the previously mentioned need for improvement in ticket resolution KPIs, some weaknesses in the BPMNs for the equipment control and regularisation processes can be noticed. The process mapping diagram shows that all tasks are carried out manually, without exception, which has a direct impact on the long average times.

3.4.1 Automation of the Information Collection Process

Collecting information is a step of the process with great automation potential. Providing a platform that makes it possible to import and collect the data needed to analyse the equipment is a start towards improving the process lead time. Some examples of the information that can be collected automatically include IQ09 via SAP and the reports extracted via the Portal de Reporting. This information is relevant to all equipment control and regularisation processes.

The individual and time-consuming analysis of each Serial Number contained in the Ticket can also be optimised by resorting to mass searches for information on platforms such as SAP and the Portal de Reporting. This would enable all the necessary information to be centralised in a single file for subsequent analysis.

3.4.2 Centralisation of the Information Needed for Analysis

Facilitating access to information is also an aspect that could be improved. The reports extracted via Portal de Reporting are a clear example of this shortcoming, illustrated in Figure 3.9, since to access all the information, it is necessary to resort to three or more reports.

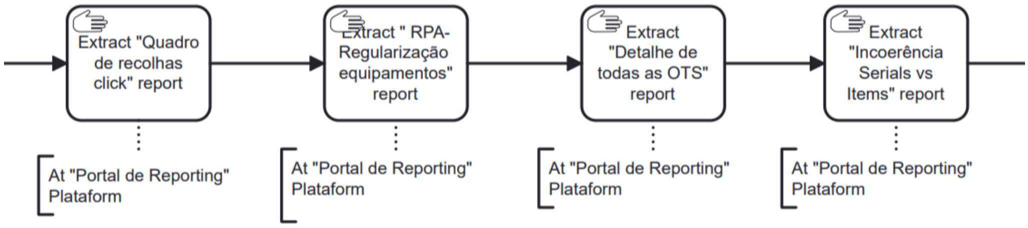


Figure 3.9: Reports used to resolve a Stock Correction Ticket

To simplify the information-collection process, it is important to create a single report that contains all relevant information from each of the different reports. This will reduce the number of steps required and make the process simpler and more efficient.

3.4.3 Interlinking Data Bases

Another step that can be automated is checking if the serial numbers in question have already been treated. This is currently done using Excel's Vlookup function individually for each SN. The creation of an interconnected data base is a very plausible possibility for counteracting this trend, making it possible to search and identify at the same time as the treatment process occurs.

3.4.4 Visibility of Processed Equipment for SPs

In order to prevent SPs from opening tickets with equipment that has already been dealt with in the SAP inconsistency process, visibility is a key issue.

To this end, sending emails that include a list of the equipment that is being treated can be a very feasible strategy, eliminating the unnecessary opening of tickets.

Chapter 4

Methodology

This chapter will present the methodology applied to counteract the problems and implement the proposed improvements identified in the previous chapter.

A PDCA cycle was drawn up specifically to act as a guide for outlining the methodology in question. Figure 4.1 illustrates the PDCA cycle.

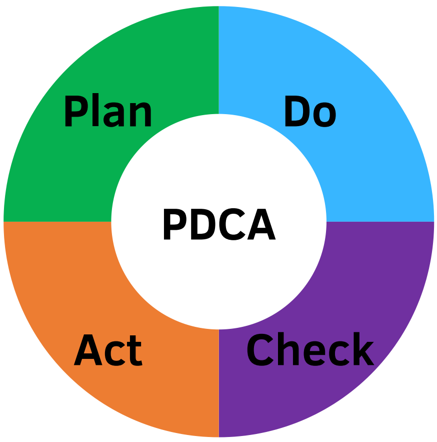


Figure 4.1: PDCA Cycle

A PDCA cycle (Plan, Do, Check, Act) is an iterative management tool used to control and continuously improve processes. In this methodology, each letter of the acronym summarises the following topics:

- **Plan**: The planning stage brings together all the approaches used to understand the process of controlling and regularising equipment and identifying suitable solutions;
- **Do**: Do represents the development of the decision support platform and the prior actions taken to ensure the platform's full functionality;

- **Check**: The check summarises the testing phase and collection of user feedback;

- **Act**: Act consists of implementing the improvements identified in the previous phase;

4.1 Study of potential solutions-Plan

After identifying the shortcomings in the equipment regularisation and control processes presented in Chapter 3, the next step was to study possible solutions capable of resolving the problems highlighted, taking into account the needs and limitations of the team.

Some priorities were established at the start of the project, which served as a guide when choosing the approach to be used.

One of them was the interconnection and dependence of information between the Ticket process and SAP inconsistencies. The fundamental concept was to create a platform for handling both processes in a simple and automatic manner.

Another priority was massifying information processing, intending to eliminate individual treatment for each piece of equipment.

The team's need for autonomy was also considered, which ruled out hypotheses such as RPAs (Robotic Process Automation). Updates to the process, however minimal, would always involve other teams, making the process dependent and unreliable.

The team's proficiency with the Excel tool and VBA programming language was taken into account, as both equipment control and regularisation processes are carried out in Excel from an as-is perspective. Therefore, to create the least impact on operations and to reduce possible resistance to the new platform, it was decided to develop the decision support platform in Excel using VBA.

In order to ensure that the platform covers all requirements, a list of necessary functionalities was created. The features include the following:

- Centralisation of information and operations, reducing as far as possible consultation outside the interface when dealing with one of the processes. This ensures that all the necessary information from the SAP ERP and Portal de Reporting is requested and stored without having to leave the processing platform;

- Storing information by creating files and data bases duly identified for each case;

- Automation of the entire process, resorting to manual tasks only when extremely necessary;

- Ensure the automation of email generation when necessary, guaranteeing the formatting of the email body and file attachment when applicable;

- Update automation of information received as feedback from other teams;

4.2 Development of the decision support platform-Do

In this section, the following explanation will outline the steps taken in developing the decision support platform and building it within the framework of Excel.

4.2.1 SAP Inconsistencies

The first process to be converted to the processing platform was SAP inconsistencies, which is explained by the fact that it is simpler than those of Tickets, as it only consists of processing the file by applying and removing filters. Figure 4.2 illustrates the Excel interface of the decision support platform created for the SAP inconsistency process.

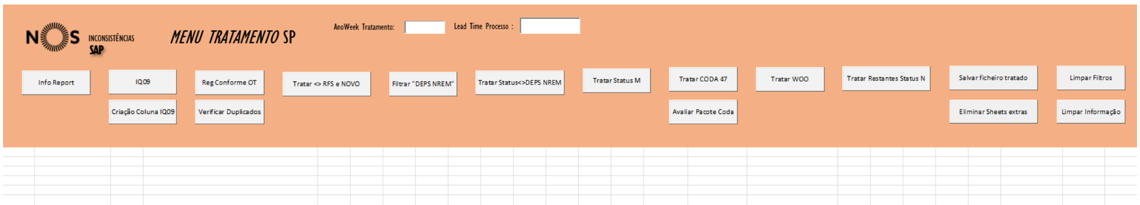


Figure 4.2: Excel interface dedicated to processing SAP inconsistencies

All the steps and checks involved in resolving SAP inconsistencies found in the process mapping on Figure 3.7 were transformed into VBA code, simplifying the process to just a button click.

The aim was to minimise the number of buttons on the user interface whenever possible. However, to enhance the visualisation of the respective button outputs, nearly one button per BPMN step was decided to be created.

In this way, the process of controlling and regulating the equipment in question has been simplified to just 17 buttons, 3 of which are dedicated to general sheet cleaning tasks. These buttons serve various functions, such as:

- Import the current week's report into the interface ;
- Automatically checking the status of the equipment in SAP ERP (via IQ09) without leaving the platform interface;
- Noting the SNs dealt with in the previous week and which reappeared for treatment in the current week's report, as well as importing their regularisation status;
- Application of filters necessary for the regularisation process;
- Automatic sending of emails to teams whose feedback is necessary for the regularisation process;

The equipment sent to other teams for regularisation is returned in the same format through email, specifically an Excel file with the updated status.

The process of updating feedback, from an as-is perspective, was carried out individually for each piece of equipment. This was a highly time-consuming task, particularly in cases where many pieces of equipment were involved.

A platform was developed within the SAP inconsistency process to streamline the process and reduce the time spent updating feedback. This platform facilitates updating feedback from other teams, such as the IT, Technical Support, and Technical Acceptance teams.

Figure 4.3 illustrates the Excel interface of the decision support platform dedicated to feedback updates.

Figure 4.3: Excel interface dedicated to Feedback Update

This interface comprises just three buttons with the following functions: selection of the feedback file, selection of the file to update, and a button for clearing the relevant sheet once the updating process is complete.

A master file has been created in the context of the SAP inconsistency process. This file includes all the equipment processed as part of the equipment regularisation process from 2024 onwards. It is updated at the same time as the treated file is created after the regularisation process is completed. This file was created to feed the Stock Dispute ticket data base. This allows for checking whether any equipment contested in a specific ticket has already been addressed in the SAP inconsistency process.

After the file processing and feedback update are completed, the treated file should be forwarded to the BI team. The current manual process for identifying the SNs to be forwarded involves filling in the respective SN's cell in yellow as each SN is processed in the file. This method allows for the convenient filtering of coloured cells at the conclusion of processing to forward the respective SNs to the BI team. Nevertheless, this manual process is labour-intensive and heightens the risk of human error and incomplete information.

To streamline the process, a dedicated interface was developed to facilitate cross-referencing of the processed information with the inconsistency report. The platform is designed to automatically identify the SNs processed and transmit them to the BI team via email. This is achieved through a lookup between the processed file and the weekly report containing the equipment to be processed. Subsequently, it verifies whether the information in both files matches the "Regularização Status" column for the same SN. If not, the SN is appended to the file for submission to the BI team. This automation enables the team to update its database, effectively preventing the recurrence of these specific SNs in the following week's reporting.

Figure 4.4 illustrates the Excel interface of the decision support platform dedicated to creating the file version for the BI team.

Figure 4.4: Excel interface dedicated to the creation of the file for the BI team

To ensure transparency and prevent service providers from opening tickets for equipment handled in the SAP inconsistency process, it has been decided to inform them about equipment with the following statuses: "Por Regularizar", "Sem Necessidade de Regularização" and "Não é Possível Regularizar". For this purpose, a platform has been created to email each service provider. This platform automatically filters equipment with the specified statuses for each service provider and generates an email accordingly.

Figure 4.5 illustrates the Excel interface of the decision support platform dedicated to sending emails to SPs.

Figure 4.5: Excel interface dedicated to sending emails to SPs

It's important to note that the decision not to link the email-sending processes to the Business Intelligence (BI) and Service Providers (SPs) interfaces was intentional. These processes should only occur after receiving updated feedback from other teams, so separate interfaces are required for these two processes.

Finally, to ensure maximum visibility of the process for the team leader of the fixed planning unit, a report was also created in email format. This report is created every time the SAP inconsistencies process is finalised, as it is associated with the button that creates the version of the treated file after the process is completed. This report includes the date the process was completed, a summary of the typifications, the number of devices each contains, and the number of devices forwarded to other teams.

4.2.2 Tickets

Prior to the platform's development, several initiatives were undertaken to establish crucial elements for automating the process. These initiatives involved centralising information, automating ticket analyses, and creating databases for referencing and flagging equipment that had already been addressed.

4.2.2.1 Information Centralisation

After conducting an analysis, an opportunity to centralise information was identified in the ticket resolution process.

As previously mentioned, analysing a piece of equipment requires extracting more than three different reports from the Portal de Reporting Platform, individually for each piece of equipment in the ticket.

In collaboration with the Business Intelligence team, a new report was created to compile relevant information from different reports and enable bulk search, eliminating the need to search individually for each piece of equipment.

This same report also included relevant information from the Siebel platform, namely information about the client's portfolio.

This way, a single report can be extracted for all the equipment in the ticket, preventing the process from being interrupted successively to collect information on these two platforms.

4.2.2.2 Automation of Analyses

An extensive analysis of the master files for each ticket type was conducted to derive findings for automating the analysis.

Master files contain all the equipment handled since 2020 and its respective analysis, regularisation action, and feedback. Thus, through this study and observation of ticket resolutions, suggestions for filling in fields such as "análise," "Ação de regulação," and "Feedback" on the treatment platform were possible.

These suggestions are based on the information provided by the SPs in the ticket opening template, the data extracted from SAP ERP (IQ09), and on the Portal de Reporting information.

An example of the suggestions functionality is as follows: In the case of a stock dispute ticket. If it is determined that the equipment is not located in the same warehouse as the SP in question or is not installed, the "análise" field is automatically filled in with "já saiu de stock" and the "feedback" field with "Resolvido."

In cases where the suggestion is not obvious, a combo box is added to the columns corresponding to "análise" and "ação de regularização" on the treatment platform. Depending on the selection in one or more combo boxes, the remaining columns are filled in, thus simplifying the previously exhaustive analysis process.

4.2.2.3 Data Base Creation

To mitigate the re-contestation of processed SNs and prevent redundant processing, databases were developed using Microsoft Access.

Three data bases were created. The first includes all the equipment handled in the Stock Dispute tickets and SAP inconsistencies process; the second includes all the equipment handled in the Deadline control-Inverse Tickets typification; and the third includes the equipment handled in Dispute inventories tickets.

Thus, whenever one of these tickets is processed on the platform, it is possible to check, before starting the analysis, whether any of this equipment is present in the database in question. If the equipment is found, the "Análise", "Ação de regularização" and "Feedback" must be incorporated into the current process before commencing the analysis.

4.2.2.4 Designing Excel Treatment Interface

In order to encompass all the particularities present in the existing ticket types, a processing platform was created for each type.

Based on the study conducted in Chapter 3, the decision support platform was only designed for the following types of tickets: Dispute Inventories, Deadline Control-Inverse, and Stock Dispute tickets. The Portal Support ticket type was excluded because it does not involve an analysis process. Figures 4.6, 4.7 and 4.8 illustrate the Excel interface of the decision support platform created for solving Tickets.

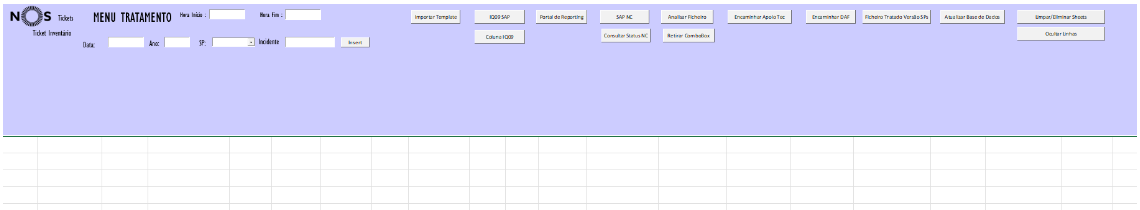


Figure 4.6: Excel interface dedicated to the resolution of Dispute Inventories Tickets

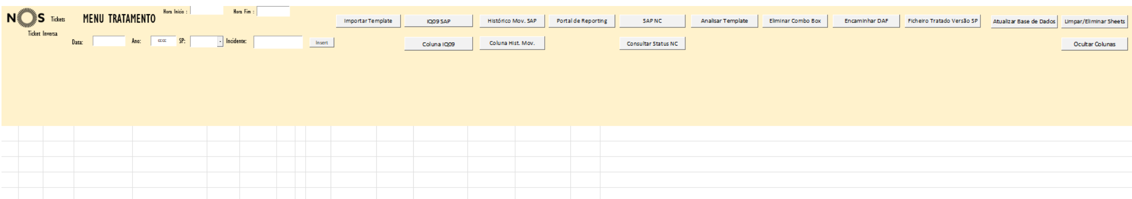


Figure 4.7: Excel interface dedicated to the resolution of Deadline Control-Inverse Tickets

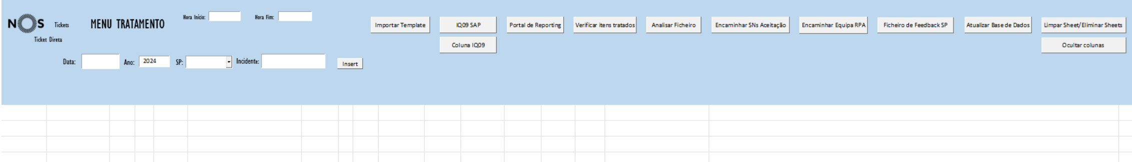


Figure 4.8: Excel interface dedicated to the resolution of Stock Dispute Tickets

Each type-specific interface consists of an average of thirteen buttons. When pressed, these buttons can trigger the following actions:

- Imports the template filled in by the service provider into the treatment page;
- Automatically check the equipment status (via IQ09) and the financial reports in SAP ERP for tickets with typification deadline control-inverse and Dispute inventories and then paste the information to the current platform interface.;
- Export the report from the Portal de Reporting to guarantee access to all the information needed for analysis;
- Automatically sending emails to teams whose feedback is needed for the ticket handling process;

This ensures that all the necessary information required to initiate ticket management is available within the treatment interface.

In addition, the platform can identify and flag SNs if the SN and SP pair are present in the master file of the respective typification. This allows for more quickly checking whether it is a new situation or whether the SN is being contested again in error.

In the case of a Stock Dispute ticket, if it turns out that the equipment in question is still in stock, it is possible to consult the master SAP inconsistency file, which copies and pastes the information in the treatment fields into the ticket treatment file.

To simplify the analysis process, an interface called "Menu Matriz Ticket" has been developed. This interface summarizes the most common classifications for the "Análise," "Ação de regularização," and "Feedback" fields for each type of ticket. These classifications are based on a study of the Ticket master files and are presented in a matrix format, allowing users to independently add new classifications.

Combo boxes have been used to simplify the process of selecting the classifications present in the ‘Menu Matriz Ticket’ on the processing platform for the ‘Análise’ and ‘Ação de regularização’ fields. The ‘Feedback’ is filled in accordingly depending on the choice made on the combo boxes. Figure 4.9 illustrates the Excel interface of the ‘Menu Matriz Ticket’.

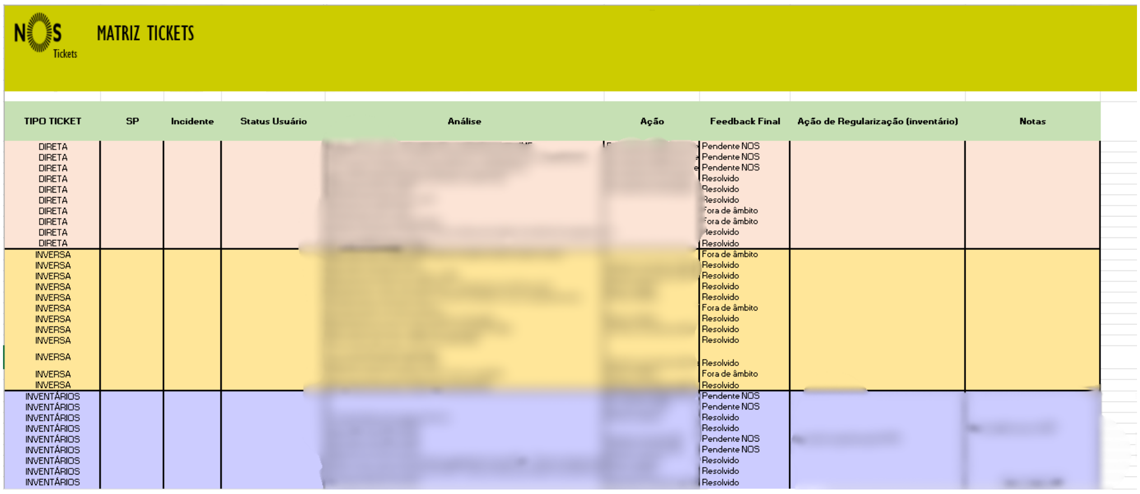


Figure 4.9: Excel interface of 'Menu Matriz Ticket'

All platform actions are executed by clicking on buttons programmed with the necessary VBA script to perform the respective tasks.

Once the processing is complete, a file containing the relevant feedback information for the service provider is generated, and the master file is updated.

The database is synchronised with the master file, ensuring that updates to the master file are reflected in the database. This process occurs dynamically, as the query to retrieve information from the master file is executed each time the database file is accessed.

4.2.3 Data base Consultation

A search interface was also created on the platform to make it possible to consult the data bases more intuitively.

Depending on the ticket type, users can search using the pair SN and SP to find out if the equipment in question has already been dealt with. If so, the platform will return the information; if not, an error message will be displayed, signalling that no match has been found.

Figure 4.10 illustrates the Excel interface for consulting the data base.

Figure 4.10: Excel interface dedicated to Data Base Consultation

It is important to emphasise that the VBA code has been written to ensure the data base is initialised when the search is performed. This guarantees that the data is correctly updated and the query runs as intended.

4.2.4 Expected impacts on KPIs

The development of this project aims to significantly impact some KPIs, namely the Service Level Agreements (SLAs), Lead Time, Average resolution time per equipment, and Operational efficiency indicators.

These KPIs were chosen considering the deficiencies identified in Chapter 3, namely the long time associated with resolving equipment control and regularisation processes.

In the case of Tickets, the performance indicators mentioned were calculated using the existing dashboard in Power BI. This dashboard is fed by information collected on the ticket-opening platform, ITSM, and allows total control of each team member's response time.

Service Level Agreements (SLAs) are already quantified in the ticket resolution process and currently stand at 73%, around 12 percentage points lower than expected. This indicator is currently measured by quantifying the response time allocated to resolving a given ticket, not counting the time it is pending from other teams, thus enabling the operational efficiency of a given team to be quantified.

The lead time indicator provides an overview of the time spent on the process and can act as a decision-support tool for implementing continuous improvement measures. By analysing lead times, process bottlenecks can be identified, and targeted actions can be taken to streamline operations, thus reducing the overall time required to complete a process.

The Average Resolution Time per equipment is another critical KPI that measures the average time taken to resolve an issue. This indicator includes all process stages for a piece of certain equipment, providing a comprehensive view of efficiency. A reduction in average resolution time signifies improved process efficiency and a quicker turnaround time for resolving issues.

Operational Efficiency indicators encompass various metrics that measure efficiency. These indicators help identify areas where resources are being underutilised or where process optimisation is needed. For instance, inefficiencies can be identified and addressed by measuring the time taken to process SAP inconsistencies or the number of steps involved in ticket resolution.

Thus, from an as-is perspective, SAP inconsistencies handling is the only process in question without a method for accounting performance indicators. This gap hinders the ability to measure and improve the process's efficiency.

To counteract this trend and ensure that KPIs are accounted for after the end of the project, a timer was added to both control and regularisation equipment processes. This timer is activated whenever the initial information import button is pressed and deactivated when the final save button of the processed file is pressed. The time counted is then imported into the reporting interface called 'Menu Métricas', thus allowing greater transparency regarding the process and its outputs. Figure 4.11 illustrates the Excel interface of 'Menu Métricas'.

Figure 4.11: Excel interface dedicated to 'Menu Métricas'

The 'Menu Métricas' allows for storing the following information for each process: type of process, resolution date, year, lead time (fed by timer information), number of pieces of equipment in question, and calculation of the average resolution time per equipment.

By systematically measuring and analysing these KPIs, the project provides a framework for ongoing performance monitoring and enhancement, thereby ensuring long-term sustainability and efficiency improvements.

4.3 Tests and Shortcomings Identification and Resolution-Check

The next step was to assess the platform's maturity level, and to this end, a series of tests were carried out.

The nature of the tests was simple and consisted only of carrying out the inherent processes of each equipment control and regularisation treatment. In each of these tests, user feedback was collected and shortcomings in the VBA code were identified for subsequent correction. In addition, the time spent on each task was documented for later analysis in Chapter 5.

As seen in Appendix A, the last month of the dissertation project was dedicated solely to testing the platform.

4.4 Creation of User's Manual-Act

Once the identified deficiencies were rectified and the platform was approved by the members of the fixed planning team, the next step involved creating a user manual for the platform.

The manual aims not only to clarify possible functional issues for the user after the project's end but also to document the process across the board so that, if the need arises, any member of the team can carry out the processes listed. Additionally, references to the developed VBA code have been included so that team members know where to make changes if necessary.

Chapter 5

Results

The following section showcases the results of assessing the developed platform's influence on improving equipment control and regulation processes.

The impact of reducing lead times in the SAP inconsistency process and on ticket resolution, as well as tracking the average resolution time for each equipment issue in tickets, was assessed. The effect on the volume of opened tickets due to the increase in transparency with partners was also examined. Additionally, a study was also carried out into the possible financial savings that the use of the platform could bring to the company.

5.1 SAP inconsistencies

As mentioned in Chapter 4, once the platform had reached a stable level of maturity, the SAP inconsistency process was resolved using the platform alone, making it possible to identify shortcomings and collect user feedback.

In addition, each attempt was timed to allow comparison of the new tool's performance with the performance of the as-is resolution model.

5.1.1 Improvement in Process Lead Time

Figure 5.1 illustrates the evolution of the lead time for the SAP inconsistency resolution process using the decision support platform. The results shown were collected based on eight attempts at using the platform.

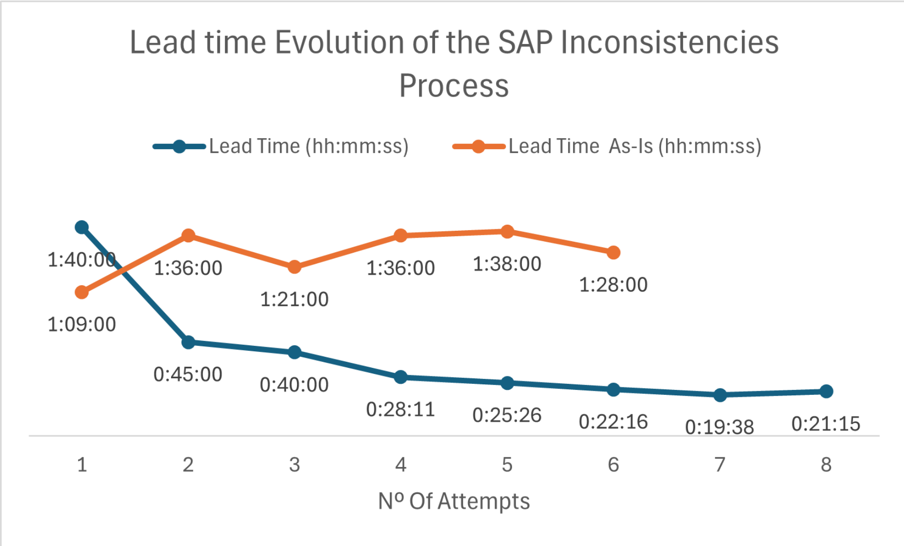


Figure 5.1: Lead time evolution of the SAP inconsistency process using the decision support platform developed

By examining the progression of processing times, it is evident that the platform's initial uses experienced longer processing periods. These prolonged times are attributed to the user's learning curve, who spent more time assessing the platform's accuracy through repeated steps and double checks. Therefore, to guarantee the reliability of the results, it was decided to consider the times only after the fourth attempt, from which point the timed values became stable.

Using the developed platform, an average lead time of around 22 minutes was achieved, a significant improvement compared to the lead time of 1 hour and 30 minutes in the as-is resolution model. This reduction pertains to both stages of the process: the analysis of the file and the updating of the feedback received from other teams. The updating of feedback can now be completed in under a minute using the interface of the decision support platform, illustrated in Figure 4.3.

As a result, the platform developed enables a monthly gain of 4 hours and 30 minutes, which can now be assigned to tasks with greater added value for the company.

5.1.2 Impact on Ticket Openings

The impact of increasing transparency towards SPs with weekly emails regarding the SAP inconsistency process was also analysed.

It's important to note that the purpose of sending emails is to decrease the number of stock dispute tickets being opened.

To evaluate the impact of the new measure, a study was carried out on the number of tickets opened for the stock dispute ticket from September 2023 to June 2024. Figure 5.2 illustrates the distribution of stock dispute tickets opened over the last 10 months.

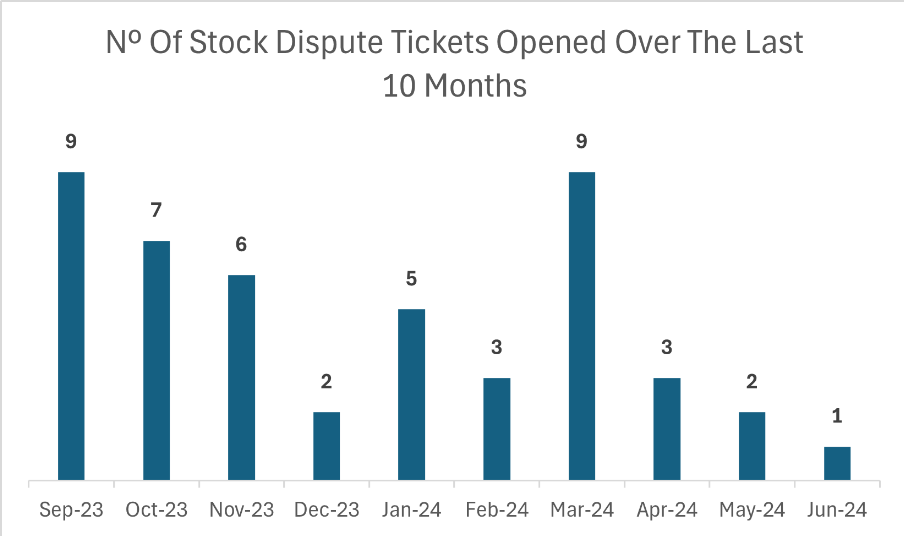


Figure 5.2: Number of Stock Dispute Tickets opened over the last ten months

Following the implementation of the email-sending measure in April 2024, the number of tickets opened has been positively impacted. The average number of tickets in recent months has been around 2, in contrast to the average of 6 tickets opened in the other months of the study period.

Although these preliminary results are promising, it is important to recognise that the observation period is relatively short. Evaluating the long-term impact the measure requires continuous monitoring and collecting additional data over the coming months. This will make it possible to check whether the improvements observed are maintained or whether secondary effects may emerge over time.

5.2 Tickets

A similar approach to the one used for SAP inconsistencies was utilised to measure the enhancements driven by the platform's implementation in the ticket-handling process. Regarding tickets, the key indicators to be analysed are SLA compliance and average resolution time per equipment.

Metrics like SLA compliance were extracted from the existing dashboard, eliminating the need to time the processes.

On the other hand, the Average Resolution Time per piece of equipment was calculated based on the time recorded on the decision support platform interface since it is important to quantify the time spent collecting information and analysing disputed equipment, considered to be the most critical phases of the process from an as-is perspective.

5.2.1 Improvement in Process Average Resolution Time Per Equipment

During the weeks designated for result collection, the limited number of tickets opened made it difficult to obtain a substantial sample for comparison due to simultaneous inventory processes.

Nonetheless, the obtained results were very encouraging.

Figure 5.3 compares the average resolution times per equipment using the as-is approach and the values obtained using the developed platform. The platform was tested on 6 different occasions with different ticket types.

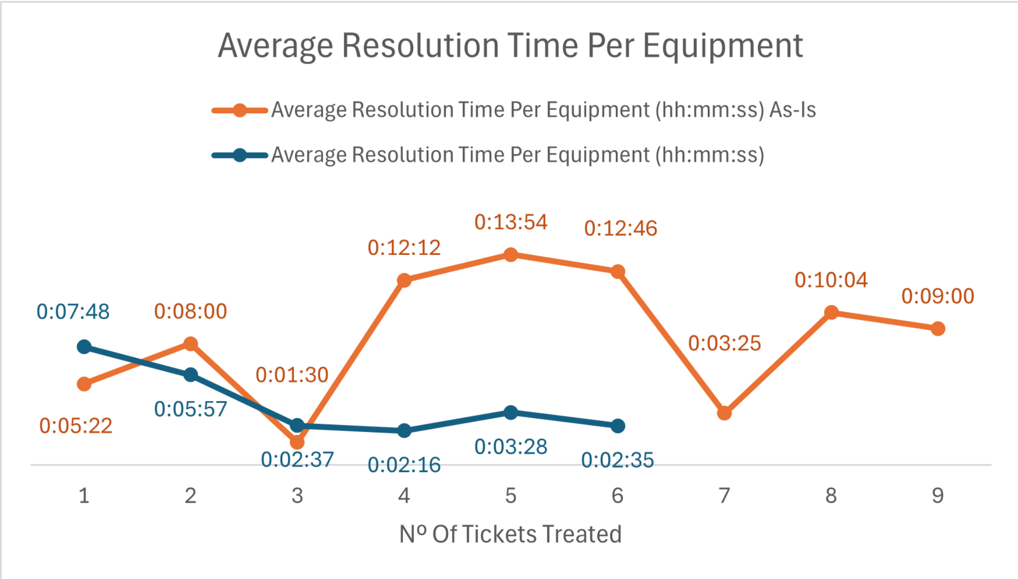


Figure 5.3: Comparison Between the Average Resolution Times per Equipment Using The As-Is Approach and the Values Obtained Using the Developed Platform

As observed in other equipment control and regularisation processes, the initial timed events are based on the user's learning curve, resulting in longer durations. However, based on the times recorded for the last four tickets, the average resolution time per equipment was reduced to approximately 2 minutes and 50 seconds, representing a reduction of 6 minutes and 10 seconds compared to the as-is model.

According to user feedback, this reduction was mainly due to the prior analysis of the information combined with the suggestion of possible feedback, which helps the user act more targeted on the issue in question. In addition, the fact that the information is available centrally to the user is also considered to positively impact the process, as it guarantees a more concentrated treatment with fewer distractions since the user does not need to navigate between all IT platforms.

Assuming a monthly average of 10 tickets to be dealt with and considering that each ticket has an average of 10 pieces of equipment, the decision support platform developed enables to spend only approximately 4 hours and 40 minutes per month on resolving tickets. This figure contrasts with the 15 monthly hours associated with the as-is resolution model.

The platform developed thus saves around 10 hours and 20 minutes of work for the employee in question.

5.2.2 Compliance with the SLA

A study was also conducted to determine whether there was any impact on ticket response capacity. This study was conducted from September 2023 to June 2024 and included the following ticket types: Stock Dispute Tickets, Deadline Control-Inverse Tickets, and Dispute inventories Tickets.

Figure 5.4 illustrates the percentage of tickets whose responsiveness was out of SLA and within SLA for each month between September 2023 and June 2024.

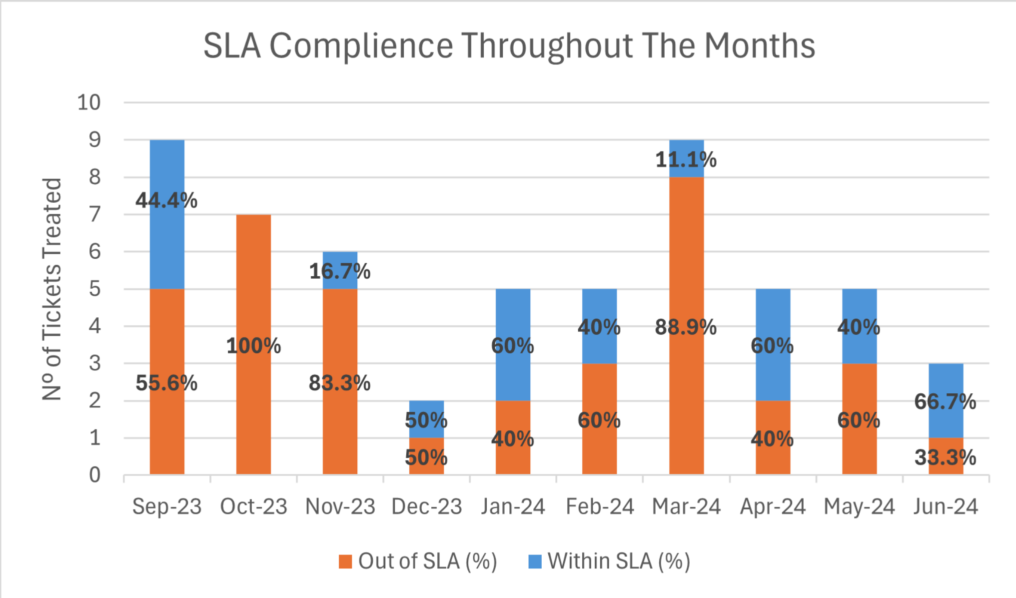


Figure 5.4: Percentage of Tickets Whose Responsiveness was out of SLA and within SLA for each month between September 2023 and June 2024

Therefore, based on the figures presented, it is possible to observe more stable values for the months between April and June of 2024, both in the number of tickets opened and in the response capacity within the established SLA. This can be explained by the reduction in the number of Stock Dispute tickets opened due to the email tool and the reduction in the average resolution time per piece of equipment, making it possible to have a more stable response time.

5.3 Financial Impact of the Platform's Implementation

To analyse the financial impact of the results obtained from implementing the platform developed, a small estimate was made, taking into account a net salary of 1500 €. A net salary of 1 500 € corresponds to a gross salary of 2 150 €. Thus, distributing paid time off, 13th and 14th salary, and the 23,75% of social security charges over the 11 months worked, a salary of 1 500 € net equates to a cost of 3 386.25 € per month to the company. So the hourly fee of an employee receiving this salary is 19.24 €, considering a daily working day of 8 hours and 22 working days per month.

Table 5.1 briefly summarises the annual savings achieved for each of the equipment control and regularisation processes with the implementation of the decision support platform developed.

Table 5.1: Total Savings Associated with the Implementation of the Decision Support Platform for Resolving Equipment Control and Regularisation Processes

Process	**Process Lead Time Reduction [Hours per month]**	**Savings per Month [€]**	**Savings per year [€]**
SAP Inconsistencies	4.5	86,58	952,38
Tickets	10,33	198,75	2 186,24
Total	14.83	285,33	3 138,62

In this way, it was possible to achieve annual savings of approximately 3 138,62 €, which can be redirected to the payment of credit notes issued in the context of Deadline Control-Inverse Tickets and Dispute inventories open tickets, for example, or to investments dedicated to a greater degree of automation of the respective processes.

Chapter 6

Conclusions and Future Work

This dissertation project arose in the context of an initiative to automate the administrative processes of the fixed planning unit of the Portuguese telecommunications company NOS. The main objective of this work was to optimise the time dedicated to equipment control and regularisation processes, which, from an as-is perspective, were considered time-consuming and inefficient.

Two of the main processes for controlling and regularising equipment were studied throughout the project: SAP inconsistencies and tickets. Opportunities for improvement were identified to directly impact the transparency and efficiency of the processes, combined with reducing lead times and average resolution times per equipment. This triggered the creation of a decision-support platform that could handle both processes, guaranteeing interconnection between them.

A methodology was followed throughout the project and included the following stages: mapping and perception of the processes, identification of opportunities for improvement, creation of the decision support platform using VBA, testing and collection of results. The decision support platform developed focused on centralising information and mass processing contested equipment, guaranteeing the automatic creation of emails and updating feedback received from the respective teams. The platform also provides data base input, which was created to solve the problem of equipment re-contests, ensuring that the equipment is flagged up and the analysis previously carried out is incorporated into the current process.

Manuals have been created to support its use and ensure that the platform is better understood. These manuals act as guidelines to guarantee the long-term accuracy of the process.

The impacts observed with using the platform in the equipment control and regularisation processes were generally very encouraging. In the case of SAP inconsistencies, achieving an hourly gain of approximately 4 hours and 30 minutes per month was possible, resulting in a reduction of around 75% in the process lead time compared to the manual as-is model. This reduction translates into annual financial savings of around 952,38 €.

Regarding tickets, the main focus was reducing the average resolution time per piece of equipment contested in each ticket. As a result, the platform developed allowed to go from an as-is average resolution time per equipment of 9 minutes to 2 minutes and 50 seconds, reflecting an average reduction of 10,33 monthly hours dedicated to ticket handling. As a result, the platform enabled annual financial savings of 2 186,24 €.

In summary, the decision-support platform developed in this project allowed it to reduce approximately 14 hours and 50 minutes per month and save around 3 138,62 € euros per year. However, this figure only refers to the costs associated with one worker in the fixed planning unit, who is responsible for carrying out the processes mentioned. It would also be possible to account for the reduced costs on other scales, such as SPs, who now receive weekly emails about the SAP inconsistency process and no longer waste time disputing equipment unnecessary in tickets.

It is important to emphasise that these processes are fundamentally based on errors, which prevent the equipment from progressing within the system. Many of these errors result from incorrect actions carried out by the SP technician or by members of other teams during the phase of activating or inserting the equipment into the reverse cycle. These errors slow down the workflow, increase operating costs, and reduce overall efficiency.

The impact of these errors is multifaceted. First, they contribute to significant downtime, as equipment has to be diagnosed, corrected, and often reprocessed, which leads to delays. Second, these errors require additional labour and resources to identify and rectify the problems, thus increasing costs. Finally, the recurrence of such errors can diminish the reliability and credibility of processes.

A comprehensive strategy focused on preventing and detecting errors is essential to resolve these issues. Therefore, it is more than necessary to develop a platform that encourages visualisation of the upstream actions responsible for assigning equipment to the processes in question. Such a platform would enable a more proactive approach to error management, highlighting the sources of errors earlier in the process, thus enabling timely interventions and preventing the spread of these errors downstream.

The proposed platform would integrate with the platform developed for handling equipment control and regularisation processes, providing real-time monitoring and feedback mechanisms to increase visualisation.

By implementing this platform, the organisation can expect to see a reduction in error rates and associated costs. Identifying and rectifying errors early in the process will streamline operations, improve efficiency and enhance the system's overall quality. In addition, the data collected through the platform can be analysed to identify trends and patterns in errors, providing valuable information for continuous improvement.

Developing and implementing a visualization platform to proactively manage these errors will mitigate their immediate impact and promote a culture of continuous improvement and operational excellence.

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Appendix A

Gantt Diagram

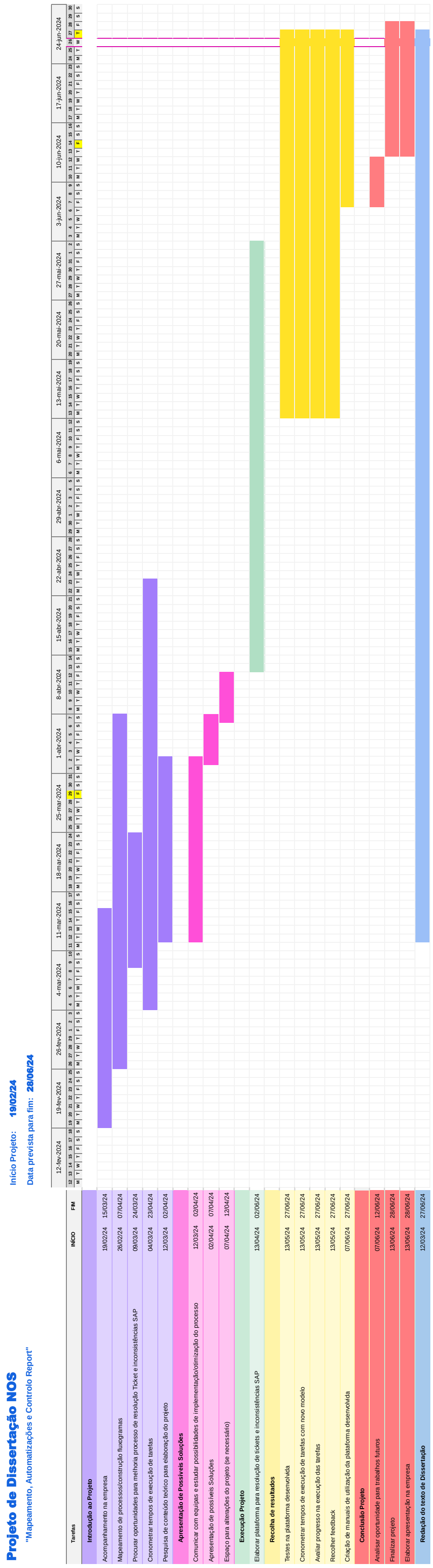

Figure A.1: Gantt Diagram

Appendix B

Performance Indexes of the Equipment Control Ticket Resolution Process

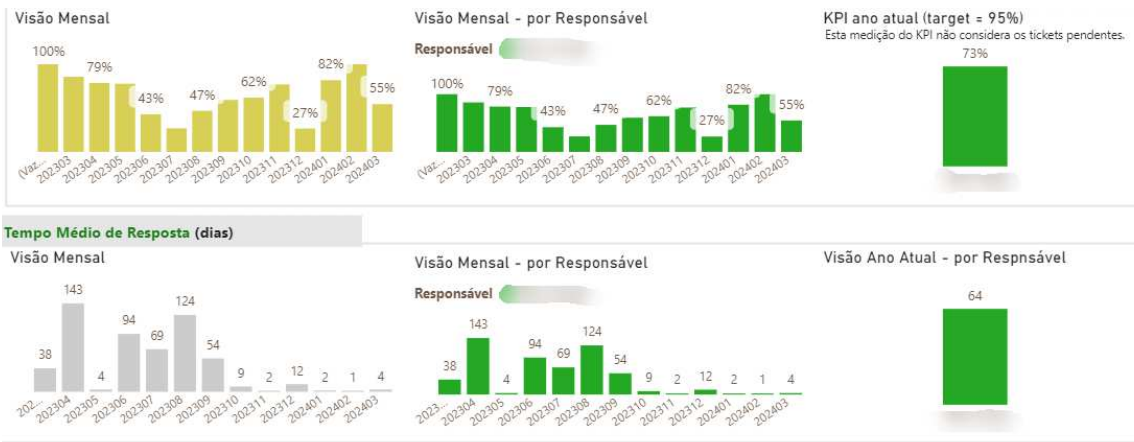

Figure B.1: SLA index for Tickets

Appendix C

BPMN for the Equipment Control and Regularisation Process

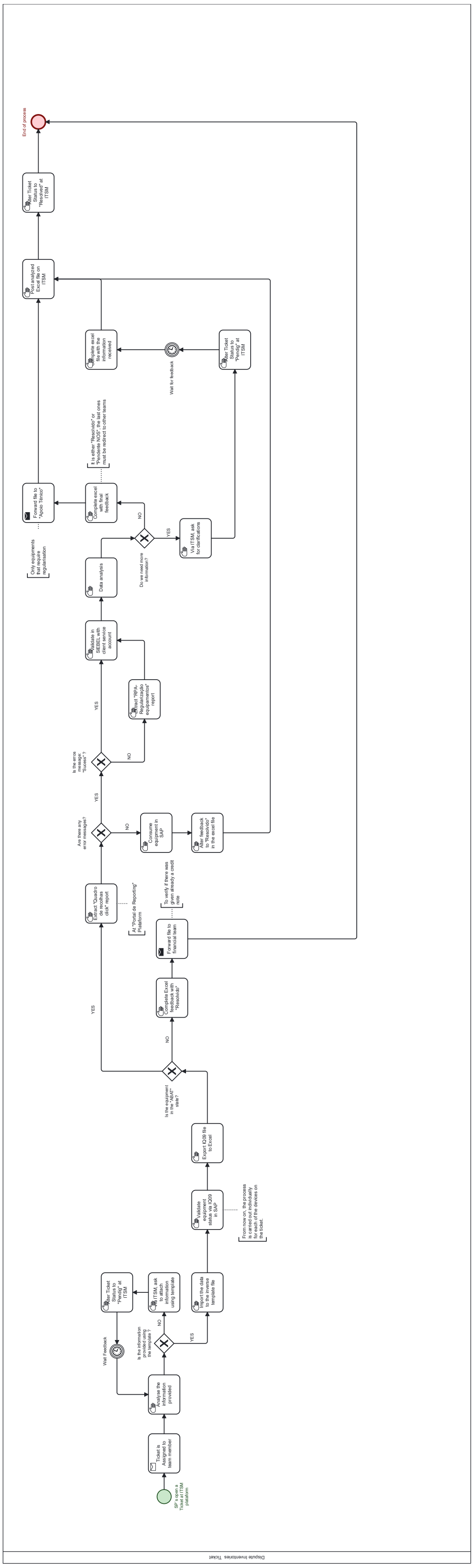

Figure C.1: Process Modelling of Dispute Inventories Ticket

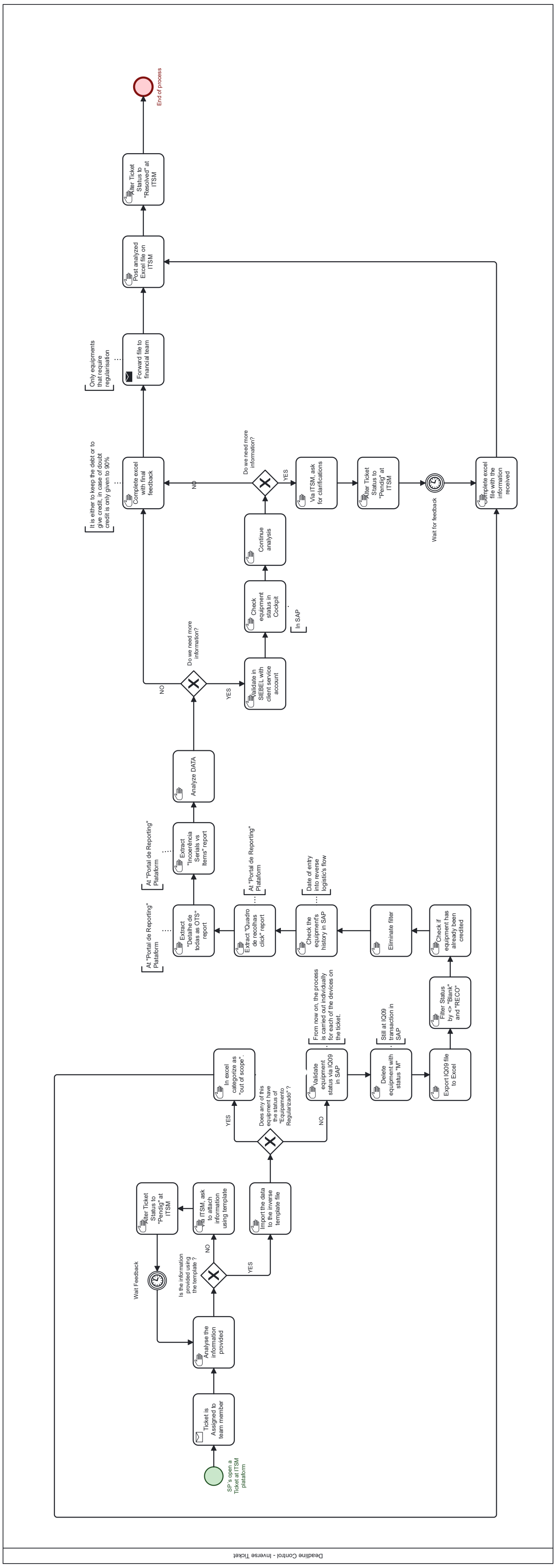

Figure C.2: Process Modelling of Deadline Control - Inverse Ticket

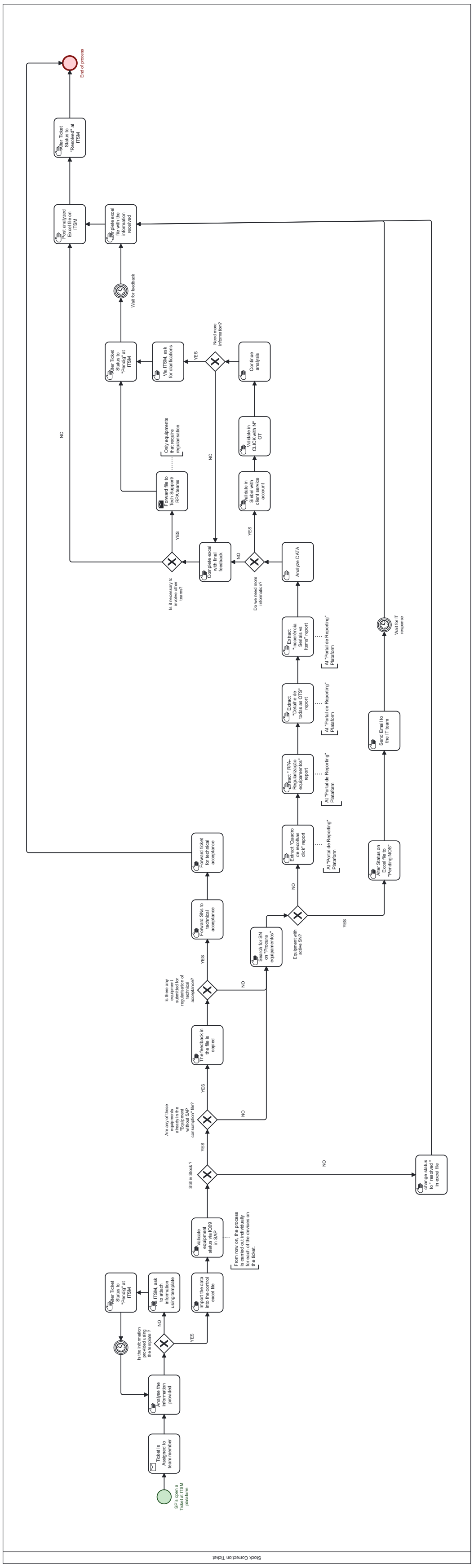

Figure C.3: Process Modelling of Stock Dispute Ticket

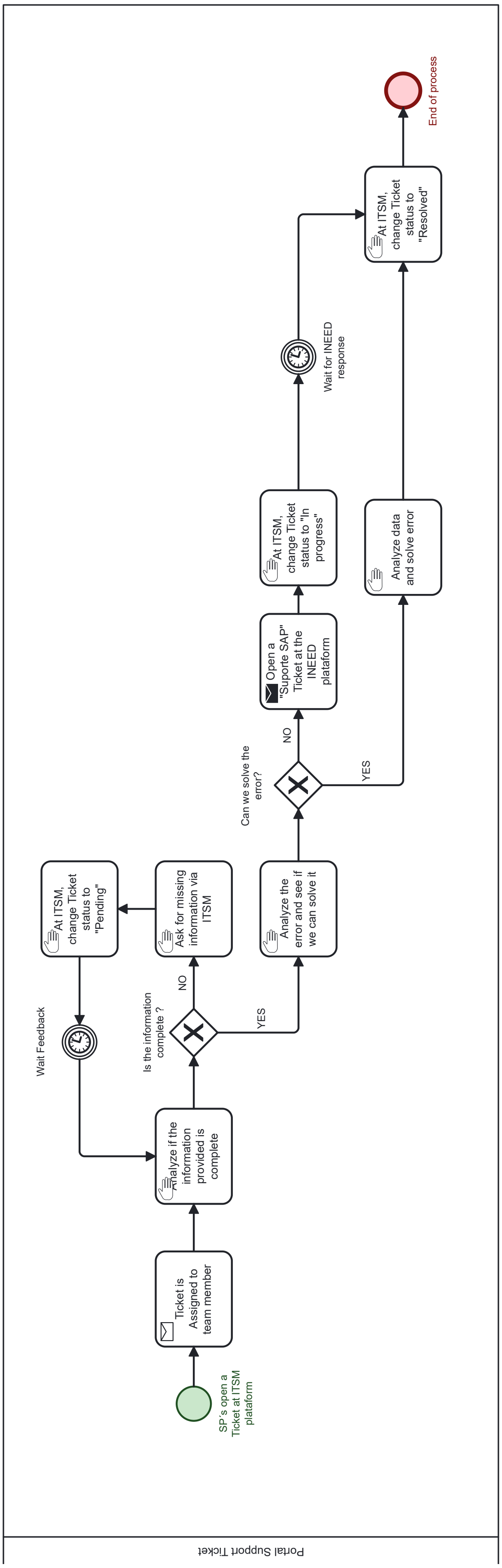

Figure C.4: Process Modelling of Portal Support Ticket

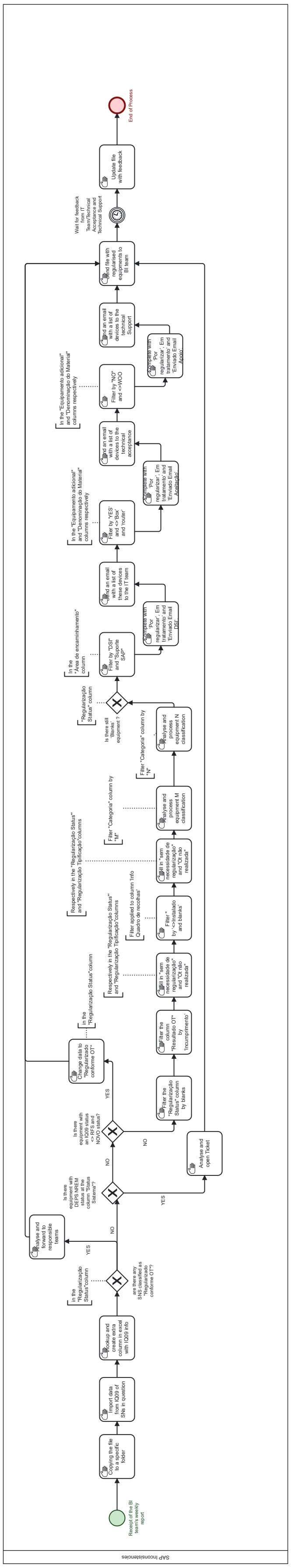

Figure C.5: Process Modelling of SAP Inconsistencies

Appendix D

Data Extracted from the Ticket Dashboard

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
20/06/2024 23:23:33		[illegible]	Contestações inventários	Pendente NOS	[illegible]	3.03	0.00	3.33	110.09%	7	Dentro SLA
18/06/2024 16:37:07		[illegible]	Contestações inventários	Pendente NOS	[illegible]	5.31	0.00	5.61	105.75%	7	Dentro SLA
06/06/2024 22:05:24	6/17/2024 5:08:24 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	10.79	0.00	10.79	99.99%		
29/05/2024 14:18:45		[illegible]	Contestações inventários	Pendente NOS	[illegible]	25.40	6.28	19.12	75.26%	7	Fora SLA
28/05/2024 11:54:19	5/28/2024 5:21:08 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.23	0.00	0.23	99.75%	1	Dentro SLA
09/05/2024 09:15:14	5/14/2024 3:47:39 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	5.27	0.00	5.27	99.99%	3	Fora SLA

Figure D.1: Ticket data from September 2023 to June 2024

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
08/05/2024 09:05:39	5/9/2024 11:08:18 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	1.09	0.00	1.08	99.96%	3	Dentro SLA
08/05/2024 09:03:47	5/28/2024 5:12:01 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	20.34	15.16	5.18	25.44%	3	Fora SLA
29/04/2024 15:50:01	5/6/2024 9:12:11 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	6.72	0.00	6.72	100.00%	1	Fora SLA
24/04/2024 09:54:41	4/29/2024 10:56:37 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	5.04	0.05	4.99	98.93%	1	Fora SLA
17/04/2024 16:45:28	4/19/2024 8:19:49 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	1.65	0.10	1.55	94.09%	1	Fora SLA
16/04/2024 12:33:58	4/16/2024 12:53:11 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.01	0.00	0.01	98.87%	1	Dentro SLA
15/04/2024 16:52:52	4/18/2024 9:47:01 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	2.70	0.91	1.80	66.48%	3	Dentro SLA
15/04/2024 15:14:24	4/16/2024 3:13:53 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	1.00	0.96	0.04	3.75%	1	Dentro SLA
10/04/2024 16:05:20	4/12/2024 7:11:11 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	2.13	1.67	0.46	21.40%	1	Dentro SLA
10/04/2024 15:39:50	4/10/2024 8:11:17 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.19	0.00	0.19	99.83%	1	Dentro SLA
10/04/2024 15:10:36	4/12/2024 3:32:57 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	2.02	1.85	0.17	8.44%	1	Dentro SLA
09/04/2024 14:32:03	4/9/2024 2:37:56 PM	[illegible]	Contestações inventários	Fechado	[illegible]	0.00	0.00	0.00	84.99%	7	Dentro SLA
08/04/2024 17:11:24	4/15/2024 11:45:50 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	6.77	0.00	6.77	100.00%	3	Fora SLA
08/04/2024 16:46:52	4/9/2024 3:44:41 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.96	0.04	0.91	95.51%	1	Dentro SLA
08/04/2024 16:36:34	4/8/2024 5:23:13 PM	[illegible]	Contestações inventários	Fechado	[illegible]	0.03	0.00	0.03	98.61%	7	Dentro SLA
01/04/2024 14:43:44	4/29/2024 1:41:36 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	27.96	13.29	14.66	52.45%	3	Fora SLA
28/03/2024 10:22:34	4/9/2024 12:22:32 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	12.08	0.04	12.04	99.65%	1	Fora SLA
26/03/2024 15:29:16	4/4/2024 11:40:19 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	8.84	0.04	8.80	99.53%	3	Fora SLA
25/03/2024 21:58:14	4/15/2024 4:20:24 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	20.77	0.04	20.72	99.80%	3	Fora SLA
21/03/2024 14:49:12	3/22/2024 3:45:29 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	1.04	0.00	1.04	99.98%	1	Fora SLA
19/03/2024 17:40:01	4/30/2024 8:38:46 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	41.62	2.82	38.81	93.23%	3	Fora SLA
19/03/2024 12:25:21	3/25/2024 10:18:17 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	5.91	0.00	5.91	99.99%	3	Fora SLA
19/03/2024 12:18:22	4/12/2024 7:34:47 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	24.30	0.04	24.26	99.83%	3	Fora SLA
15/03/2024 09:44:39	5/13/2024 2:31:13 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	59.20	0.04	59.16	99.93%	3	Fora SLA
15/03/2024 09:32:53	3/15/2024 5:12:14 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.32	0.00	0.32	99.92%	3	Dentro SLA
13/03/2024 17:32:18	3/13/2024 6:33:11 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.04	0.00	0.04	98.55%	1	Dentro SLA
13/03/2024 09:20:44	3/15/2024 3:29:29 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	2.26	0.00	2.26	99.98%	3	Dentro SLA
12/03/2024 10:18:08		[illegible]	Objeto ou Equipamento Danificado	Pendente SPs/Armazém	[illegible]	103.57	103.57			3	Fora SLA
05/03/2024 12:26:10	3/25/2024 8:59:21 AM	[illegible]	Controlo de Prazos - Inversa	Fechado	[illegible]	19.86	0.00	19.86	100.00%	3	Fora SLA
05/03/2024 10:22:28	3/8/2024 5:46:44 PM	[illegible]	Controlo de Prazos - Inversa	Fechado	[illegible]	3.31	0.00	3.31	99.99%	3	Fora SLA

Figure D.2: Ticket data from September 2023 to June 2024

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
[illegible]	[illegible]	[illegible]	[illegible] Inversa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
05/03/2024 10:22:28	3/8/2024 5:46:44 PM	[illegible]	Controlo de Prazos - Inversa	Fechado	[illegible]	3.31	0.00	3.31	99.99%	3	Fora SLA
04/03/2024 11:19:33	5/14/2024 1:07:00 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	71.07	49.66	21.41	30.13%	3	Fora SLA
01/03/2024 15:56:47	3/15/2024 5:09:56 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	14.05	8.06	5.99	42.64%	1	Fora SLA
01/03/2024 15:04:42	3/5/2024 9:17:04 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	3.76	0.00	3.76	99.99%	1	Fora SLA
22/02/2024 10:28:15	2/22/2024 12:14:45 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.07	0.00	0.07	99.53%	3	Dentro SLA
19/02/2024 15:51:15	3/13/2024 9:59:55 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	22.76	19.88	2.87	12.63%	3	Dentro SLA
16/02/2024 19:26:38	2/23/2024 3:09:19 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	6.82	6.71	0.11	1.59%	1	Dentro SLA
12/02/2024 00:48:58	3/8/2024 2:25:34 PM	[illegible]	Controlo de Prazos - Inversa	Fechado	[illegible]	25.57	0.00	25.57	100.00%	3	Fora SLA
12/02/2024 00:17:56	3/11/2024 2:23:56 PM	[illegible]	Controlo de Prazos - Inversa	Fechado	[illegible]	28.59	0.00	28.59	100.00%	3	Fora SLA
05/02/2024 11:44:39	3/6/2024 9:09:51 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	29.89	19.89	10.00	33.46%	3	Fora SLA
29/01/2024 10:52:43	1/29/2024 1:24:33 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.11	0.00	0.10	99.45%	1	Dentro SLA
25/01/2024 16:55:08	1/31/2024 10:57:41 AM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	5.75	4.77	0.98	17.08%	3	Dentro SLA
22/01/2024 15:15:06	1/22/2024 3:55:35 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.03	0.00	0.03	98.81%	1	Dentro SLA
22/01/2024 14:45:03	2/23/2024 9:22:11 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	31.78	30.14	1.63	5.14%	3	Dentro SLA
18/01/2024 11:58:04	1/23/2024 11:27:08 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	4.98	0.00	4.98	100.00%	3	Dentro SLA
17/01/2024 10:57:05	1/17/2024 11:06:40 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.01	0.00	0.01	93.91%	1	Dentro SLA
16/01/2024 15:46:26	1/17/2024 8:55:04 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.71	0.00	0.71	99.94%	1	Dentro SLA
08/01/2024 17:20:21	1/9/2024 4:23:42 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.96	0.00	0.96	99.97%	3	Dentro SLA
08/01/2024 17:16:37	3/25/2024 8:58:25 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	76.65	27.70	48.96	63.87%	3	Fora SLA
08/01/2024 11:24:43	2/15/2024 2:02:51 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	38.11	21.91	16.20	42.51%	3	Fora SLA
19/12/2023 11:58:30	1/5/2024 2:49:55 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	17.12	12.22	4.90	28.64%	3	Fora SLA
18/12/2023 18:26:03	1/10/2024 9:20:16 AM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	22.62	21.67	0.95	4.18%	3	Dentro SLA
13/12/2023 14:39:49	12/14/2023 11:33:26 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.87	0.86	0.01	0.88%	1	Dentro SLA
11/12/2023 17:30:14	12/12/2023 3:57:07 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.94	0.21	0.73	77.81%	1	Dentro SLA
11/12/2023 16:31:08	12/12/2023 10:32:00	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.75	0.00	0.75	99.92%	1	Dentro SLA

Figure D.3: Ticket data from September 2023 to June 2024

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
11/12/2023 17:30:14	12/12/2023 3:57:07 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.94	0.21	0.73	77.81%	1	Dentro SLA
11/12/2023 16:31:08	12/12/2023 10:32:00 AM	[illegible]	uporte ao Portal	Fechado	[illegible]	0.75	0.00	0.75	99.92%	1	Dentro SLA
11/12/2023 14:21:28	12/13/2023 2:12:26 PM	[illegible]	orreção de Stocks	Fechado	[illegible]	1.99	0.00	1.99	99.97%	3	Dentro SLA
29/11/2023 10:24:51	12/6/2023 12:14:46 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	7.08	0.00	7.08	99.99%	1	Fora SLA
28/11/2023 16:57:18	12/6/2023 12:18:38 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	7.81	0.00	7.81	100.00%	1	Fora SLA
28/11/2023 12:27:34	12/6/2023 12:15:49 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	7.99	0.00	7.99	100.00%	1	Fora SLA
27/11/2023 16:08:04	1/3/2024 12:55:11 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	36.87	36.80	0.06	0.18%	3	Dentro SLA
23/11/2023 15:51:47	11/23/2023 3:54:18 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.00	0.00	0.00	79.47%	1	Dentro SLA
23/11/2023 15:36:57	11/23/2023 3:52:49 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.01	0.00	0.01	94.54%	1	Dentro SLA
23/11/2023 15:28:53	11/27/2023 7:27:01 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	4.17	4.10	0.06	1.55%	1	Dentro SLA
23/11/2023 14:48:47	11/23/2023 3:33:39 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.03	0.00	0.03	98.07%	1	Dentro SLA
23/11/2023 14:02:01	11/23/2023 2:09:07 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.00	0.00	0.00	98.59%	1	Dentro SLA
23/11/2023 12:04:00	11/27/2023 7:29:25 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	4.31	0.95	3.36	78.06%	1	Fora SLA
21/11/2023 14:45:23	11/21/2023 2:49:38 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.00	0.00	0.00	94.12%	1	Dentro SLA
20/11/2023 10:09:03	12/14/2023 11:08:56 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	24.04	0.00	24.04	100.00%	3	Fora SLA
20/11/2023 10:06:03	11/23/2023 2:43:43 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	3.19	0.00	3.19	99.99%	3	Fora SLA
17/11/2023 09:03:42	11/21/2023 8:46:12 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	3.99	0.00	3.99	99.99%	3	Dentro SLA
13/11/2023 23:08:38	12/22/2023 11:50:44 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	38.53	1.93	36.60	95.00%	3	Fora SLA
13/11/2023 23:01:49	12/12/2023 12:01:22 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	28.54	0.00	28.54	100.00%	3	Fora SLA
13/11/2023 10:38:50	1/8/2024 10:57:09 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	56.51	21.99	34.52	61.09%	3	Fora SLA
09/11/2023 15:16:29	11/9/2023 3:26:58 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.01	0.00	0.01	95.39%	1	Dentro SLA
02/11/2023 15:15:45	11/21/2023 10:00:29 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	18.78	0.00	18.78	100.00%	1	Fora SLA
02/11/2023 12:13:41	11/2/2023 12:48:28 P	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.02	0.00	0.02	97.75%	1	Dentro SLA
31/10/2023 14:33:27	10/31/2023 4:36:18 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.09	0.00	0.08	99.31%	1	Dentro SLA
31/10/2023 10:02:56	12/7/2023 12:15:29 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	37.09	13.97	23.12	62.34%	3	Fora SLA

Figure D.4: Ticket data from September 2023 to June 2024

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
31/10/2023 10:02:56	12/7/2023 12:15:29 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	37.09	13.97	23.12	62.34%	3	Fora SLA
30/10/2023 14:25:10	12/12/2023 10:43:47 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	42.85	19.02	23.82	55.60%	3	Fora SLA
27/10/2023 09:19:39	10/27/2023 11:42:27 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	0.10	0.00	0.10	99.44%	3	Dentro SLA
25/10/2023 14:27:11	10/25/2023 3:01:59 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.02	0.00	0.02	97.70%	1	Dentro SLA
24/10/2023 16:04:01	10/25/2023 3:12:21 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.96	0.01	0.95	98.90%	1	Dentro SLA
20/10/2023 18:15:25	11/9/2023 5:19:32 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	19.96	0.00	20.00	100.21%	3	Fora SLA
20/10/2023 15:39:44	10/25/2023 4:10:39 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	5.02	0.02	5.00	99.64%	1	Fora SLA
20/10/2023 14:13:13	10/20/2023 4:38:17 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.10	0.06	0.04	39.98%	1	Dentro SLA
18/10/2023 12:06:53	10/18/2023 2:15:31 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.09	0.00	0.09	99.51%	1	Dentro SLA
18/10/2023 11:40:37	10/20/2023 10:24:08 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	1.95	1.81	0.14	7.06%	1	Dentro SLA
16/10/2023 17:24:35	12/7/2023 12:02:31 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	51.78	37.06	14.72	28.42%	3	Fora SLA
16/10/2023 14:55:27	12/12/2023 10:41:52 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	56.82	43.76	13.06	22.99%	3	Fora SLA
13/10/2023 09:42:41	10/13/2023 10:06:35 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	0.02	0.00	0.02	96.23%	3	Dentro SLA
13/10/2023 09:26:54	10/13/2023 10:03:38 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	0.03	0.00	0.03	98.00%	3	Dentro SLA
09/10/2023 14:10:09	10/27/2023 5:46:48 PM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	18.15	15.94	2.21	12.18%	3	Dentro SLA
02/10/2023 18:29:56	10/27/2023 5:44:08 PM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	24.97	22.76	2.21	8.85%	3	Dentro SLA
02/10/2023 14:28:13	10/6/2023 3:25:46 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	4.04	0.00	4.04	99.99%	3	Fora SLA
02/10/2023 14:25:16	12/14/2023 11:07:43 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	72.86	18.73	54.13	74.29%	3	Fora SLA
29/09/2023 09:01:09	9/29/2023 4:39:21 PM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	0.32	0.00	0.32	99.96%	3	Dentro SLA

Figure D.5: Ticket data from September 2023 to June 2024

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
			fisicamente								
29/09/2023 08:55:35	9/29/2023 4:36:49 PM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	0.32	0.00	0.32	99.95%	3	Dentro SLA
26/09/2023 10:33:01	9/26/2023 10:33:46 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.00	0.00			3	Dentro SLA
26/09/2023 09:42:27	9/26/2023 9:46:23 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.00	0.00			3	Dentro SLA
25/09/2023 17:51:56	10/26/2023 2:42:47 PM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	30.87	27.72	3.15	10.19%	3	Fora SLA
25/09/2023 17:38:02	9/26/2023 9:51:12 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.68	0.68			3	Dentro SLA
22/09/2023 08:54:12	9/25/2023 8:56:56 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	3.00	0.00	3.00	99.98%	3	Dentro SLA
18/09/2023 21:50:26	10/18/2023 8:59:32 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	29.46	0.00	29.46	100.00%	3	Fora SLA
18/09/2023 12:27:26	9/26/2023 9:48:00 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	7.89	7.89			3	Fora SLA
18/09/2023 12:26:08	10/12/2023 3:49:05 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	24.14	0.00	24.14	100.00%	3	Fora SLA
18/09/2023 11:23:31	9/26/2023 9:28:29 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	7.92	0.00	7.92	99.99%	3	Fora SLA
15/09/2023 09:48:45	9/18/2023 10:13:48 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	3.02	0.00	3.02	100.00%	3	Dentro SLA
15/09/2023 09:44:06	9/18/2023 10:12:24 AM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	3.02	0.00	3.02	99.99%	3	Dentro SLA
15/09/2023 09:24:26	9/25/2023 8:53:35 AM	[illegible]	Suporte ao Portal	Fechado	[illegible]	9.98	0.00	9.98	100.00%	1	Fora SLA
13/09/2023 16:10:34	9/19/2023 12:28:11 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	5.85	5.80	0.05	0.78%	1	Dentro SLA
12/09/2023 12:43:38	9/12/2023 12:46:29 PM	[illegible]	Correção de Stocks	Fechado	[illegible]	0.00	0.00			3	Dentro SLA
11/09/2023 09:29:36	10/2/2023 12:09:05 PM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	21.11	17.47	3.64	17.24%	3	Fora SLA
11/09/2023 08:57:15	9/11/2023 12:13:12 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.14	0.00	0.14	99.52%	1	Dentro SLA
08/09/2023 08:35:38	9/11/2023 12:12:36 PM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	3.15	0.00	3.15	99.98%	3	Dentro SLA
08/09/2023 08:28:38	9/11/2023 12:09:25 PM	[illegible]	Equipamento em trânsito	Fechado	[illegible]	3.15	0.00	3.15	99.98%	3	Dentro SLA

Figure D.6: Ticket data from September 2023 to June 2024

Data Criação	Data Fecho	Incidente	Tipificação	Status_Ticket	Responsável	Tempo Total	Tempo Outras Equipas	Tempo no Planeamento	% tempo Planeamento	SLA dias	Cumprimento SLA PL
08/09/2023 08:28:38	9/11/2023 12:09:25 PM	[illegible]	Equipamento em trânsito e SP não tem equip. fisicamente	Fechado	[illegible]	3.15	0.00	3.15	99.98%	3	Dentro SLA
07/09/2023 12:58:49	9/8/2023 12:14:35 PM	[illegible]	Suporte ao Portal	Fechado	[illegible]	0.97	0.00	0.97	99.95%	1	Dentro SLA
05/09/2023 14:49:19	10/2/2023 12:07:57 PM	[illegible]	Quantidade no Objeto Divergente	Fechado	[illegible]	26.89	23.23	3.66	13.61%	3	Fora SLA
04/09/2023 15:58:19	10/18/2023 11:52:16 AM	[illegible]	Correção de Stocks	Fechado	[illegible]	43.83	0.00	43.83	100.00%	3	Fora SLA

Figure D.7: Ticket data from September 2023 to June 2024