



ACADEMIA MILITAR

The Modernization of the Portuguese Army Administration through the Application of New Technologies

Aspirante de Administração Militar Tiago Sena Fonseca Claro de Castro

Dissertação

Ciências Militares na Especialidade de Administração

Orientador: Professor Doutor Flávio Ivo Riedlinger de Magalhães

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Presidente: Professora Doutora Olga Maria Oliveira Duarte

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EPIGRAPH

“Some people don't like change, but you need to embrace change if the
alternative is disaster.”

Elon Musk

DEDICATION

To my Mother, Father, Sister, Brother, Grandmothers, Grandfather and extended family members, for the indispensable role you played throughout this journey. Your unconditional support, unwavering love, and spirit of sacrifice formed the solid foundation upon which I built both my academical and personal development.

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ABSTRACT

This dissertation addresses the theme: “The Modernization of the Portuguese Army Administration through the Application of New Technologies,” with the primary objective of analysing the organizational implications resulting from the adoption of new technologies aimed at modernizing administrative processes within the Portuguese Army.

The research begins with the primary research question: What are the organizational implications of applying new technologies in the modernization of the Portuguese Army's administration, and how can these technologies optimize administrative processes in the military context? Four secondary objectives were established: (1) to assess the current state of digitalization and the adequacy of available technological and human resources; (2) to analyse the influence of organizational culture and leadership on technological change implementation and identify associated risks and vulnerabilities; (3) to identify currently digitalized administrative practices and determine areas for further technological application to enhance organizational performance; and (4) to examine how process optimization is operationalized through technological adoption.

The dissertation is structured into three chapters: Chapter 1 provides a literature review; Chapter 2 outlines the qualitative research design; Chapter 3 presents and discusses empirical results and optimization proposals.

Methodologically, the study employs qualitative approaches, including cross-participant question-by-question analysis, lexical analysis with MAXQDA software, SWOT analysis, and Six Sigma-inspired workflow mapping to identify process inefficiencies and propose targeted improvements.

The findings highlight notable strengths such as institutional commitment and emerging digital literacy among younger personnel; key weaknesses including fragmented systems and resistance to change; opportunities presented by expanding technological tools and strategic alignment with broader modernization agendas; and significant threats related to organizational rigidity, cybersecurity risks, and financial constraints.

The research concludes that a comprehensive approach combining technological investments, continuous training, strategic leadership, and robust cybersecurity frameworks is essential for meaningful administrative modernization. Recommendations include systematic training programs, infrastructure investments, leadership-driven change management, and scaling Artificial Intelligence based pilot projects with defined performance metrics.

Keywords: Administrative Modernization, Technology, Optimization, Portuguese Army.

RESUMO

Esta dissertação aborda o tema: “A Modernização da Administração do Exército Português através da Aplicação de Novas Tecnologias”, tendo como objetivo principal analisar as implicações organizacionais resultantes da adoção de novas tecnologias destinadas à modernização dos processos administrativos no Exército Português.

A investigação parte da questão central: Quais as implicações organizacionais da aplicação de novas tecnologias na modernização da administração do Exército Português e como podem estas tecnologias otimizar os processos administrativos no contexto militar? Foram estabelecidos quatro objetivos secundários: (1) avaliar o estado atual da digitalização e a adequação dos recursos tecnológicos e humanos disponíveis; (2) analisar a influência da cultura organizacional e liderança na implementação da mudança tecnológica, identificando riscos e vulnerabilidades associados; (3) identificar as práticas administrativas atualmente digitalizadas e determinar áreas adicionais para aplicação tecnológica que melhorem o desempenho organizacional; e (4) examinar como a otimização de processos é operacionalizada através da adoção tecnológica.

A dissertação está estruturada em três capítulos: Capítulo 1 apresenta a revisão da literatura; Capítulo 2 descreve o desenho qualitativo da investigação; Capítulo 3 apresenta e discute os resultados empíricos e as propostas de otimização.

Metodologicamente, o estudo utiliza abordagens qualitativas, incluindo análise cruzada das respostas dos participantes, análise lexical com o software MAXQDA, análise SWOT e mapeamento de fluxos de trabalho inspirado no modelo Six Sigma para identificar ineficiências e propor melhorias específicas.

Os principais resultados destacam pontos fortes como o compromisso institucional e literacia digital emergente entre os militares mais jovens; fragilidades chave, incluindo sistemas fragmentados e resistência à mudança; oportunidades proporcionadas pela expansão das ferramentas tecnológicas e alinhamento estratégico com agendas mais amplas de modernização; e ameaças relacionadas com rigidez organizacional, riscos de cibersegurança e restrições financeiras.

A investigação conclui que uma abordagem abrangente, combinando investimentos tecnológicos, formação contínua, liderança estratégica e estruturas robustas de cibersegurança é essencial para uma modernização administrativa significativa. As recomendações incluem programas sistemáticos de formação, investimentos em

infraestruturas, gestão da mudança impulsionada pela liderança e escalabilidade de projetos piloto baseados em Inteligência Artificial com métricas definidas de desempenho.

Palavras-chave: Modernização Administrativa, Tecnologia, Otimização, Exército Português.

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LIST OF ABBREVIATIONS, INITIALS AND ACRONYMS

AE2S	Army Equipping Enterprise System
AI	Artificial Intelligence
API	Application Programming Interface
BPM	Business Process Management
CEMTE_x	Army Centre for Experimentation and Technological Modernisation
CoT	Chain-of-Thought
DFIN	Army Finance Department
DL	Deep Learning
DMAIC	Define – Measure – Analyse – Improve – Control
DoD	Department of Defense
DRT	Army Fuelling & Transport Directorate
ERP	Enterprise Resource Planning
EU	European Union
GDPR	General Data Protection Regulation
ICT	Information and Communication Technology
IoT	Internet of Things
ISR	Intelligence, Surveillance and Reconnaissance
LLM	Large Language Model
MDN	Ministry of National Defence
MIS	Management Information Systems
ML	Machine Learning
NLP	Natural Language Processing
PDF	Portable Document Format
PO	Primary Objective
PRQ	Primary Research Question
QR	Quick Response code
RAG	Retrieval-Augmented Generation
ReAct	Reasoning and Acting framework
RPA	Robotic Process Automation

SALE	Single Army Logistics Enterprise
SAP	Systems, Applications and Products
SIGDN	National Defence Management Information System
SIGNet	Internal MoD digital logistics network
SO	Secondary Objective
SRQ	Secondary Research Question
SWOT	Strengths, Weaknesses, Opportunities and Threats
U/E/O	Units, Establishments and Organisations
US	United States
XML	eXtensible Markup Language

INTRODUCTION

The relevance of studying the application of new technologies in the administrative structures of the Portuguese Army is underpinned by a range of governmental initiatives and directives that underscore the imperative of modernising public administration, with particular emphasis on the Armed Forces.

The Council of Ministers Resolution No. 94/2024 (Resolução do Conselho de Ministros n.º 94/2024), of 25 July, establishes the creation of the project group “Conselho para o Digital na Administração Pública” (Council for Digital in Public Administration), with the aim of promoting digital transition and administrative modernisation. This resolution highlights the need to propose measures targeting digital transition and the simplification of processes within public administration (Diário da República, 2024a).

Additionally, Council of Ministers Resolution No. 207/2024 (Resolução do Conselho de Ministros n.º 207/2024), of 30 December, approves the National Digital Strategy (Estratégia Digital Nacional), reinforcing the Government's commitment to transforming Portugal's digital potential into a tangible reality that fosters economic development, innovation, and inclusion. This strategy aims to prepare the country for the challenges and opportunities of the global digital economy, placing people at the centre of all initiatives and ensuring that technology contributes to social and economic progress (Diário da República, 2024b).

In the specific context of the Portuguese Army, the Army Strategic Directive 2024 - 2026 (Diretiva Estratégica do Exército 2024 - 2026) identifies “Knowledge, Innovation, and Technological Modernisation” (Conhecimento, Inovação e Modernização Tecnológica) as one of the four main strategic pillars for this period. This axis aims to conceptualise technological systems and processes that drive technological modernisation and the subsequent optimisation of processes and capabilities, ultimately resulting in a modern and digital Army. It also stresses the importance of having well-trained, committed, and motivated human resources (Exército Português, 2024).

The “Availability of Resources” (Disponibilidade de Recursos) is another strategic pillar present in the directive, which asserts that the efficiency of tangible and intangible resources depends on the optimised management of human, material, financial, and infrastructure resources, directly influencing the Army's performance.

Regarding performance perspectives, the directive is structured around Resources (Means), Processes (Ways), and Outcomes (Ends) (Recursos (Means), Processos (Ways) e Resultados (Ends)) “thus enabling the strategic objectives to be organised in a way that reflects the optimisation of resource management and the identification of critical processes where the Army must excel in order to accomplish its Mission” (Exército Português, 2024).

These initiatives and directives clearly demonstrate the priority assigned by both the Government and the Portuguese Army to digital transformation and the modernisation of administrative processes. In this regard, the proposed study aligns with national strategic orientations, contributing to the optimisation of information and process management through digitalisation, automation, and Artificial Intelligence (AI) within the administration of the Portuguese Army.

This research aims to understand how the application of new technologies can contribute to the modernization of the Portuguese Army's administration, particularly through process optimization and organizational transformation. In this context, the following Primary Objective (PO) was established: “To analyse the organizational implications of the application of new technologies in the modernization of the Portuguese Army's administration, identifying potentialities, challenges, and strategies to optimize administrative processes in the military context.” To implement the PO, four Secondary Objectives (SO) were defined to guide the thematic focus and structure of the research. Furthermore, a Primary Research Question (PRQ) frames and gives meaning to the investigation as a whole, directly reflecting the PO: “What are the organizational implications of applying new technologies in the modernization of the Portuguese Army's administration, and how can these technologies optimize administrative processes in the military context?” To ensure a comprehensive and coherent analysis, four Secondary Research Questions (SRQ) were also defined, each corresponding to one of the previously presented SO. This structure aims to ensure a systematic and integrated approach to the research topic, enabling a critical and well-founded analysis of the dynamics involved in administrative modernization within a military context.

Table 1- Correspondence between Objectives and Research Questions

PO	To analyse the organizational implications of the application of new technologies in the modernization of the Portuguese Army's administration, identifying opportunities, constraints, and strategies for process optimisation.	PRQ	What are the organisational implications of applying new technologies to the modernisation of the Portuguese Army's administration, and how can these technologies contribute to process optimisation?
SO1	To assess the current state of digitalization and the adequacy of the technological and human resources available in the Army's administration.	SRQ1	What is the current state of digitalization in the Army's administration, and to what extent are the available technological and human resources adequate?
SO2	To analyse the influence of organisational culture and leadership on implementing technological changes, and to identify associated risks and vulnerabilities.	SRQ2	How do organisational culture and leadership affect technological change in the Army's administration, and what are the main associated risks and vulnerabilities?
SO3	To identify currently digitalised administrative practices and to determine where the further technological application could enhance organisational performance.	SRQ3	Which administrative practices are currently digitalised, and in which areas could the application of new technologies yield the most significant benefit?
SO4	To examine how process optimisation is being operationalised by implementing new technologies.	SRQ4	How is process optimisation implemented through technological adoption in the Army's administration?

The dissertation is structured into three main chapters. Chapter 1 provides a comprehensive literature review on modernization concepts, digitalization within public and military sectors, enabling technologies, process optimization frameworks, organizational culture and change management, cybersecurity challenges, and relevant international experiences. Chapter 2 details the qualitative and abductive research design, including semi-structured interviews and a field-based workflow analysis conducted at the Regimento de Transportes. Chapter 3 presents and discusses empirical results, encompassing cross-participant analyses, lexical examination, SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis derived from interviews, and in-depth workflow mapping highlighting specific inefficiencies and optimization proposals. Finally, the Conclusions summarise the main findings, reflect critically on the research process and its limitations, and present practical recommendations and suggestions for future studies.

CHAPTER 1 – LITERATURE REVIEW

To address the research objectives, this literature review is organized into thematic sections, enabling a comprehensive understanding of the organizational and technological dynamics involved in the modernization of the Portuguese Army Administration. The following chapters of the literature review delve into various themes and trends that have emerged within the field of modernization and the use of technology. Key theoretical frameworks, influential studies, and prevailing methodologies are examined to illustrate the current state of knowledge. Each chapter critically analyses the contributions of different scholars, identifying both areas of consensus and ongoing debate. Furthermore, the review highlights existing gaps in the literature that merit further investigation, thereby providing a foundation for subsequent empirical inquiry. This comprehensive examination seeks to synthesize existing knowledge and stimulate future research within the domain.

1.1. Fundamental Concepts

1.1.1. Modernization

Modernization refers to the process of systematically improving and adapting organizational structures, processes, and practices to align with contemporary standards, technologies, and strategic objectives (Inglehart, 2001). In the context of public and military administration, modernization entails the integration of new technologies, the enhancement of institutional efficiency, and the promotion of transparency, responsiveness, and adaptability to changing operational environments. It involves not only the adoption of digital tools but also the transformation of organizational culture, leadership practices, and governance models to meet current and future demands (Yucebas, 2019). New technologies, particularly new technologies of information, refer to recently developed or continuously evolving tools, systems, and methods used to create, process, store, secure, and exchange digital information (Fitzpatrick, 2003). These technologies are characterized by their novelty, rapid growth, and significant potential to transform how individuals, businesses, and society operate and interact with information. They often build upon or improve existing technologies and can lead to new capabilities or more efficient ways of doing things (Alemie, 1998).

1.1.2. Digitalization, Digitization, Digital Transformation and Dematerialization

Digitalization refers to the process of converting information into a digital format, enabling it to be processed, stored, and transmitted electronically. (He et al., 2015) This transformation often involves the use of digital technologies to improve business processes, enhance customer experiences, and create new opportunities for innovation (Ablyazov et al., 2018). It is distinct from Digitization, which refers to converting analog data into digital form, and digital transformation, which encompasses broader organizational changes driven by digital technology adoption (González-Anta, 2024; Kamphake, 2020). It is important to note that there exists a related concept which is Dematerialization, that encompasses shifting from physical objects or processes to digital or less tangible forms, such as converting paper documents to electronic files or using less raw material to produce goods (Petrides et al., 2018). Digitalization can encompass a wide range of activities, from automating manual tasks to implementing advanced data analytics and integrating digital tools into everyday operations (Schreckling & Steiger, 2017). Digitalization is reshaping industries by enhancing efficiency, innovation, and customer experiences, while also presenting challenges such as security risks, technological dependency, and ethical considerations (Benga & Elhamma, 2024). In business management, digitalization is seen as a sociotechnical process that requires organizational adaptability and the development of digital competences to leverage technology effectively (González-Anta, 2024). Furthermore, digitalization is crucial for maintaining competitiveness in the business world, as it influences production, marketing, sales, and supply chain management, aligning with Porter's five forces model (a framework for analyzing industry competition and profitability. The 5 forces are: Competitive rivalry, Threat of new entrants, Threat of substitutes, Bargaining power of suppliers, Bargaining power of buyers) to navigate market dynamics (Kızıldağ & Uğurlu, 2023). However, the process is not without its challenges, as it can disrupt existing business models and require significant organizational change, particularly for companies and organizations not originally "born digital" (Lang, 2021), as is the case for the Portuguese Army. In the context of management accounting, digitalization can streamline processes and introduce disruptive changes (Heinzelmann, 2019). Additionally, during the Covid-19 pandemic, digitalization has proven essential in reducing tasks without added value or human contact, thereby altering labor markets and impacting business models (Hassan & Resmi, 2021). Overall, while digitalization offers numerous opportunities for

innovation and efficiency, it also necessitates careful consideration of its potential threats and the development of strategies to mitigate them (Novikova, 2020).

1.2. Digitalization in the Public Sector

1.2.1. Digitalization in the administrative sector of public organizations

Digitalization in the administrative sector of public organizations has emerged as a transformative force, enhancing efficiency and responsiveness to citizen needs. Studies indicate that digitalization streamlines decision-making processes and improves service delivery by making public services more accessible, transparent, and user-friendly (Imanbekova et al., 2024; Băeșu, 2022). For instance, the Norwegian Customs Agency's analysis over two decades revealed a shift towards emphasizing user feedback, highlighting the importance of citizen participation in digital initiatives (Fossheim & Lund-Tønnesen, 2023). Furthermore, the integration of automation and AI has altered the nature of administrative tasks, leading to a demand for new competencies among public servants, while also creating additional workloads associated with digital maintenance (Gräfe et al., 2024). In Latvia, varying levels of digital maturity across public institutions underscore the necessity for continuous investment in technology to meet the growing expectations for 24/7 service availability (Pelse et al., 2021). Overall, the digitalization of public administration not only enhances operational efficiency but also necessitates a reevaluation of workforce skills and organizational structures. This evolution emphasizes the need for public administration institutions to adapt and innovate in response to the increasing demands for efficient and transparent services from citizens (Băeșu, 2022).

Moreover, the shift towards digitalization in public administration brings forth significant challenges related to workforce adaptation and skill development. As organizations increasingly rely on technology, there is a pressing need for targeted training programs that equip employees with the necessary digital competencies to navigate new systems effectively. This emphasis on continuous learning not only helps mitigate resistance to change but also fosters a culture of innovation within public institutions, as employees become more adept at leveraging digital tools to enhance service delivery (Distel et al., 2019). Furthermore, the implementation of frameworks such as the New Public Management highlights the importance of performance measurement and accountability, which are essential for ensuring that digital initiatives yield tangible benefits for citizens (Del Sordo et al., 2015). Thus, as public organizations embrace digital transformation, a holistic approach that integrates skill development, performance metrics, and citizen engagement will be

crucial for achieving sustainable improvements in public service. This integrated strategy will empower public institutions to effectively address the complexities of digital transformation while enhancing service quality and citizen trust in government operations (Mahmood, 2016).

1.2.2. Digitalization in the Portuguese public sector

Digitalization in the Portuguese public sector has been a multifaceted process, driven by the need for increased efficiency, improved service delivery, and enhanced public value (Faro et al., 2019). The digital transformation in Portugal's public administration has been significantly influenced by the integration of knowledge management practices, which are essential for process improvement and innovation in service delivery models (Antunes, 2022). A notable success story within this transformation is the electronic procurement system, which has positioned Portugal as a leader in Europe due to its unique business model and strong political commitment (Rosa & Almeida, 2017). This digital shift is part of a broader global trend where governments are implementing digital projects to enhance efficiency and cost savings, with Portugal developing a framework to better align strategies and resources for digital transformation projects (Gomes & Romão, 2024). The relationship between digital transformation and knowledge management is crucial, as effective knowledge management can significantly enhance the success of digital government initiatives (Alvarenga et al., 2020). Portugal's advancements in e-government have been recognized at the European level, with the country moving from below average to a leader in online public services, highlighting the strategic focus on Information and Communication Technology (ICT) and electronic government (Marques, 2016). The digital transition in Portugal has been characterized by a shift from bureaucratic to digital paradigms, with a focus on networked policy entrepreneurship and diverse policy instruments (Secchi et al., 2024). Furthermore, digital innovations have been identified as key facilitators for improving the business environment, although Portugal still lags behind top performers in certain areas (Martins & Veiga, 2018). Despite progress, challenges remain, particularly in addressing digital exclusion and enhancing digital literacy, which are critical for ensuring inclusive digital transformation (Magaña et al., 2023). The importance of digital literacy is underscored by the need for technologically skilled employees who can drive and sustain digital transformation in local public administration (Arnaud et al., 2023). Overall, while Portugal has made significant strides in digitalizing its public sector, ongoing

efforts are needed to address existing challenges and fully realize the potential of digital transformation.

1.3. Digitalization and modernization in the Portuguese Army

There is a lack of diverse literature addressing specifically the digitalization of the Portuguese Army and its modernization. The only adequate source is a master thesis from 2021 written in the same context as this master thesis by Portuguese Army officer Peniche, titled “Dematerialization and procedural digitalization in the Portuguese Army: Diagnosis, impact, and opportunities for improvement”. (Peniche & Saraiva, 2021)

The study concludes that the implementation of digitalization and dematerialization in the Portuguese Army brings about a mix of beneficial and challenging outcomes, all of which are significant for modernizing the institution. The research shows that, when successfully implemented, shifting from paper-based procedures to digital processes not only streamlines administrative operations but also improves efficiency and effectiveness. By reducing reliance on paper, the Portuguese Army can simplify complex bureaucratic processes, improve the speed of information access, and ultimately increase overall productivity, which means that tasks can be completed more quickly and with less effort. One of the major benefits of digital transformation is economic savings, despite initial investments in digital infrastructure and training. Long-term advantages include reduced costs for printing, document handling, and physical storage, as well as more efficient use of human resources, allowing staff to focus on essential tasks instead of managing outdated paperwork. Furthermore, the study points out that the initiatives contribute to environmental sustainability by substantially cutting down paper consumption. This reduction in paper use implies less waste and supports a greener, more sustainable operation, reinforcing a commitment to environmental responsibility. (Peniche & Saraiva, 2021)

Despite these benefits, the research also highlights several challenges that need to be overcome to ensure the success of the digitalization process. One of the main issues is the risk associated with cybersecurity, where storing information digitally exposes the system to potential cyberattacks and data loss. Thus, ensuring robust security measures is essential for protecting sensitive information from such risks. Moreover, the study emphasizes the role of human factors. The organizational culture within the Army, which has been accustomed to traditional paper-based methods for many years, shows evidence of resistance to change. This resistance is partly due to a lack of familiarity with digital tools and the need

for comprehensive training to help staff adapt to new technological methods (Peniche & Saraiva, 2021).

The study further recommends a structured model for implementing these digital transformation projects. This model includes an initial feasibility study and requirements analysis, followed by a phase focused on constructing and testing the new systems. Then comes a critical stage of training and transition where personnel are gradually introduced to the digital tools and processes. During this transitional period, continuous support, guidance, and leadership are essential to ensure that staff overcome their initial apprehensions and fully embrace the new procedures (Peniche & Saraiva, 2021). Ultimately, the conclusions of the study underline the importance of a balanced approach that considers both the technological and human aspects of digital transformation within the Army, ensuring that improvements in efficiency, sustainability, and cost reduction are achieved while mitigating any risks or resistance to change (Peniche & Saraiva, 2021). Although the study provides a valuable analysis of dematerialization and digitalization in the Portuguese Army, it remains limited to a single empirical case and lacks a broader analysis of the organizational and cultural implications of new technological adoption. My thesis seeks to contribute to this field, deepening the study of the impact of new technologies on the administrative modernization of the military institution, including aspects related to leadership, organizational culture and process optimization.

1.4. Enabling Technologies

1.4.1. ERP Systems

Enterprise Resource Planning (ERP) systems play a pivotal role in optimizing processes and enhancing decision-making quality within military administration, particularly in the context of the Department of Defense (DoD) and other military branches. These systems facilitate the integration of various administrative functions, such as logistics, finance, and human resources, into a cohesive framework, thereby enabling real-time data access and process standardization. For instance, the United States (US) Army's implementation of the Single Army Logistics Enterprise (SALE) using Systems, Applications and Products (SAP) has transformed its logistics operations from a supply-based model to a more integrated and responsive distribution system, ensuring that resources are delivered efficiently to soldiers in the field (Ledwon et al., 2006). The benefits of ERP systems in the military context include reduced duplication of effort and enhanced operational efficiency, as evidenced by the DoD's efforts to replace outdated legacy systems

with modern ERP solutions to improve strategic alignment and support for warfighters (Revenaugh & Cook, 2013; Mueller, 2012). However, the implementation of ERP systems in the military is not without challenges. High costs, interoperability issues with existing legacy systems, and the need for extensive user training are significant hurdles that must be addressed (Odell et al., 2012; Khan et al., 2012). Despite these challenges, the potential for ERP systems to improve decision-making quality is substantial, as they provide a unified platform for data analysis and reporting, which is crucial for informed decision-making in complex military operations (Ghulaxe, 2024; Rosa, 2002). The DoD's ongoing investment in ERP systems underscores their critical role in transforming business operations and achieving strategic objectives, such as financial auditability and improved supply chain management (Hill, 2007; Khan et al., 2012). Overall, while the path to full ERP integration in military settings is fraught with obstacles, the potential benefits in terms of process optimization and decision-making quality make it a worthwhile endeavor. Despite the evident potential of ERP systems in enhancing operational efficiency, existing literature often overlooks the unique constraints posed by military bureaucracy, particularly in contexts like the Portuguese Army where legacy systems, difficulties in data insertion and rigid hierarchies pose significant challenges.

1.4.2. Cloud Computing and Collaboration and Communication Platforms

Cloud computing is the delivery of on-demand computing services - like servers, storage, databases, networking, software, and analytics - over the Internet ("the cloud") typically on a pay-as-you-go basis. It has revolutionized the way organizations manage data and applications, providing scalable resources and enabling efficient collaboration across various sectors (Sowndarya & Umarani, 2013). It offers significant advantages, including enhanced flexibility, cost savings, and improved data accessibility, real time collaborative tools, which are essential for modern organizational operations. As organizations increasingly adopt cloud solutions, they can streamline processes and enhance collaboration, leading to improved productivity and innovation (Maresova et al., 2017). The integration of cloud computing with ERP systems can further amplify these benefits, allowing organizations to leverage real-time data and analytics for better decision-making and operational efficiency (Loo Gil, 2021). Cloud computing has become a pivotal technology in transforming secure and governmental settings, particularly through the adoption of hybrid cloud models that balance security with flexibility. In military contexts, hybrid cloud solutions are increasingly favoured due to their ability to integrate the scalability and

flexibility of public clouds with the security and control of private clouds. This model allows military organizations to optimize resource utilization and enhance operational resilience while maintaining stringent security protocols necessary for classified and unclassified data management (ȚIGĂNUȘ, 2023). The US DoD exemplifies this approach by leveraging cloud computing to rapidly provision computing resources for intelligence, surveillance, and reconnaissance (ISR) data analysis, thereby improving mission readiness and operational efficiency (Schear et al., 2015). However, the migration to cloud platforms in governmental settings is fraught with challenges, particularly concerning data sovereignty and cybersecurity. Governments are increasingly concerned about data sovereignty, as cloud services often involve data storage across international borders, which can expose sensitive information to foreign jurisdictions (Irion, 2012; Kushwaha et al., 2020). To mitigate these risks, strategies such as retaining exclusive jurisdiction over government data and employing robust security measures, including advanced encryption and multi-factor authentication, are essential (Abikoye, n.d.). Furthermore, the hybrid cloud model addresses these concerns by allowing sensitive data to be stored in private clouds while utilizing public clouds for less critical workloads, thus ensuring compliance with national and international data protection regulations (Vankayalapati, 2025). This approach not only enhances security but also facilitates real-time access and collaboration across departments, significantly improving efficiency and mission readiness in governmental operations (Piduru, 2022). Collaboration and Communication Platforms, such as Microsoft Teams and Nextcloud, play a significant role in influencing the dynamics of internal communication and fostering a sense of administrative cohesion within organizations, which ultimately enhances teamwork and streamlines processes. These platforms facilitate real-time collaboration, enabling teams to work together more effectively and respond swiftly to emerging challenges in military and public sector administration (Ireddy & Nungonda, 2019).

In conclusion, cloud computing has revolutionized operations in government and military sectors by offering scalable resources, flexibility, and enhanced data accessibility. The hybrid cloud model balances security with public cloud scalability, addressing data sovereignty and cybersecurity challenges. As organizations embrace these technologies, they improve operational efficiency, mission readiness, and regulatory compliance, ultimately driving productivity and resilience.

1.4.3. Artificial Intelligence, Machine Learning, Robotic Process Automation

AI is a concept that refers to the simulation of human intelligence in machines that are programmed to think, learn, and problem-solve like humans (Ghosh & Thirugnanam, 2021). Machine Learning (ML) is a technology in the AI spectrum that enables computer systems to learn from and make decisions or predictions based on data, without being explicitly programmed for each specific task (Baloglu et al., 2021). Deep Learning (DL), which represents an advanced subset of ML, is characterized by its ability to process and analyze complex data patterns through multi-layered artificial neural networks, thereby enhancing the capacity for tasks such as image and speech recognition (Goodfellow et al., 2016).

Robotic Process Automation (RPA) and AI are increasingly being integrated to enhance business process automation, offering significant improvements in efficiency, accuracy, and adaptability across various sectors (Ma, 2025). RPA, known for automating repetitive and rule-based tasks, such as data entry and invoice processing, is being augmented by AI technologies like ML and Natural Language Processing (NLP) to handle more complex tasks that require decision-making and data analysis (Anitha et al., 2024; Mangal, 2024). This integration, often referred to as intelligent automation, allows organizations to not only automate routine tasks but also to optimize operations through predictive analytics and cognitive computing, thereby improving overall business performance (JingXuan et al., 2024; Afrin et al., 2024). For instance, in the banking sector, RPA combined with AI-driven predictive analytics enhances fraud detection capabilities by analyzing vast transaction data to identify fraudulent patterns in real-time (Venigandla & Vemuri, 2022). Similarly, in network field services, AI-powered RPA facilitates anticipatory maintenance and preemptive network administration, leading to improved service quality and efficiency (Yendluri et al., 2023). The integration of RPA and AI also extends to innovative applications such as intelligent security monitoring systems, where AI enhances RPA's ability to process and analyze surveillance data, reducing human error and operational costs (Shi et al., 2023). Despite these advantages, challenges such as data privacy, system compatibility, and ethical considerations remain significant hurdles that organizations must address to fully leverage the potential of RPA and AI (Mangal, 2024; Afrin et al., 2024; Lo et al., 2024). As industries continue to evolve towards Industry 4.0 (the integration of smart, connected, and automated technologies), the synergy between RPA and AI is expected to

play a crucial role in driving digital transformation and maintaining competitive advantage (Afrin et al., 2024; Lo et al., 2024).

1.4.4. LLMs, AI workflows and AI agents

The integration of Large Language Models (LLMs) with Retrieval-Augmented Generation (RAG) systems and frameworks like ReAct (Reasoning and Acting), combining chain of thought (CoT) reasoning with external tool use, is significantly enhancing administrative efficiency across various domains. LLMs, while powerful, often rely on static datasets, which can limit their responsiveness to dynamic queries. RAG addresses this by incorporating real-time data retrieval, thus improving the relevance and accuracy of responses. This is particularly beneficial in administrative contexts where up-to-date information is crucial (Singh et al., 2025; Rathod, 2024). The Agentic RAG model further enhances this by embedding autonomous AI agents that dynamically manage retrieval strategies and adapt workflows, offering flexibility and scalability in complex task management (Singh et al., 2025). Multi-agent RAG systems, which utilize specialized agents for different data sources, improve efficiency and accuracy by reducing bottlenecks and ensuring that each agent focuses on its specialized task (Salve et al., 2024). In software companies, generative AI, including RAG and agent-based frameworks, is reshaping operations by reducing development cycles and improving service quality, thus enhancing operational efficiency (Khokhlov, 2025). The ReAct framework, which combines reasoning and acting, is instrumental in managing complex workflows and decision-making processes, as seen in smart city management where LLM agents improve urban decision-making by processing complex queries and generating contextually relevant responses (Kalyuzhnaya et al., 2025). Moreover, the modular and reproducible architecture of RAG systems ensures scalability and transparency, which are essential for maintaining ethical standards in e-government services (Papageorgiou et al., 2024). These advancements highlight the potential of LLMs and RAG systems in improving administrative efficiency by providing accurate, timely, and contextually relevant information, thereby supporting strategic planning and decision-making processes across various sectors (Prabhune & Berndt, 2024; Gao et al., 2023).

1.4.5. Artificial Intelligence in Enhancing Administrative Efficiency

The integration of AI into management and administration can significantly enhance organizational efficiency by automating routine tasks, improving decision-making, and

optimizing resource allocation. AI technologies, such as ML, predictive analytics, and NLP, enable organizations to automate mundane tasks, thereby freeing up human resources for more strategic activities (Bhima et al., 2023). This automation not only reduces human error but also accelerates processes. AI's predictive capabilities allow organizations to forecast trends and make data-driven decisions, which enhances competitiveness and operational efficiency (Cáceres et al., 2024; Susilo & Susanto, 2024). In financial and administrative domains, AI improves risk assessment, fraud detection, and portfolio management, contributing to cost-effectiveness and accuracy (Al-E'mari et al., 2025). However, the integration of AI is not without challenges. Technical barriers, such as algorithm compatibility with existing systems, and ethical concerns, including data privacy and algorithmic bias, must be addressed (Bhima et al., 2023; Cáceres et al., 2024; Coelho & Silva, 2024). To mitigate these challenges, organizations should invest in employee training, establish cross-disciplinary teams, and develop robust ethical guidelines (Bhima et al., 2023; Kediya et al., 2024). Furthermore, AI's role in enhancing Management Information Systems (MIS) is crucial, as it significantly reduces data processing time and increases decision-making accuracy, leading to improved customer satisfaction and reduced operational costs (Susilo & Susanto, 2024). In educational institutions, AI-integrated Campus Management Systems streamline administrative workflows, thereby enhancing institutional effectiveness (Zahid et al., 2024). Overall, a strategic and ethical approach to AI integration can transform administrative landscapes, fostering heightened efficiency and accuracy in contemporary workplaces (Kumar, 2024; Mahmood et al., 2023).

1.5. Process Optimization through Technology

Process optimization in administrative settings involves the systematic improvement of workflows to enhance efficiency, reduce waste, and improve service quality. This can be achieved through various models and methodologies, such as Lean, Six Sigma, and Business Process Management (BPM). Lean and Six Sigma focus on eliminating waste and reducing process variation, respectively, while BPM provides a structured approach to analysing and improving business processes (Rajić et al., 2023; Teixeira et al., 2024). The integration of digital tools like AI, automation, and Internet of Things (IoT), has significantly enhanced these methodologies by enabling more precise data analysis, real-time monitoring, and automated decision-making, thus optimizing workflows and increasing productivity (Golding & Nicola, 2019). IoT refers to the network of physical objects or "things" that are embedded with sensors, software, and other technologies to connect and exchange data with

other devices and systems over the internet. This interconnected network allows everyday objects, from household appliances to industrial machinery, to send and receive data, enabling them to be monitored and controlled remotely (Sendler, 2018). Furthermore, AI has been shown to drastically reduce processing times in public administration by automating routine tasks and improving data consistency, as evidenced by a reduction in citizen inquiry processing time from seven to two days in a district state administration (Bashuk & Chechel, 2024). Similarly, the use of RPA in healthcare has demonstrated substantial efficiency gains, reducing process time by 380 minutes and increasing Process Cycle Efficiency from 69.07% to 95.54% (Huang et al., 2024). Theories on efficiency and productivity gains from technology adoption suggest that these tools not only streamline operations but also enhance decision-making and employee collaboration, leading to overall business agility (Al-Khattab & Saeed, 2016). Case studies in public and military administration have shown the successful application of Lean and Six Sigma methodologies, often supported by digital tools, to improve service delivery and operational efficiency (Huang et al., 2024). However, challenges in scaling and maintaining optimized digital systems include technical infrastructure requirements, the need for continuous staff training, and concerns about data privacy and security. Overcoming these challenges requires strategic planning, stakeholder engagement, and ongoing evaluation to ensure the sustainability of digital transformations (Ruhana et al., 2023).

As digital transformation progresses within military and public sector administrations, the importance of establishing robust cybersecurity frameworks becomes increasingly apparent. The interconnected nature of modern digital systems makes them vulnerable to cyber threats, necessitating a proactive approach to security that encompasses both technology and personnel training (Park et al., 2018). For instance, the integration of advanced technologies such as AI and ML into cybersecurity protocols can enhance threat detection and response capabilities, thereby safeguarding critical infrastructure from sophisticated attacks (Gils & Weigand, 2020). Moreover, fostering a culture of cybersecurity awareness among personnel is vital, as human error remains one of the leading causes of security breaches. This dual focus on technological advancement and human factors not only strengthens defences but also promotes resilience against emerging cyber threats, ensuring that digitalization efforts yield sustainable benefits for public institutions and military organizations alike (Corradini, 2020).

1.6. Organizational Culture and Change Management in Military Institutions

Organizational culture in military institutions, characterized by hierarchical and bureaucratic structures, significantly influences change management and innovation. Military culture, deeply rooted in shared history, values, and beliefs, often presents resistance to change, particularly when it challenges established norms and practices. This resistance is evident in the military's reliance on standardization and consistency, which innovation inherently disrupts by introducing variance and necessitating cultural change (Hill, 2015; Popa, 2022). The role of military leadership is crucial in overcoming this cultural inertia, as leaders are responsible for shaping and reinforcing organizational culture and creating systems that promote innovation (Popa, 2022). Successful change management in military contexts often requires frameworks adapted to the unique challenges of defence settings. For instance, while John Kotter's Eight-Step change management model is a popular framework, its application in military settings is often inhibited by existing cultural norms, highlighting the need for formal change management training in military education ("Technology and the Roadblock. When Change Meets Organisational Culture," 2022). Case studies, such as the U.S. Marine Corps' implementation of the Don't Ask Don't Tell repeal, demonstrate how deeply ingrained cultural values can impact the success of organizational change, requiring careful management of cultural differences and resistance (Moran & Lynch, 2017). Similarly, the Royal Australian Air Force's integration of the MQ-28A Ghost Bat illustrates the challenges and opportunities of embracing technological innovation within a traditional military culture (Harris, 2023). The Israel Defence Forces provide a contrasting example, where a unique organizational culture facilitated innovation following operational shortcomings, demonstrating the potential for cultural adaptation to drive successful transformation (Jordán, 2015). Military leadership and innovation, particularly in the realm of transformational leadership, encompasses a broad spectrum of strategies and methodologies that are designed to inspire and motivate individuals within a military context to embrace change and adapt to new challenges, ultimately enhancing the effectiveness and efficiency of military personnel (Hill, 2015). Theories on organizational learning and the development of digital competence delve into the intricate processes by which organizations acquire, disseminate, and utilize knowledge, as well as how they cultivate the necessary skills and capabilities to thrive in an increasingly digital landscape, ensuring that employees are well-equipped to navigate technological advancements (Ganz et al., 2018). Sociotechnical systems theory, which holds significant importance in

understanding the integration of human and technology components within complex systems, provides a comprehensive framework for analysing how social factors and technical systems interact and influence one another, thereby shaping the overall effectiveness and sustainability of these intricate systems. (Burns & Machado, 2009) Overall, the interplay between military culture and leadership is pivotal in navigating the complexities of change management, with a focus on fostering an innovative culture that aligns with enduring organizational values (Rusu, 2023).

1.7. Cybersecurity Challenges in Defense Digitalization

The adoption of digital systems in military and defence sectors introduces significant cybersecurity risks, data protection challenges, and vulnerabilities, which are compounded by the dependence on foreign technology and concerns over national sovereignty. The integration of information and operational technology systems, as highlighted by Savin, exposes critical infrastructures to new vulnerabilities, necessitating robust cybersecurity measures to protect against sophisticated cyber-attacks like Stuxnet and Wiper (Savin, 2021). The legal and ethical frameworks regulating digital transformation in defence are crucial for safeguarding digital assets and privacy rights. Vdovenko et al. emphasize the importance of a scientifically substantiated legislative and normative-legal framework to support cybersecurity and cyber defence systems, aligning with international rules such as the Geneva Convention (Vdovenko et al., 2022). The complexity of cybersecurity law, as discussed by Khanna and Himanshu, involves balancing security imperatives with individual rights, addressing challenges like data breaches, malware attacks, and state-sponsored cyber espionage (Khanna, 2024; Himanshu, 2024). The reliance on foreign technology raises sovereignty concerns, as noted by Kavanagh, who discusses the implications of cybersecurity on U.S. foreign policy and national security (Kavanagh, 2014). This dependence can compromise national security, as foreign technologies may introduce vulnerabilities that adversaries could exploit. The collaborative and technologically driven approach advocated by Ansar et al. suggests leveraging emerging technologies such as AI, ML, blockchain, and quantum computing to enhance military cybersecurity, although these technologies also present new challenges and policy implications (Ansar et al., 2023). In India, Kumar and Bansal highlight the need for a multi-stakeholder approach to secure the digital economy, emphasizing the interplay between technological adoption, regulatory frameworks, and public awareness to mitigate cyber risks (Kumar & Bansal, 2024). In order to ensure the safety and protection of sensitive information and systems, it is absolutely

essential to actively cultivate and encourage a robust culture that prioritizes and champions cybersecurity awareness among all personnel, as this plays a crucial role in safeguarding the organization against potential threats and vulnerabilities (Boeke et al., 2015). Overall, the integration of digital systems in defence necessitates a comprehensive approach that includes robust legal frameworks, international cooperation, and the strategic use of emerging technologies to address cybersecurity risks and protect national sovereignty.

1.8. Digitalization in Military and Public Sector Administration Abroad

Digitalization in military and public sector administration encompasses a broad range of initiatives aimed at enhancing efficiency, transparency, and service delivery through the integration of digital technologies. In the public sector, digital transformation involves the adoption of e-Government and digital government frameworks, which facilitate citizen-centric services and improve policy-making processes (Viana, 2021). Countries like Albania, Türkiye, and North Macedonia have made significant strides in digitalizing public administration, focusing on e-services and digital infrastructure to foster transparency and participatory governance (Fjolla et al., 2024). Similarly, Brazil's public administration has seen an increased use of technological tools to restructure management and public policies, highlighting the relevance of digital transformation for administrative improvement (Junior et al., 2022). In Germany, digital transformation in public administration is supported by comprehensive management strategies that address personnel, processes, and data infrastructure, providing practical examples and solutions for effective implementation (Friedländer, 2024).

Comparatively, the digital maturity of armed forces varies across countries, with some nations integrating advanced digital technologies to enhance situational awareness and command and control capabilities. The U.S. Army, for instance, employs a strategy of horizontal battlefield digitization to synchronize forces and improve operational tempo through integrated management activities and systems engineering ("Digitization," 2020). In Slovenia, digital maturity assessments reveal that ministries possess more advanced digital infrastructure than municipalities, indicating disparities in ICT development and integration (Aristovnik et al., 2024).

Technological infrastructure and human capital readiness are critical for successful digital transformation in military contexts. The integration of systems such as the Army Equipping Enterprise System (AE2S) demonstrates the importance of cohesive digital systems for operational efficiency ("Digitization," 2020). However, challenges remain in

achieving coherent development of digital skills and policy implementation, as seen in Slovenia's efforts to align with the EU digital strategy (Aristovnik et al., 2024).

Best practices in digital transformation include setting strategic visions, securing organizational leadership, and fostering collaboration across sectors (Digital by Design: Steering an Inclusive Digital Transformation of the Public Sector, 2023). The Public Services Digitalisation Index offers a framework for assessing and comparing digitalization efforts, aiding decision-makers in charting a course toward comprehensive digital transformation (Frach et al., 2017). Despite these advancements, gaps persist in the transition from partial to full digitalization, often due to internal and external barriers such as trust, privacy, and equity concerns (Goldbach et al., 2024). Addressing these gaps requires targeted improvements and strategic planning to harness the full potential of digitalization in both public and military administration (Aristovnik et al., 2024).

1.9. Frameworks for Sustainable Technological Integration

The strategic implementation and evaluation of technological integration involve a multifaceted approach that incorporates various models and frameworks to ensure successful adoption and long-term sustainability. The Technology Acceptance Model and the Diffusion of Innovation theory are foundational in understanding how technologies are adopted within organizations, emphasizing the importance of user acceptance and the spread of new technologies through social systems (Schoville & Titler, 2015). Strategic management frameworks, such as those discussed by Rahman and Siallagan (2023), highlight the necessity of environmental scanning, organizational readiness, and strategic alignment to effectively integrate disruptive technologies. Evaluation frameworks, like the one proposed by Elliot and Melhuish, focus on assessing the suitability and potential benefits of information technology, ensuring that strategic objectives align with technological capabilities (Elliot & Melhuish, 1995). The integration of technology in strategic management is further enhanced by frameworks that consider both internal and external factors, allowing organizations to prioritize projects and allocate resources effectively (Hou et al., 2008). In the military context, the long-term sustainability of digital initiatives is crucial, requiring alignment with national defence strategies and broader public administration modernization policies. This alignment ensures that technological advancements contribute to strategic objectives and enhance operational capabilities (Lobkova, 2022). The strategic planning model developed by Santarsiero, which combines the balanced scorecard and logical framework approach, provides a comprehensive tool for

planning, monitoring, and evaluating digital transformation initiatives, ensuring they are sustainable and aligned with broader strategic goals (Santarsiero, 2023). Additionally, the integration of technology-enhanced learning in education, as explored by Fatadona et al. (2024), underscores the importance of strategic planning tools and stakeholder engagement in achieving sustainable educational outcomes (Fatadona et al., 2024). Overall, the strategic implementation and evaluation of technological integration require a holistic approach that considers user acceptance, strategic alignment, and continuous evaluation to ensure long-term success and alignment with broader strategic objectives.

1.10. Synthesis of the Literature Review

In conclusion, the modernization of the Portuguese Army's administration through the application of new technologies represents a crucial evolution in military administration, emphasizing the need for strategic integration of digital tools to enhance efficiency, transparency, and workplace effectiveness. This literature review has systematically explored the multifaceted dynamics of modernization, highlighting the transformative potential of digitalization, AI, and process optimization within military contexts. The findings underscore the importance of addressing both technological and human factors, including organizational culture and workforce adaptation, to ensure the successful implementation of digital initiatives. Furthermore, the analysis reveals significant challenges, such as cybersecurity risks and resistance to change, that must be navigated to realize the full benefits of modernization efforts. By synthesizing existing knowledge and identifying gaps in the literature, this review lays the groundwork for future empirical research aimed at deepening our understanding of how new technologies can reshape military administration, ultimately contributing to a more agile, responsive, and sustainable Portuguese Army.

CHAPTER 2 – RESEARCH DESIGN AND METHODS

This dissertation chapter outlines and justifies the methodological choices that guided the empirical component of the research. It explains the research design, the qualitative strategy adopted, the rationale for selecting specific data collection and analysis techniques, and the tools employed throughout the process. Particular attention is given to the coherence between the methodological approach and the research objectives and the procedures adopted to ensure analytical rigour, transparency, and relevance to the specific context of

military public administration. By clarifying how data were obtained, treated, and interpreted, this chapter establishes the foundation for the validity and reliability of the study's findings.

2.1. Research Design

This study adopts a qualitative and abductive research design, deemed most appropriate given its foundation in a pragmatic research philosophy, its exploratory nature, and the focus on understanding perceptions, practices, and expectations related to the application of digital technologies within the administrative structures of the Portuguese Army. The aim was not to test predefined hypotheses but to uncover in-depth insights into organisational and operational realities as perceived by those directly involved. Pragmatism, as the underlying philosophical stance, emphasises the practical applicability of knowledge and supports methodological flexibility, both of which are reflected in the design and execution of this study. The temporal horizon of the research is cross-sectional, as the data collection and analysis were conducted within a specific timeframe to capture a snapshot of current perceptions and practices. The methodological strategy consists of a dual empirical approach - semi-structured interviews and field-based observation - enabling a multidimensional understanding of the organisational implications of technological adoption within the military administrative context.

Table 2- Summary of the Methodological Framework

Philosophy	Pragmatism
Method	Abductive
Methodological Design	Qualitative
Strategy	Semi-structured Interviews
	Field-based Observation (Case Study)
Temporal Horizon	Cross-sectional

The methodological plan was designed to address the PRQ - What are the organizational implications of applying new technologies in the modernization of the Portuguese Army's administration, and how can these technologies optimize administrative processes in the military context? - and the four derived SRQ:

Table 3 - PRQ and SRQs of the Research Design

PRQ	What are the organisational implications of applying new technologies to the modernisation of the Portuguese Army's administration, and how can these technologies contribute to process optimisation?
SRQ1	What is the current state of digitalization in the Army's administration, and to what extent are the available technological and human resources adequate?
SRQ2	How do organisational culture and leadership affect technological change in the Army's administration, and what are the main associated risks and vulnerabilities?
SRQ3	Which administrative practices are currently digitalised, and in which areas could the application of new technologies yield the most significant benefit?
SRQ4	How is process optimisation implemented through technological adoption in the Army's administration?

At the initial stage of the research process, two exploratory interviews were conducted to help refine the scope of the study. These interviews were unstructured and aimed at capturing broad expert perspectives that could inform the definition of the research problem and the development of specific objectives. One interview was held with a recognised academic researcher specialising in computer science and AI, while the other involved a consultant with professional experience in process optimisation and digital transformation in organisational settings. During the interviews detailed field notes were taken. Their primary purpose was to guide the direction of the study and contribute to the conceptual design of the subsequent semi-structured interview guide.

Following this exploratory phase, a semi-structured interview guide consisting of 16 questions and 5 thematic axes was developed based on the research questions and was conducted with military officers from the Military Administration branch in order to gather empirical data.

To examine the interview responses, a cross-participant question-by-question analysis was conducted, allowing for a comparative view of how different participants approached each topic. To complement this interpretive reading, a lexical analysis was also undertaken using MAXQDA Analytics Pro to identify and visualise key terms from the Portuguese transcripts through word frequency and word cloud tools. These results were translated into English for consistency with the language of the dissertation.

Based on the interview data, a SWOT analysis was developed to synthesize the key findings and structure the interpretation of results. This technique made it possible to articulate the perceived Strengths, Weaknesses, Opportunities, and Threats associated with the modernization of administrative processes in the Army context.

Finally, a field-based workflow mapping was conducted at the Regimento de Transportes to deepen the empirical component of the study. This involved observing and analysing a real administrative process - the fuel supply workflow and its associated information management - in order to identify concrete inefficiencies and improvement opportunities. The mapping was an applied case study, complementing the qualitative interview data and offering a grounded basis for process-level proposals.

2.2. Data Collection

2.2.1. Semi-structured interviews

Semi-structured interviews were used to collect empirical data. The interview guide was developed by the researcher based on the literature review findings, with support from the dissertation supervisor. The guide underwent multiple iterations throughout the research design phase. It was structured to directly address the SRQs, which, in turn, contribute to answering the PRQ. Its content was also informed by the conceptual framework established in the literature review, which played a critical role in shaping the formulation of the interview questions. Although the initial exploratory interviews did not directly shape the guide's structure, they played a foundational role in refining the research questions, thereby indirectly influencing the formulation of the interview content. A preliminary version of the guide was piloted with one participant to assess clarity and usability and following feedback from this trial as well as subsequent input from the dissertation supervisor, the final version was validated and applied in the empirical phase. The interview guide was structured around a set of thematic axes. These axes were distributed as follows: Axis 1 – General Framework and Current Perception (4 questions), Axis 2 – Digitalisation and Current Practices (3 questions), Axis 3 – Organisational Culture and Change (4 questions), Axis 4 – Artificial Intelligence (3 questions), and Axis 5 – Difficulties, Risks and Limitations (2 questions). This format provided a balance between consistency across interviews and flexibility for participants to elaborate on their experiences and insights. The open-ended nature of the questions allowed for in-depth responses, while the structure ensured coverage of all key topics relevant to the study's objectives. The complete interview guide, which also includes the informed consent terms and confidentiality guarantees, is provided in Appendix A.

The participants included six officers from the Military Administration branch, holding various positions across different Army units. The selection of participants followed an expert sampling strategy, based on prior recommendations from academic and institutional stakeholders with recognised knowledge in the field. Military Administration Officers were identified as particularly relevant due to their professional involvement in the digitalisation and modernisation of administrative structures within the Army, thus ensuring their suitability for providing informed and context-specific insights. Their roles, ranks, and organisational contexts are summarised in Appendix B. The average duration of the interviews was approximately 36 minutes. The transcribed responses from each interview contained, on average 1.706 words, providing a substantial textual basis for qualitative analysis.

Two different modes of data collection were employed. For the in-person interviews, audio was recorded using the native voice recording application of the researcher's personal Samsung smartphone. These recordings were subsequently transcribed using the device's AI-assisted transcription functionality, followed by manual review and correction to ensure accuracy and fidelity. For the interviews conducted remotely, participants responded in writing via email, using Portable Document Format (PDF) files.

All participants were informed about the voluntary nature of their involvement, the confidentiality of their responses, and their right to withdraw at any time. These ethical safeguards were outlined in the introductory section of the interview guide (Appendix A).

The transcripts - both from oral and written sources - were produced in Portuguese to preserve the cultural and linguistic nuances of the participants' discourse. The subsequent analytical procedures applied to this material are detailed in Section 2.3.

2.2.2. Field-Based Observation and Unstructured Interviews

This subsection details the fieldwork conducted to map a specific administrative process within the Portuguese Army - the fuel supply workflow and its associated information management - as part of the empirical research strategy. The goal was to understand, in practice, how administrative processes are currently structured and where digitalization might be effectively introduced to improve operational efficiency.

The methodological approach for this workflow mapping was inspired by the principles of the Six Sigma model, particularly its focus on identifying inefficiencies and improving process quality through data-driven analysis. Six Sigma is a management framework that aims to enhance operational performance by reducing process variation and

eliminating defects, typically through the DMAIC cycle (Define, Measure, Analyze, Improve, Control) (Majstorovic & Stefanovic, 2005).

I was supported throughout this field-based work by a specialist in process optimization, who works professionally in a company dedicated to optimizing organizational processes. This expert provided methodological guidance at different stages of the fieldwork. Before collecting data, I held exploratory conversations with him to understand how to structure the process mapping. Additional discussions followed the data collection phase and continued throughout the analysis phase, allowing me to iteratively refine both my observations and interpretations. His name and affiliation have been omitted for confidentiality reasons.

The mapping was carried out through direct observation and unstructured interviews at the Regimento de Transportes with the personnel involved in the process, including a civilian technician from the logistics subsection of the regiment, a duty soldier responsible for refueling vehicles, and an officer with knowledge of the process. Conversations were guided by a preliminary outline based on prior knowledge of the process and were audio-recorded to ensure the accuracy and integrity of the information collected. Additionally, participants were asked about the types of errors that can occur, their frequency, and the most recurrent operational difficulties they experience. These insights contributed to a better understanding of the perceived weaknesses in the workflow and informed subsequent stages of the analysis.

During the field-based work, I accompanied the full cycle of the fuel supply and information management procedure, from the decision to refuel a military vehicle to the final data entry in the SIGNet system. I recorded time measurements, documented task flows, and systematically noted inefficiencies. Photographs were taken throughout the observation, as well as screenshots of the SIGNet interface, all of which are included in Appendix D, which contains a deeper explanation about the interface use. The resulting mapping, which includes process steps, actors involved, physical and digital tools used, and bottlenecks encountered, is presented in Appendix E.

This workflow mapping serves as an empirical anchor for the analysis developed in Chapter 3, particularly in relation to SRQ4, which seeks to explore how administrative process optimization is practically achieved through the implementation of new technologies in the Portuguese Army.

2.3. Data Analysis Procedures

The analytical model adopted in this research follows a qualitative logic and is structured around four complementary methods: cross-participant question-by-question analysis, lexical analysis, SWOT analysis, and a field-based workflow mapping analysis. These procedures were selected to address the central and secondary research questions and to ensure a multidimensional interpretation of the empirical material.

2.3.1. Cross-Participant question-by-question analysis

To systematically examine the empirical material collected, the responses to each interview question were reviewed collectively, enabling a comparative analysis of how different participants addressed the same topic. The analysis was conducted manually in Portuguese to preserve the original linguistic and cultural nuances of the participants' discourse. Emphasis was placed on identifying recurring patterns, points of divergence, and particularly insightful contributions.

Rather than quoting participants verbatim, their responses were synthesised into analytical summaries that integrate representative ideas and illustrative examples in a concise and coherent manner. This approach ensured that the analysis adhered to the structure of the interview guide while also capturing the diversity of perspectives expressed across the thematic axes. At the same time, it allowed for sufficient flexibility to explore participant-driven insights that emerged beyond the predefined questions.

2.3.2. Lexical Analysis

The software MAXQDA Analytics Pro was employed to support the lexical exploration of the data. The software was used to generate a word frequency table and a word cloud based on the Portuguese transcripts of the interviews. For presentation purposes, all relevant terms were subsequently translated into English to ensure consistency with the language of the dissertation.

The frequency analysis began by applying MAXQDA's default stop word list to exclude common non-analytical terms such as prepositions, articles, and pronouns. This list was then manually expanded to exclude additional irrelevant terms that persisted in the dataset. The refined list was exported into Excel, where further treatment was applied: filtering out remaining non-conceptual words, consolidating singular and plural forms (e.g., system and systems), and grouping morphologically related terms under unified concepts (e.g., technology and technological were merged under technology).

To ensure conceptual focus and visual clarity, a minimum threshold of 15 occurrences per word was defined. Only terms meeting this threshold were retained, resulting in a final set of 52 relevant concepts. Based on this data, two visual representations were created: a word cloud, generated directly in MAXQDA, and a horizontal bar chart, manually produced based on the final frequency data. Together, these tools enhance the interpretability of the findings and offer a visually accessible overview of the most prominent themes that emerged from the participants' discourse.

2.3.3. SWOT Analysis

SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis, a strategic planning tool used to identify strengths, weaknesses, opportunities, and threats, has been effectively applied in various academic contexts, including interview analysis. This method provides a structured approach to evaluate and improve organizational strategies by integrating insights from in-depth interviews and other qualitative data sources (Casebeer, 1993). The application of SWOT analysis in qualitative research can illuminate the strengths and weaknesses of digitalization initiatives, guiding organizations in crafting more effective strategies for implementation (Kudriavtceva, 2019). Overall, SWOT analysis serves as a versatile tool in academic interview analysis, enabling the synthesis of qualitative insights into strategic frameworks that guide decision-making and improvement initiatives across various domains (Milgram et al., 1999).

A SWOT analysis was undertaken with the objective of critically further assessing the perspectives gathered through the interviews conducted with officers of the Portuguese Army. These interviews constitute a primary empirical foundation for the investigation, offering insights derived from direct operational experience and from the implementation of technological tools in administrative contexts. By systematically identifying the internal strengths and weaknesses, as well as the external opportunities and threats, this analysis aims to contextualize the current state of digital transformation within the Army's administrative structures. It provides a structured framework through which the empirical narratives can be interpreted not only in isolation but also in relation to broader institutional, technological, and strategic dynamics. In doing so, the SWOT analysis contributes to a deeper understanding of the enablers and constraints shaping the modernization process and ultimately supports the formulation of evidence-based recommendations that are both operationally relevant and strategically aligned with the goals of a digitally integrated defence administration.

2.3.4. Field-Based Workflow Mapping Analysis

The analysis of the workflow mapping undertaken in this research draws methodological inspiration from the Six Sigma model, particularly its emphasis on structured problem identification and process optimization. Although the full DMAIC cycle (Define, Measure, Analyze, Improve, Control) was not formally implemented - due to the scope and nature of this academic project - the principles of systematic observation, measurement, and critical analysis served as guiding elements in the development of this empirical component.

The field-based analysis was informed by continuous methodological guidance from a specialist in process optimization, who works professionally in a company dedicated to process optimization. Although his name and affiliation are omitted for confidentiality, the specialist provided advice throughout the different phases of the empirical work, from initial planning to post-observation interpretation. Several meetings and consultations were held before and after data collection to ensure the structure and focus of the mapping aligned with process improvement principles.

The workflow analysis followed the field-based work described in Section 2.2.2 and was carried out with continuous methodological input from the same specialist. It combined qualitative and quantitative techniques: direct observation of procedural flows, time tracking of each task, and informal interviews with those involved in the process. Particular attention was given to identifying operational inefficiencies, recurrent risks, and frequently reported pain points. Microsoft Excel was used as the primary analytical tool to organize, structure, and interpret the data - enabling the visual mapping of the workflow, the estimation of task durations, and the categorization of process vulnerabilities.

The ultimate objective of this analytical exercise was to identify concrete improvement opportunities and to generate well-founded improvement proposals tailored to the operational realities of the Portuguese Army. These proposals were not merely technical suggestions but emerged from a structured and evidence-based understanding of procedural dysfunctions observed in situ.

This methodological approach enabled a comprehensive and data-informed analysis of a representative workflow, providing empirical support for SRQ4. The resulting insights, detailed in Section 3.2, offer a practical illustration of how digitalization, automation, and procedural redesign can contribute to administrative modernization within the Portuguese Army.

CHAPTER 3 – RESULTS AND DISCUSSION

This chapter presents and interprets the empirical findings of this research. In accordance with the methodological procedures outlined in Chapter 2, the analysis structure follows the two primary data sources. Section 3.1 focuses on the results from the semi-structured interviews, analysed through a cross-participant question-by-question framework, complemented by lexical analysis and a SWOT analysis. Section 3.2 is dedicated to the field-based workflow mapping analysis, treated as an autonomous empirical unit. This analytical separation by data source aims to preserve contextual coherence, enhance interpretive clarity, and reflect the distinct methodological treatment applied to each empirical component.

3.1. Interview-Based Results and Interpretation

3.1.1. Cross-Participant Question-by-Question Interview Analysis

This section presents a structured synthesis of the empirical findings, grouped according to the five thematic axes outlined in the interview guide. The objective is to highlight the most relevant and representative insights drawn from participant testimonies, since the complete Cross-Participant question-by-question Analysis, available in Appendix C, would not fit here. Appendix C indicates the SRQ it most directly addresses for each interview question. This cross-referencing facilitates analytical traceability between the empirical material and the research framework presented in Chapter 2.

Axis 1 - General Framework and Current Perception: interviewees acknowledged substantial progress in digitalization within the Portuguese Army's administration, noting a transition from paper replacement to integrated systems. Nonetheless, full digital maturity remains distant, as many processes still rely on manual signatures. While upper echelons prioritize digitalization rhetorically, structural inertia and bureaucratic rigidity hinder its practical implementation. Technological resources are generally adequate, but minor investments - especially in hardware and server capacity - are needed. Excessive bureaucracy persists across key processes such as financial reporting and activity planning, despite some successful digitalization efforts.

Axis 2 - Ongoing Practices and Implementation: digitalization has demonstrably enhanced administrative efficiency, reducing time demands, eliminating redundancies, and promoting informed decision-making. Tools such as the HelpDesk platform (an internal

platform that centralizes and organizes financial requests from U/E/O, replacing informal systems like emails and allowing for more efficient analysis and response from DFIN (Army Finance Department)) are particularly valued for enabling real-time monitoring and corrective actions. However, digital proficiency is uneven: younger personnel exhibit greater ease, whereas senior staff often struggle, largely due to inadequate institutional training. Some procedures remain partially analogue due to normative constraints, particularly regarding formal approvals. Full digitalization is expected to streamline workflows, reduce costs, and enable better system integration.

Axis 3 - Organizational Culture and Change: senior leadership is perceived as supportive of modernization, with tangible impacts in promoting adoption across various units. Nonetheless, cultural resistance endures - especially among older personnel more accustomed to legacy systems. Acceptance improves significantly when new tools are introduced through contextualized, practical training. Environmental awareness exists but is driven primarily by efficiency concerns, not ecological values. The electronic format is now the standard for information sharing, with paper use limited to legal obligations.

Axis 4 - Artificial Intelligence: participants identified finance, human resources, procurement, and document management as areas most suited for AI integration. Anticipated benefits include automation of routine tasks, enhanced analytical capabilities, and improved decision support. Although AI tools (e.g., ChatGPT, Copilot, Mistral) are already in use, mostly with positive outcomes, the Army is not yet institutionally prepared for systematic AI deployment. Key limitations include insufficient structured data and server capacity, lack of specialized knowledge, and absence of internal policy frameworks. Alignment with EU legislation, particularly the AI Act, is considered essential.

Axis 5 - Challenges, Risks, and Limitations: main challenges include structural rigidity, underutilization of existing technologies, and excessive dependence on external consultants. Resistance to change is exacerbated by an aging workforce and limited in-house capacity. In terms of cybersecurity, concerns focus on data exposure, third-party dependency, and lack of secure file-sharing protocols. Suggested mitigation strategies encompass end-to-end encryption, internalization of digital platforms, regular audits, and comprehensive cybersecurity training aligned with EU standards.

3.1.2. Lexical Analysis of Interview Data

The figure below displays a word cloud generated using MAXQDA Analytics Pro, based on the lexical frequency of terms mentioned by interviewees. The visualization

- I. processes and procedures, indicating an interest in optimizing administrative workflows;
- II. technological tools and infrastructure, reflecting the awareness of ongoing digital transformation;
- III. organizational adaptation, highlighting the relevance of human, managerial, and training-related factors in the modernization effort.

Specific references to tools like ChatGPT and Copilot indicate a growing awareness and usage of emerging technologies among participants. This supports the analytical alignment between the empirical data and the literature review, particularly regarding the enabling technologies driving administrative modernization.

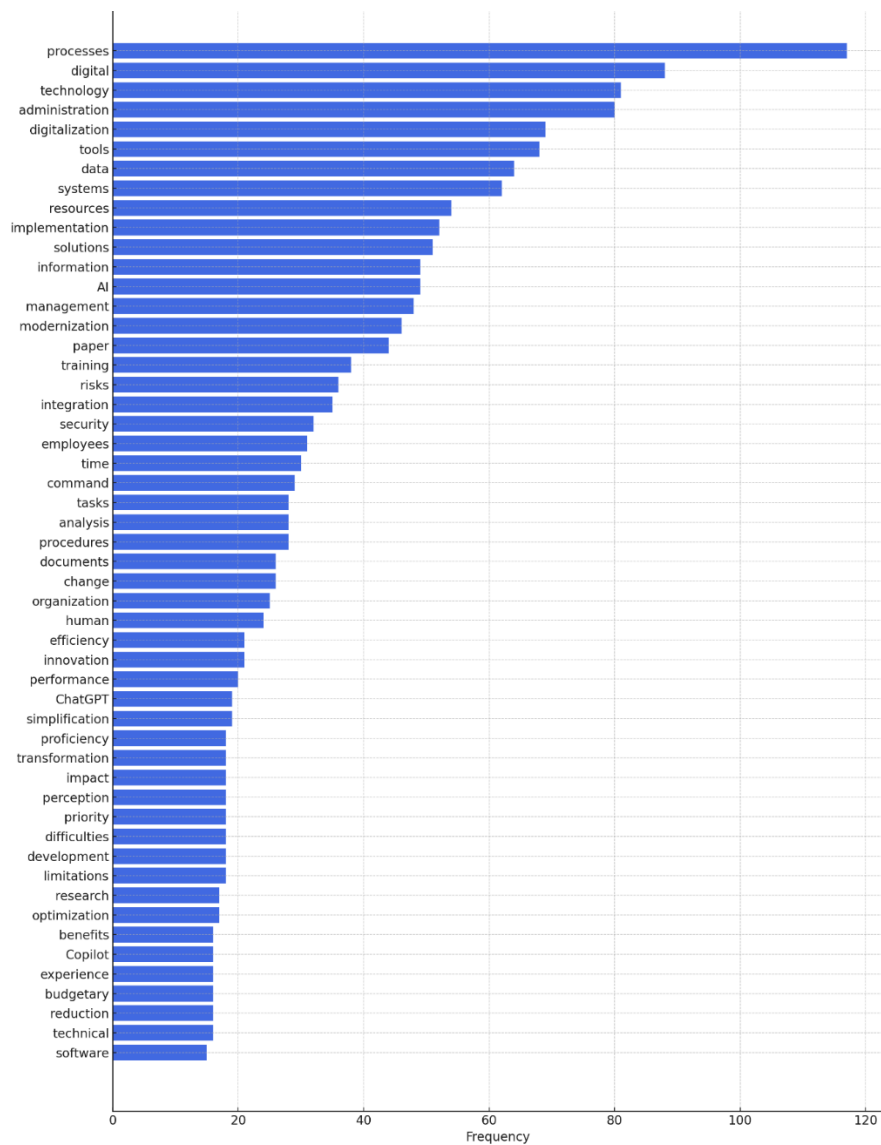


Figure 2- Frequency Chart of key concepts mentioned in the interviews.

3.1.3. SWOT Analysis of Interview Findings

The full SWOT analysis is presented in the following subsections, starting with Strengths, followed by Weaknesses, Opportunities and ending with Threats. The figure below shows a synthesis the undertaken analysis.

	Helpful	Harmful
Internal factors	<ul style="list-style-type: none"> • Strategic commitment from senior leadership to innovation and digitalization. • Positive operational impacts from digital tools: increased efficiency, transparency, and traceability. • Proactive implementation of internal digital solutions by personnel. • Conceptual clarity distinguishing digitalization from full dematerialization. • High digital proficiency and initiative among younger personnel. <p style="text-align: right;">S</p>	<ul style="list-style-type: none"> • Lack of interoperability between systems, resulting in data silos. • Continued dependence on paper-based steps in otherwise digital processes. • Uneven digital literacy, particularly among older or civilian staff. • Implementation inertia within middle management and operational layers. • Reliance on isolated, bottom-up initiatives rather than a centralized strategy. • Technological infrastructure not yet ready for advanced AI integration. <p style="text-align: right;">W</p>
External factors	<ul style="list-style-type: none"> • Growing availability of digital tools that support scalable solutions. • Increasing user engagement with AI tools for automation and decision support. • Generational shift provides a digitally native workforce for future leadership. • Existing pilot projects offer replicable, scalable models. • Alignment with national digital administration agendas and EU frameworks. • Upcoming AI and data governance regulations can drive secure and ethical integration. <p style="text-align: right;">O</p>	<ul style="list-style-type: none"> • Organizational conservatism and hierarchical rigidity slow transformation. • Dependence on external consultants and proprietary systems increases long-term vulnerability. • Heightened cybersecurity risks from third-party tools and cloud services. • Financial constraints limit sustained investment in infrastructure and training. • Ageing workforce contributes to a digital divide and slows adoption. • Regulatory complexity may hinder rapid deployment of innovations. <p style="text-align: right;">T</p>

Figure 3 – SWOT Analysis of Interview Findings

3.1.3.1. Strengths

The analysis of the strengths derived from the interviews conducted reveals several structurally significant and strategically valuable aspects of the application of new technologies within the administrative framework of the Portuguese Army.

Foremost among these is a discernible institutional commitment to administrative modernization. The interviewees consistently report that the Army's senior command levels have attributed increasing priority to innovation and digitalization, as evidenced by the establishment of entities such as the CEMTEEx (Centro de Experimentação e Modernização Tecnológica do Exército, in English Army Centre for Experimentation and Technological Modernisation), the articulation of digital transformation goals within strategic planning documents, and the implementation of pilot projects. This alignment at the strategic level enhances both the legitimacy and sustainability of ongoing initiatives.

A further strength lies in the proactive and solution-oriented attitudes demonstrated by the interviewees themselves. The implementation of internally developed platforms - such as HelpDesk systems, requisition management tools, and integrated financial processes - utilizing existing Microsoft tools (e.g., Teams, SharePoint, PowerApps) underscores a pragmatic ethos of internal optimization. These efforts reveal not only technical ingenuity but also a realistic appraisal of budgetary constraints and a focus on maximizing existing resources.

In operational terms, the digitalization efforts, while not yet fully mature, have already produced tangible benefits in terms of administrative efficiency, procedural speed, and information traceability. The widespread adoption of digital signatures, the progressive replacement of paper-based procedures, and the growing reliance on collaborative platforms reflect a substantive shift towards more agile and transparent administrative practices.

An additional asset is the emergent digital literacy among younger personnel, who demonstrate high levels of proficiency in contemporary digital tools. Their use of AI applications - such as ChatGPT, Copilot, and Grok - for automating bureaucratic tasks, generating documentation, and assisting in decision-making highlights a critical generational shift. This evolving technological fluency represents a strategic advantage in sustaining digital transformation.

Of particular note is the conceptual clarity with which digitalization is distinguished from process dematerialization. Several participants emphasized that the mere digitization of documents does not equate to true administrative reform. Rather, a fully digital workflow - encompassing the development, authorization, execution, and archiving of processes - is necessary to achieve meaningful transformation. This reflects a sophisticated understanding of what genuine modernization entails.

Finally, the interviews indicate a positive evolution in institutional culture. While resistance persists among some older personnel, younger staff tend to embrace technological

change, and the interviewees themselves have assumed active roles as internal change agents. This form of transformational leadership at the intermediate level is a critical enabler of successful digital reform in a traditionally hierarchical and bureaucratically structured organization such as the military.

3.1.3.2. Weaknesses

The analysis of the interview data reveals several weaknesses that continue to hinder the full realization of a digitally mature administrative framework within the Portuguese Army. These weaknesses span structural, technological, organizational, and human resource dimensions, highlighting systemic challenges that must be addressed to ensure the success and sustainability of digital transformation initiatives.

One of the most prominent weaknesses identified across all interviews is the persistence of a fragmented digital landscape. Despite notable progress in the development and deployment of digital tools, the lack of interoperability among systems - particularly those shared across the Ministry of National Defence (MDN) - creates operational silos and hampers data integration. The coexistence of multiple platforms (e.g., GesDoc, SIGDN, SAP, Microsoft 365) without seamless interconnection leads to redundancies, inefficiencies, and an increased cognitive load on users, who are required to navigate disparate systems for related tasks.

A closely related issue is the incomplete dematerialization of administrative processes. Although digitalization efforts have been initiated, many procedures remain partially reliant on physical documentation, particularly at the stages of signature and approval. The continued prevalence of manual endorsements by senior officers and the formal requirement for printed documentation, in some cases due to outdated regulatory frameworks, severely limits the efficiency gains associated with digital systems. As several participants noted, such partial digitalization risks merely shifting, rather than eliminating, bureaucratic burdens.

Human capital limitations also emerge as a significant impediment to modernization. There is a recurrent acknowledgment of the low digital literacy among segments of the workforce, particularly among older personnel and civilian staff. The absence of a comprehensive, continuous training framework exacerbates this issue. While ad hoc training sessions have been implemented, they are insufficient to ensure sustained competence across all levels. The observed generational gap in digital proficiency not only affects the adoption

of new technologies but also contributes to uneven productivity and a reliance on informal peer support networks.

Another critical weakness pertains to the institutional resistance to change, particularly within middle management structures. Although senior leadership appears supportive of modernization efforts, there is a disconnect between strategic vision and operational execution. Implementation is often slow, due to rigid hierarchical procedures, entrenched organizational cultures, and reluctance among certain actors to deviate from established routines. This inertia is compounded by a lack of decentralized decision-making autonomy, limiting the ability of local units to adapt solutions to their specific needs in a timely and effective manner.

Furthermore, the digital transformation process remains highly dependent on the initiative of individual actors rather than being driven by a coherent, institution-wide strategy. Many of the successful implementations described in the interviews - such as the development of requisition platforms or digital workflows - have resulted from isolated efforts by motivated officers, rather than from a structured, top-down program. This project-based approach creates inconsistencies in adoption and hinders scalability, potentially undermining the sustainability and institutionalization of innovation.

Finally, the current technological infrastructure - while functional in many respects - is not fully prepared to support advanced capabilities such as AI or predictive analytics. Limitations in server capacity, lack of integration of intelligent automation tools (e.g., RPA, machine learning modules), and the absence of a robust data governance framework constrain the potential for the Army to evolve towards data-driven administrative decision-making. This technological lag poses a structural weakness in the context of an increasingly digital operational environment.

3.1.3.3. Opportunities

The interview data highlights a range of promising opportunities that the Portuguese Army can leverage to accelerate and deepen its administrative modernization through the integration of new technologies. These opportunities span technological, organizational, strategic, and generational dimensions, presenting a favourable context for structural transformation if properly capitalized upon.

A key opportunity lies in the expanding accessibility and maturity of digital tools and platforms, particularly those offered through integrated ecosystems such as Microsoft 365. The increasing adoption of applications such as Power Automate, Power Apps, SharePoint,

and Teams has already enabled the creation of customized, low-code solutions for process management and internal communication. These tools offer significant scalability and interoperability potential, especially when paired with AI-powered features such as Copilot. Their modular architecture facilitates the development of user-centric solutions that can be tailored to the needs of various units, streamlining administrative workflows and reducing reliance on paper-based processes.

Another salient opportunity is the growing internal familiarity and experimentation with AI. Across the interviews, several respondents report regular use of AI tools - such as ChatGPT, Copilot, Grok, and Gemini - for drafting documents, automating repetitive tasks, developing macros, and supporting decision-making processes. This spontaneous engagement with AI among digitally literate personnel creates fertile ground for institutionalizing AI-assisted workflows. The strategic integration of AI solutions into core administrative functions - such as financial forecasting, human resource planning, and document classification - could significantly enhance organizational efficiency, enabling a shift from reactive to predictive management.

Furthermore, the interviews suggest that there is increasing cultural receptivity to technological change, particularly among younger military personnel. This generational shift represents an opportunity to build a digitally native workforce capable of sustaining and driving innovation. By designing targeted digital upskilling programs and formalizing mentorship structures where experienced users guide less proficient colleagues, the Army could harness this latent human capital to foster a culture of continuous digital learning and adaptation.

The potential for institutional learning is also enhanced by the existence of pilot initiatives and internal success stories, such as the development of HelpDesk platforms, requisition management systems, and digitally integrated financial processes. These initiatives not only serve as proof of concept for what can be achieved with existing tools and limited resources but also provide replicable models that can be scaled across other units. Formalizing these practices into standardized templates, supported by central guidance and training, could rapidly extend the benefits of digital transformation across the organization.

At the strategic level, there is also an opportunity to align more closely with broader public administration modernization agendas. As noted by the interviewees, the Army's digital efforts have increasingly intersected with Ministry of Defence and state-wide initiatives. This alignment could be further strengthened through inter-agency partnerships,

shared services platforms, and joint procurement strategies, allowing for economies of scale and more cohesive interoperability across governmental systems.

Finally, the emerging European regulatory landscape, particularly the EU AI Act, although presenting compliance challenges, offers a unique opportunity to establish robust data governance and ethical AI frameworks early in the transformation process. By proactively adapting to these norms and investing in transparent, secure, and accountable digital infrastructures, the Portuguese Army can position itself as a leader in trustworthy military administration in the digital age.

In sum, the convergence of technological maturity, internal competencies, generational change, and strategic alignment offers a unique window of opportunity for the Portuguese Army to transition from isolated innovation to systemic, scalable digital transformation.

3.1.3.4. Threats

The analysis of the interview data also reveals a range of external and internal threats that may compromise or delay the successful implementation of digital transformation within the Portuguese Army. These threats are particularly salient given the hierarchical structure of the institution, the sensitivity of the data handled, and the complex interplay between legacy systems, organizational culture, and evolving technological environments.

A primary threat stems from the rigidity of the organizational structure and the persistence of deeply entrenched bureaucratic procedures. Despite strategic intent and isolated successful initiatives, the Army remains a highly hierarchical institution with a strong culture of tradition and adherence to protocol. Such structural conservatism can generate significant inertia, impeding the adoption of disruptive technologies and limiting the scope for bottom-up innovation. The interviews reveal that even when strategic leadership is supportive, implementation at the operational level often encounters resistance, particularly among personnel accustomed to long-standing processes.

Another critical threat is the ongoing dependence on external consultants and proprietary platforms, whose costs are increasing due to rising demand and inflation. While the use of external providers can accelerate technical development in the short term, an over-reliance on outsourced expertise - particularly for the customization and maintenance of systems such as SAP, SIGDN, or even Microsoft-based infrastructures - undermines internal autonomy and increases long-term costs. This reliance also introduces vulnerabilities in

terms of knowledge transfer, system continuity, and vendor lock-in, especially if contractual or financial constraints arise.

Cybersecurity risks represent a further significant threat. As the interviews highlight, the integration of third-party tools (including AI applications and cloud-based services) inevitably exposes the Army to heightened risks regarding data breaches, unauthorized access, and digital espionage. Given the sensitivity of military data, even seemingly benign tools - such as automated file-sharing platforms or AI-powered chat interfaces - can become conduits for security breaches if not rigorously controlled. The use of external AI tools not integrated into secure, military-grade systems amplifies these risks, particularly in the absence of strict protocols and comprehensive user training.

Financial constraints continue to be an omnipresent threat. As several interviewees note, digital transformation - especially when involving infrastructure upgrades, licensing of advanced software, server expansion, or AI integration - requires substantial and sustained investment. Budgetary capping mechanisms, unpredictable public funding cycles, and competing operational priorities can limit the capacity of units to acquire and implement the necessary technologies, particularly if digital initiatives are not prioritized at the resource allocation level.

A related threat is the ageing profile of a significant segment of the workforce, which poses both an operational and strategic risk. Older personnel often display lower digital fluency, which not only hampers the immediate adoption of new systems but also generates a dual-speed organization in which efficiency gains are unevenly distributed. The generational digital divide, if not mitigated through structured training and human resource planning, may exacerbate internal tensions, reduce morale, and undermine cohesion during periods of change.

Finally, regulatory uncertainty and compliance burdens - particularly in the context of emerging European legislation on data protection and AI - may impose constraints on the scope and speed of innovation. The necessity to ensure strict alignment with the General Data Protection Regulation (GDPR) and the upcoming AI Act introduces additional layers of procedural complexity, potentially slowing down experimentation and the deployment of AI-based solutions. If not accompanied by institutional awareness and legal-technical preparedness, these regulations may become barriers rather than enablers of responsible innovation.

Taken together, these threats underscore the importance of adopting a coherent, risk-informed, and institutionally integrated approach to digital transformation. Without

addressing these vulnerabilities, the Portuguese Army's modernization efforts risk becoming fragmented, under-resourced, or exposed to operational and reputational harm.

3.2. Field-Based Workflow Analysis

3.2.1. Description of the Workflow

This section presents a summary of the workflow mapping carried out at the Regimento de Transportes, focused on the fuel supply process and its associated information management. The field-based workflow mapping, detailed in Appendix E, documents the operational and administrative sequence of tasks involved in fueling military vehicles, highlighting both physical and digital interactions.

The process begins with the decision to refuel and involves the physical act of fueling, the manual recording of data, and the subsequent transcription into the SIGNet system, an internal digital platform within the Portuguese Ministry of Defense used for fuel management, among other functions. Key steps include the completion of a paper form with details such as license plate, mileage, date, and vehicle type; signature collection; the physical transfer of documents; and the final digital entry into the system by the logistics section of the Regiment. The workflow requires the involvement of multiple actors, including the vehicle driver, the service soldier assigned to fuel operations, and the civilian technician of the Logistics Section, responsible for compiling, validating, and inserting administrative data into the SIGNet system.

The mapping revealed several inefficiencies, including redundancies in documentation, reliance on paper-based forms, and the risk of transcription errors - exacerbated by illegible handwriting or inconsistent vehicle identification. Additionally, the SIGNet system presents limitations such as slow response times and the inability for end-users to correct data entry mistakes without resorting to centralized technical support.

Overall, the workflow illustrates the coexistence of analogue and digital elements, offering a practical case for analyzing the challenges and opportunities associated with the digitalization of military administrative processes.

3.2.2. Identified Inefficiencies and Improvement Opportunities

The workflow mapping exercise uncovered several inefficiencies, operational frictions, and recurring pain points throughout the fuel supply process. These inefficiencies arise both from procedural redundancies and from the technological limitations of the systems in use.

Firstly, the continued reliance on physical paper forms for capturing fueling data introduces multiple vulnerabilities. Issues such as illegible handwriting, incomplete or inconsistent information, and the physical deterioration or loss of documents compromise the accuracy and reliability of the administrative workflow. These vulnerabilities are compounded by the need to later transcribe this information manually into the SIGNet platform, which adds time, increases the workload, and creates potential for transcription errors.

Secondly, the process is marked by frequent displacements between physical locations, including trips from the fueling station to the administrative office and then to the logistics section. These movements, while seemingly minor individually, accumulate into significant inefficiencies over time and represent a suboptimal allocation of personnel resources.

Moreover, the system suffers from unnecessary repetition of data input. The same information - such as vehicle identification and fueling details - is written manually on paper, transcribed to SIGNet, and duplicated for local archiving and reporting purposes. This duplication not only increases workload but also raises paper and printing expenditures.

Technological constraints further exacerbate the situation. SIGNet, although fundamental to administrative operations, has been described as slow, occasionally unstable, and non-intuitive. End-users lack the autonomy to correct errors once data is submitted, depending instead on centralized intervention by the DRT (Direção de Reabastecimento e Transportes), which delays resolution and contributes to administrative rigidity.

Additionally, the absence of automation or digital integration at the point of fueling - such as Application Programming Interface (API) enabled fuel pumps or mobile interfaces - limits real-time data capture and perpetuates dependency on outdated practices. The system also depends heavily on the availability of physical supplies (paper, pens, printed forms), all of which are prone to stock-outs, further slowing down the workflow.

These inefficiencies not only delay operations but also reduce data reliability and limit transparency and traceability. As such, they represent concrete opportunities for process optimization through technological innovation, system integration, and procedural redesign.

3.2.3. Improvement Proposals and Final Reflection

Based on the inefficiencies identified, several concrete improvements can be proposed to optimize the workflow and enhance the integration of digital tools within the fuel supply process.

First, the adoption of digital data capture at the point of fueling should be prioritized. This could be achieved through the implementation of tablet-based forms or directly integrating the fuel pump system with SIGNet via an API, allowing real-time transmission of fueling data without the need for paper-based intermediaries. Such a solution would eliminate the risks associated with illegible handwriting and reduce the need for physical document transfer.

Second, the SIGNet platform should be upgraded to allow end-user data input modification in a controlled environment, reducing dependency on the DRT for minor administrative corrections. Improving the system's responsiveness and usability through interface redesign or infrastructure upgrades would also increase efficiency and user satisfaction.

Third, implementing an automated validation mechanism for data entry - such as mandatory field checks, dropdown menus, and error alerts - could help prevent data inconsistencies before submission. This would reduce the need for retroactive problem-solving and improve overall data quality.

Additionally, equipping service personnel with mobile terminals or portable devices would enhance operational agility and reduce time lost in physical displacements between operational and administrative areas. These devices could incorporate Quick Response (QR) code scanning to facilitate vehicle identification and enable pre-populated forms based on existing databases, further streamlining the workflow. Furthermore, the individuals involved in this process demonstrated not only openness but also enthusiasm regarding the prospect of the proposed improvements. This receptiveness reinforces the feasibility of implementing the proposed improvements and signals a readiness for change that may serve as a facilitating factor in future digitalisation efforts.

From a procedural standpoint, digitally centralising document handling and gradually phasing out redundant paper-based archiving would not only cut resource consumption but also better align with the strategic objectives of administrative modernisation and environmental sustainability. Although this analysis focuses on a specific logistical and administrative process within a single unit, the inefficiencies observed and the proposals

suggested here may be extrapolated to other workflows within the Portuguese Army. The coexistence of paper-based and digital systems, fragmented administrative platforms, and rigid operational procedures are structural characteristics that extend beyond the fuel supply domain. As such, this case serves as a micro-level reflection of broader structural challenges - and opportunities - in the ongoing technological advancement in the Portuguese Military Administration.

Importantly, this component of the field-based analysis corroborates several points raised in the semi-structured interviews, especially those concerning the misalignment between technological capabilities and administrative routines. While field observations emphasised searching for practical inefficiencies, interview participants highlighted cultural resistance and structural inertia as barriers to change. The convergence of these two sources thus reinforces the addressing of SRQ4, which seeks to understand how process optimization is practically achieved through the implementation of new technologies in the administrative structures of the Portuguese Army.

This targeted analysis of the fuel supply process exemplifies the broader challenges of administrative modernization and reinforces the findings derived from the interviews. While the field-based observations highlight operational inefficiencies and rigid procedures, the interview data emphasize cultural resistance, hierarchical constraints, and the need for digital literacy. These sources converge to illustrate the multifaceted nature of technological transformation in the Portuguese Army, underscoring the need for integrated, scalable, and user-centred solutions across administrative domains.

CONCLUSIONS

This study addressed the organizational implications of applying new technologies within the modernization of the Portuguese Army's administration, specifically focusing on process optimization. The primary research question (PRQ) - "What are the organizational implications of applying new technologies in the modernization of the Portuguese Army's administration, and how can these technologies contribute to process optimization?" - guided the empirical exploration conducted through interviews and field-based observations.

In responding systematically to the secondary research questions (SRQ), it was found that, regarding SRQ1 - "What is the current state of digitalization in the Army's administration, and to what extent are the available technological and human resources adequate?" - the Portuguese Army has advanced significantly in digitalization efforts. However, these efforts remain fragmented and incomplete. Technological resources such as Microsoft 365 and internal platforms have shown substantial promise, yet existing hardware limitations and interoperability issues continue to impede full digital maturity. Additionally, the human resources dimension reflects clear generational disparities in digital proficiency, highlighting the urgent need for structured and continuous training programs.

Concerning SRQ2 - "How do organisational culture and leadership affect technological change in the Army's administration, and what are the main associated risks and vulnerabilities?" - leadership at senior levels has demonstrated consistent commitment towards digital transformation, fostering an environment conducive to technological acceptance. Nonetheless, substantial cultural resistance persists, particularly among senior personnel, who remain accustomed to traditional processes. This cultural inertia represents a critical barrier, posing risks related to slow adoption and partial resistance to comprehensive change, exacerbated by hierarchical rigidity and limited decision-making autonomy at operational levels.

Addressing SRQ3 - "Which administrative practices are currently digitalised, and in which areas could the application of new technologies yield the most significant benefit?" - the research identified several successfully digitalized practices, including requisition management systems and financial workflows. Notably, respondents frequently referenced artificial intelligence as a significant area of potential enhancement, particularly in finance, human resources, procurement, and document management. Practical instances from the interviews, such as AI-assisted drafting tools (e.g., ChatGPT and Copilot), underscored

tangible efficiency gains, highlighting AI's potential to automate routine tasks and support analytical decision-making.

Regarding SRQ4 - "How is process optimisation implemented through technological adoption in the Army's administration?" - field-based workflow analysis at the Regimento de Transportes provided robust empirical insights. The study illustrated that digitalization at the operational level remains partial, with significant manual elements and redundancies present in the fuel management process. The introduction of tablet-based data entry or API integration with SIGNet was identified as a key area for improvement, with the potential to streamline operations significantly, reduce errors, and enhance overall process efficiency and data reliability.

Overall, addressing the PRQ - "What are the organizational implications of applying new technologies in the modernization of the Portuguese Army's administration, and how can these technologies contribute to process optimization?" - this research highlights several critical implications. Technological integration significantly impacts administrative efficiency by streamlining workflows, reducing manual tasks, and enhancing decision-making through real-time and accurate data management. However, these benefits depend heavily on overcoming existing challenges related to cultural resistance, infrastructural limitations, and uneven digital competencies across the workforce. Effective technological adoption necessitates a coordinated approach involving comprehensive training, strategic infrastructure investments, and cultural shifts supported by strong and committed leadership at all organizational levels. Importantly, these empirical findings align closely with the insights drawn from the literature review, confirming the theoretical expectations regarding the benefits and challenges of digital transformation.

Cross-analysis of interview and field data revealed complementary findings. Both sources consistently identified the coexistence of analogue and digital practices as problematic. However, while interviewees emphasized broad organizational and cultural challenges, the field observations highlighted specific procedural inefficiencies. These perspectives converge on the necessity for targeted investments in infrastructure upgrades, user-friendly interfaces, and real-time data capture solutions.

Given these findings, several practical recommendations can be proposed. Institutional training programs should be systematically expanded to ensure administrative personnel effectively use digital and AI-based tools. Leadership engagement must be reinforced through strategic communication that frames digitalization as an enabler of mission readiness and operational agility rather than a threat to tradition. Investments in

infrastructure, particularly in interoperable systems and cybersecurity safeguards, should be prioritized to ensure sustainable and secure digital transformation. Additionally, pilot projects involving AI in administrative tasks such as resource allocation, workload management, and document automation should be scaled and evaluated using defined performance metrics.

This research has produced significant theoretical and practical knowledge on modernization in a military administrative context, highlighting crucial organizational dynamics, technical infrastructure considerations, and the essential role of human factors. The theoretical contributions significantly enrich the understanding of digital transformation in military contexts, particularly concerning the interplay between resistance to change, technological adoption, and digital literacy. On a practical level, the findings provide actionable strategies such as API integration, the deployment of mobile devices for real-time data capture, and structured training programs, offering clear guidelines for enhancing administrative operations.

The insights from this study can also inform institutional and governmental policymaking regarding administrative modernization, shaping strategic planning and resource allocation within broader public sector digital transformation initiatives. Socially, improvements in administrative efficiency have broader implications, contributing positively to optimized public resource utilization, enhanced responsiveness, accountability, and improved service delivery to citizens.

For future research, it is recommended to conduct longitudinal studies to assess the impact of digitalization initiatives over time within the Portuguese Army or comparable military institutions. Additionally, extending analysis to operational applications of AI, in the Army's administration would offer a more holistic perspective. Exploring comparative studies across different branches of the Armed Forces to identify best practices and institutional learning patterns could further enrich the understanding of digital modernization dynamics.

In conclusion, this investigation underscores the Portuguese Army's significant progress and identifies crucial gaps to address to fully realize the benefits of digital modernization. By strategically capitalizing on identified strengths and opportunities while mitigating existing weaknesses and threats, the Portuguese Army can ensure a coherent, effective, and sustainable trajectory towards administrative digital maturity.

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APPENDICES

APPENDIX A – SEMI-STRUCTURED INTERVIEW GUIDE

GUIÃO DA ENTREVISTA

Consentimento Informado

Este inquérito por entrevista é realizado no âmbito do Trabalho de Investigação Aplicada que confere o grau de Mestre em Ciências Militares, na especialidade de Administração Militar, subordinado ao tema "A Modernização da Administração do Exército Português através da Aplicação de Novas Tecnologias". A sua participação é essencial para o desenvolvimento desta investigação, contribuindo para a análise crítica e fundamentada da modernização administrativa no contexto militar.

Os dados obtidos serão tratados de forma geral e não individualizada, garantindo-se o anonimato e a confidencialidade de todas as informações recolhidas. A conservação dos dados respeitará os prazos e condições legalmente definidos, de acordo com o previsto no Regulamento (UE) 2016/679, de 27 de abril de 2016, que entrou em vigor a 25 de maio de 2018, bem como com as orientações da Comissão Nacional de Proteção de Dados.

No final do estudo será elaborado um relatório em linguagem não técnica, destinado aos órgãos de comando das unidades envolvidas. Caso pretenda receber individualmente essa informação, poderá contactar o orientador do projeto, Professor-Auxiliar Flávio Ivo Riedlinger de Magalhães (flavioivo@uchicago.edu), ou o autor do trabalho, o Aspirante Tiago Sena Fonseca Claro de Castro (castro.tsfc@academiamilitar.pt).

Consentimento para Realização de Entrevista

Eu, _____, declaro que fui informado(a) sobre os objetivos e procedimentos da investigação acima referida, autorizando a realização da entrevista e o uso dos dados fornecidos, de forma exclusiva, para fins académicos no contexto deste estudo.

Local: _____

Data: _____, ____ de _____ de _____

GUIÃO

Nome:

Cargo/função:

Em funções desde:

Local de Trabalho:

Data:

Local da Entrevista:

Este guião tem como objetivo recolher contributos fundamentados no exercício de funções sobre a aplicação de novas tecnologias na administração do Exército Português, visando identificar de forma sistemática as implicações organizacionais decorrentes do processo de modernização administrativa em contexto de paz.

Sempre que considere pertinente, poderá complementar as suas respostas com exemplos concretos, de modo a enriquecer a análise do estudo.

O guião divide-se em 5 eixos temáticos, correspondendo a um total de 16 perguntas.

1: Enquadramento geral e perceção atual

- a. Como avalia o estado atual da digitalização na administração do Exército Português?

R:

- b. Na sua perceção, que nível de prioridade considera ter sido atribuído pelos escalões de comando do Exército Português à inovação, modernização, e digitalização administrativa?

R:

- c. Na sua perspetiva, o Exército Português dispõe atualmente dos recursos tecnológicos adequados - em termos de hardware e software - para aplicar eficazmente novas tecnologias? Que tipo de investimentos adicionais devem ser realizados?

R:

- d. Os processos administrativos no seu contexto de trabalho são simples e eficientes, ou pelo contrário, considera que se encontram excessivamente burocratizados e passíveis de otimização?

R:

2: Digitalização e práticas em curso

- a. Na sua experiência, a digitalização tem contribuído para a agilização e eficácia dos procedimentos administrativos? Sente que a digitalização tem tido impacto no desempenho diário das suas funções?

R:

- b. Qual o nível de proficiência demonstrado pelos colaboradores no seu contexto de trabalho, nomeadamente pelos seus subordinados, na utilização das ferramentas digitais existentes? Considera que a formação disponibilizada tem sido adequada para apoiar essa utilização?

R:

- c. Consegue, no seu contexto de trabalho, identificar procedimentos ou processos administrativos que ainda não se encontram digitalizados? Que benefícios adviriam da sua digitalização?

R:

3: Cultura organizacional e mudança

- a. Na sua perspetiva, qual tem sido o papel específico do comando superior na modernização administrativa? Têm conseguido influenciar as atitudes e comportamentos dos subordinados, acelerando a transição para um ambiente de trabalho mais moderno?

R:

- b. No seu local de trabalho, como caracteriza a reação dos colaboradores perante a introdução de novas tecnologias? Identifica, de forma geral, abertura à mudança ou prevalece alguma resistência à sua adoção?

R:

- c. Tem identificado a presença de uma consciência ambiental no seu local de trabalho, nomeadamente no que se refere à preocupação com a redução do uso de papel e de impressões?

R:

- d. No seu local de trabalho, qual considera ser o método preferencial de distribuição de informação: em suporte físico ou em formato eletrónico?

R:

4: Inteligência Artificial

- a. Atendendo ao crescente impacto da Inteligência Artificial nas organizações, na sua perspetiva, que áreas administrativas do Exército Português poderão beneficiar mais com a integração de soluções baseadas em Inteligência Artificial? Quais são os principais benefícios, se existentes, que poderão resultar da sua integração?

R:

- b. Considera que o Exército Português se encontra preparado para integrar soluções baseadas em Inteligência Artificial na gestão documental e informacional?

R:

- c. Já recorreu, no âmbito das suas funções, a ferramentas baseadas em Inteligência Artificial, como sistemas de leitura automática de documentos ou assistentes digitais (por exemplo, o *Document AI* da *Google*, o *Copilot* ou *ChatGPT*)? Em caso afirmativo, quais utilizou e como avalia o desempenho e utilidade das mesmas?

R:

5: Dificuldades, riscos e limitações

- a. Quais são, na sua perspetiva, as principais dificuldades, riscos e limitações associadas à implementação de novas tecnologias na administração do Exército Português?

R:

- b. Na sua perspetiva, que riscos ou vulnerabilidades em matéria de segurança digital podem decorrer da implementação de novas tecnologias? Que estratégias considera adequadas para a sua mitigação no contexto do Exército Português?

R:

Muito obrigado pela sua cooperação!

APPENDIX B – CHARACTERIZATION OF INTERVIEW PARTICIPANTS

Table 4 - Characterization of Interview Participants

Participant	Rank	Position held with relevance to the research project	Interview format	Place	Date
P1	Tenente	Chief of the Financial Subsection of the Academia Militar	In-person interview	Academia Militar Sede	05MAY25
P2	Tenente	Chief of the Financial Subsection of Escola dos Serviços	Written remote interview		08MAY25
P3	Tenente	Chief of the Financial Subsection of Regimento de Transportes	In-person interview	Regimento de Transportes	09MAY25
P4	Capitão	Deputy Officer of the Financial Accounting Section within the Departamento de Finanças	Written remote interview		10MAY25
P5	Tenente	Deputy Officer of the Budgetary Accounting Section within the Departamento de Finanças	Written remote interview		14MAY25
P6	Capitão	Chief Financial Officer of the Portuguese Contingent to the EUMAM Mozambique Military Mission	Written remote interview		14MAY25

APPENDIX C – CROSS-PARTICIPANT QUESTION-BY-QUESTION ANALYSIS TABLE

Table 5 - Cross-Participant Question-by-Question Analysis Table

Thematic Axis	SQR	Interview Question	Analytical Summary
1. General Framework and Current Perception	SRQ1	1a. How do you assess the current state of digitalization in the administration of the Portuguese Army?	All interviewees unanimously agree that digitalization within the Army has evolved significantly in recent years, although it still remains at an intermediate stage. They highlight a shift from basic digitalization (replacing paper) to more integrated initiatives. More than 16 applications developed by DCI (Directorate of Communications and Information) were mentioned, including systems for training, meal registration, mission planning, inspections, and acquisitions. Nevertheless, paper use persists, especially for manual signatures by general officers. Full digital maturity has not yet been reached, with total dematerialization remaining an aspirational goal.
	SRQ2	1b. In your view, what level of priority has been given by Army leadership to innovation, modernization, and administrative digitalization?	Digitalization is increasingly prioritized by upper command levels, as reflected in directives and working groups. However, interviewees note structural difficulties in putting conclusions into practice. One participant stated that true modernization requires rethinking structures, merging departments, and redesigning processes - all of which clash with rigid career systems and local influences. There is willpower, but execution remains insufficient.
	SRQ1	1c. In your opinion, does the Portuguese Army currently have the necessary technological resources - in terms of hardware and software - to effectively implement new technologies? What additional investments are required?	Most believe the current resources are generally adequate, noting that many solutions were developed using existing tools such as SharePoint (Microsoft platform for content and document collaboration), PowerApps (used to create custom enterprise applications without advanced programming), PowerAutomate (used to automate workflows across apps and services), Lists (for collaborative list and data management), and Teams (Microsoft communication and collaboration platform). A concrete example mentioned is the platform developed to connect the U/E/O (Units, Establishments and Bodies of the Portuguese Army)

Thematic Axis	SQR	Interview Question	Analytical Summary
			with the DFIN (Army Finance Department), through HelpDesk (an internal platform that centralizes and organizes financial requests from U/E/O, replacing informal systems like emails and allowing for more efficient analysis and response from DFIN), eliminating physical printing and manual signatures. Nonetheless, some investment is still required in hardware (e.g., second monitors, PC upgrades) and servers to support higher data loads.
	SRQ4	1d. Are administrative processes in your work context simple and efficient, or do you consider them excessively bureaucratic and in need of optimization?	There is consensus that many processes remain overly bureaucratic. Examples include financial reporting, activity planning, and management accounts. A positive example was the digitalization of supply notices and budget changes, which used to be handled via PDFs and emails and are now fully integrated into an online tool.
2. Current Practices and Implementation	SRQ4	2a. In your experience, has digitalization contributed to streamlining and increasing the effectiveness of administrative procedures? Has it had an impact on your daily performance?	All respondents acknowledged a significant positive impact. Digitalization, particularly dematerialization, resulted in time savings, greater responsiveness, and a more informed management culture. It also contributed to the elimination of redundant workflows and the reduction of manual bottlenecks in administrative cycles. One interviewee noted that the HelpDesk tool, beyond centralizing requests, now serves as a data source for identifying trends and applying corrective actions such as issuing explanatory manuals or organizing targeted training sessions.
	SRQ1	2b. What level of proficiency is demonstrated by your colleagues and subordinates in using the available digital tools? Do you consider the training provided to be adequate to support this use?	A clear generational divide was noted: younger personnel are more proficient and receptive, whereas older colleagues often struggle more. While internal training sessions were held (e.g., during the introduction of the HelpDesk), the overall institutional training is considered insufficient and poorly structured. Respondents advocated for continuous, hands-on training and the designation of local digital transformation facilitators.

Thematic Axis	SQR	Interview Question	Analytical Summary
	SRQ3 SRQ4	2c. Are there any administrative procedures in your context that have not yet been digitalized? What benefits would result from their digitalization?	Yes. Several processes, although initiated digitally, still require printing and physical handling at their final stages, particularly when they involve formal approvals by senior officers. Interviewees mentioned that normative and regulatory requirements often compel the generation of paper copies even after the digital phase is complete. A concrete example was the requisition process at UnApEME (Support Unit of the Army General Staff), which transitioned from around 100 paper-based procedures to a centralized digital platform. Despite this progress, documents still need to be printed at the end due to formal rules. The benefits expected from fully digitalizing these processes include faster workflows, fewer manual errors, improved traceability, and reduced material costs. Additionally, digital integration would allow these procedures to be more easily synchronized with related systems in human resources and financial management, contributing to more efficient and coherent administrative operations.
3. Organizational Culture and Change	SRQ2	3a. In your view, what specific role has the senior command played in administrative modernization? Have they managed to influence attitudes and behaviors among subordinates, accelerating the transition to a more modern working environment?	The role of the senior command is viewed positively. One interviewee reported successfully implementing tools (HelpDesk, requisition management) across multiple U/E/O with leadership support. While the process is gradual, the cultural shift is visible and ongoing.
	SRQ2	3b. In your workplace, how do colleagues react to the introduction of new technologies? Is there, in general, openness to change or prevailing resistance to adoption?	A range of reactions was noted across different generations and ranks. Older personnel, particularly those with longer service and more exposure to legacy systems, tend to exhibit greater initial resistance to new technologies. This reluctance is often linked to limited familiarity and anxiety around learning new tools without sufficient support. In contrast, younger staff members demonstrate much greater openness, agility, and curiosity, particularly when they perceive a direct benefit in terms of time savings or task simplification. However,

Thematic Axis	SQR	Interview Question	Analytical Summary
			interviewees emphasized that resistance is not immutable. When digital tools are introduced with practical demonstrations and proper hands-on training, the reluctance tends to dissipate. The real determinant of success is not age per se, but whether the change is supported by contextualized communication and capacity-building. As such, the key lies in showing the clear, tangible value of the tool and avoiding abrupt top-down mandates that ignore the daily realities of those affected.
	SRQ2	3c. Have you noticed an environmental awareness in your workplace, particularly regarding reducing paper use and printing?	Yes, though the motivation is more practical than ecological. Respondents cited concerns about budget constraints and efficiency, leading to conscious reductions in printing. Paper usage has decreased considerably, with most internal procedures now conducted digitally, except when legal or external requirements dictate otherwise. One interviewee specifically mentioned that certain processes, such as fuel supply records, are still handled manually and kept on paper, indicating that some residual practices remain resistant to digital transition despite broader institutional trends.
	SRQ3	3d. What is the preferred method of information distribution in your workplace: physical or electronic format?	Electronic format is universally preferred and has become the standard mode of communication and documentation in most Army units. It ensures greater speed, traceability, and efficiency in handling information. According to the interviewees, the use of paper has become increasingly rare and is only maintained in situations where legal obligations or external constraints explicitly require physical documentation. The transition to digital formats is not only operationally more practical but is already viewed as a default expectation in internal workflows.
4. Artificial Intelligence	SRQ3	4a. Which administrative areas of the Portuguese Army could benefit most from the integration of AI-	The areas most frequently mentioned were finance (budget forecasting, expenditure classification), human resources (career management, automation of routine processes), public procurement (irregularity detection), and document management. Interviewees emphasized AI's

Thematic Axis	SQR	Interview Question	Analytical Summary
		based solutions? What are the potential benefits of their adoption?	role in automating repetitive tasks, strengthening analytical capacity, and supporting decision-making. The importance of integrating these solutions into existing systems like SAP (enterprise resource planning software used for managing military administrative functions) or PHC (business management software) was also underlined.
	SRQ1	4b. Do you believe the Portuguese Army is prepared to integrate AI-based solutions in document and information management?	Interviewees unanimously stated that the Army is not yet ready. While the technological base exists, there is a lack of structured data, computing capacity, specialized knowledge, and internal policies. One participant specifically highlighted the need to ensure alignment with the AI Act (European Regulation on AI), and to establish human oversight and transparency mechanisms for all AI-driven processes.
	SRQ3 SRQ4	4c. Have you used AI-based tools in your functions? Which ones, and how would you evaluate their performance and usefulness?	Yes. All interviewees reported having used AI-based tools in their professional duties. Among the most frequently mentioned were ChatGPT, Copilot, Grok, and Mistral AI - that is, intelligent assistants designed to support a wide range of administrative, analytical, and communication tasks. These tools were applied to several practical purposes: drafting emails, synthesizing complex legislation, structuring technical reports, classifying financial expenditures, developing digital platforms, and supporting basic programming. One interviewee noted the usefulness of ChatGPT in drafting internal memoranda and reducing the time required to process regulatory references. Another mentioned using Copilot to automate repetitive tasks in Microsoft Excel and to pre-fill structured emails based on historical templates. Grok and Mistral were referenced primarily for their speed and contextual reasoning capabilities. The overall evaluation was highly positive. The tools were regarded as valuable time-saving instruments, particularly in environments with high documentation and communication demands. Nevertheless, all interviewees stressed that the effectiveness of these tools depends greatly on

Thematic Axis	SQR	Interview Question	Analytical Summary
			the user's ability to formulate clear, specific prompts (well-structured questions or instructions) and to frame the request within the correct operational context.
5. Challenges, Risks, and Limitations	SRQ2	5a. In your view, what are the main challenges, risks, and limitations associated with implementing new technologies in the administration of the Portuguese Army?	The main challenges identified relate to structural rigidity, a conservative organizational culture, and frequent resistance to change. Interviewees noted the aging workforce, high turnover rates, and lack of specialized internal teams dedicated to technological development. They also emphasized the underutilization of existing technology due to lack of training and follow-up. Additionally, respondents mentioned the excessive reliance on external consultants, especially for system configuration and customization, which reduces internal autonomy. Interoperability between legacy systems and modern solutions was cited as a major limitation, as was the absence of phased implementation plans and long-term strategic alignment.
	SRQ2	5b. From your perspective, what digital security risks or vulnerabilities could arise from the implementation of new technologies? What strategies do you consider appropriate for mitigating them within the context of the Portuguese Army?	Interviewees identified several relevant digital security risks, including the exposure of sensitive data through AI systems or misconfigured APIs, increased attack surface due to the integration of new platforms, and the risk of unauthorized or improper file sharing using external services such as WeTransfer (a cloud-based platform for sending large files between users). They also raised concerns about dependency on third-party providers like Microsoft or SAP, and insufficient auditing of data flows and access controls. To mitigate these risks, the following strategies were suggested: the implementation of end-to-end encryption across all critical channels; the development of internal and secure systems for file sharing to replace external services; the integration of collaborative platforms such as Microsoft Teams into the Army's secure internal network; regular technical audits and continuous risk assessments; and the establishment of rigid cybersecurity norms aligned with EU regulations. Comprehensive and transversal cybersecurity training for all personnel was also emphasized as essential.
Note: when two SRQ codes appear, the first represents the stronger analytical linkage; the second is secondary but still substantively justified			

APPENDIX D – DIRECT OBSERVATION: PHOTOGRAPHIC AND SCREENSHOT RECORD

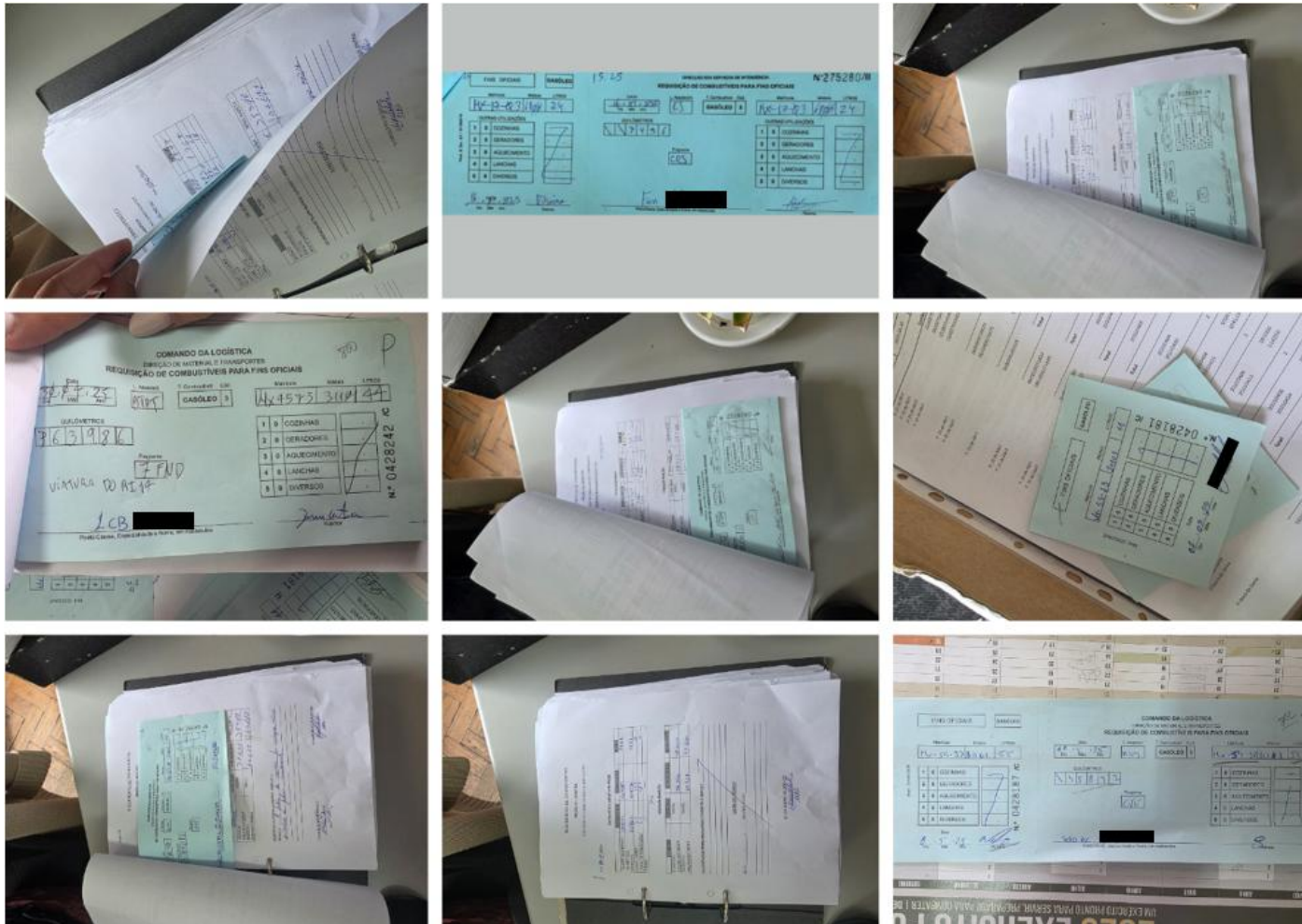


Figure 4 - Direct observation on Paper documents used in the mapped process in Regimento de Transportes and their respective Archives

Defesa Portal INTRANET Procura Avançada

Ministério da Defesa Nacional PORTUGAL

SIGNet > Gestão de Combustíveis > Processo de Despesa > Alterar Password

SIG NET

SIGNet > Gestão de Combustíveis > Movimentos de Mercadoria > Movimento

Perfil: [] [Alterar]

Gestão de Combustíveis

Reservas

Entradas de Mercadorias

Controlo de Qualidade

Inspecção Pontual

Movimentos de Mercadoria

Consumo de Purga

Defueling

Stocks

Contadores

Processo de Despesa

Delegação de Competências

Documentos Assinados

Lista de Tarefas Pendentes

Alterar Password

Movimentos de mercadorias

Foram registados 4 movimentos de material.

- ▶ 44,0L de 9140MD0220713 de 4D316F5453 para MX-04-69 com o número 4900218818
- ▶ Documento de medição de Km registado com o número 4010758.
- ▶ Documento de medição de combustível registado com o número 4010757.
- ▶ 55,0L de 9140MD0220713 de 4D316F5453 para MX-59-37 com o número 4900218819
- ▶ Documento de medição de Km registado com o número 4010760.
- ▶ Documento de medição de combustível registado com o número 4010759.
- ▶ 12,0L de 9140MD0220713 de 4D316F5453 para MX-44-45 com o número 4900218822
- ▶ Documento de medição de Km registado com o número 4010762.
- ▶ Documento de medição de combustível registado com o número 4010761.
- ▶ 35,0L de 9140MD0220713 de 4D316F5453 para MX-46-15 com o número 4900218823
- ▶ Documento de medição de Km registado com o número 4010764.
- ▶ Documento de medição de combustível registado com o número 4010763.

Voltar


Figure 5 - SIGnet Main page and localization of the interface for fuel management

Movimentos de mercadorias

Origem material

Material	Estrutura	Estado depósito	Serviço	0% ocupação
<input type="text" value="- Selecione uma opção -"/>	<input type="text"/>	Stock disponível	L	
		Capacidade total	L	
		Capacidade livre	L	

Destino material

Estrutura	Quantidade (Lts)	Data e hora transporte	Operador	Estado depósito	Serviço	0% ocupação
<input type="text"/>	<input type="text"/>	09/05/2025	<input type="text"/>	Stock disponível		
Registo KM:	Registo Horas:	Registo Milhas:		Capacidade total		
<input type="text"/>	<input type="text"/>	<input type="text"/>		Capacidade livre		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>			

Submeter

Cancelar

Figure 6 - Blank interface for fuel management

Movimentos de mercadorias
Origem material

Material	Estrutura	Estado depósito	Serviço	94% ocupação
9140MD0220713 - GASÓLEO RODOVIÁRIO	4D316F5453	Stock disponível	47103,30L	
		Capacidade total	50000,00L	
		Capacidade livre	2896,70L	

Destino material

Estrutura	Quantidade (Lts)	Data e hora transporte	Operador	Estado depósito	Serviço	0% ocupação
MX-04-69 Registo KM: 114875	44 Registo Horas:	08/05/2025 08:01 Registo Milhas:	N [Redacted]	Stock disponível	0,00L	
				Capacidade total	2000,00L	
				Capacidade livre	2000,00L	
MX-59-37 Registo KM: 45892	55 Registo Horas:	08/05/2025 08:02 Registo Milhas:	N [Redacted] x	Stock disponível	0,00L	
				Capacidade total	2000,00L	
				Capacidade livre	2000,00L	
MX-44-45 Registo KM: 163401	12 Registo Horas:	08/05/2025 08:03 Registo Milhas:	N [Redacted] x	Stock disponível	0,00L	
				Capacidade total	2000,00L	
				Capacidade livre	2000,00L	
MX-46-15 Registo KM: 243643	35 Registo Horas:	08/05/2025 08:04 Registo Milhas:	M [Redacted] x	Stock disponível	0,00L	
				Capacidade total	2000,00L	
				Capacidade livre	2000,00L	

Figure 7 - Interface for fuel management with the required information

Movimentos de mercadorias



Foram registados 4 movimentos de material.

- ▶ 44,0L de 9140MD0220713 de 4D316F5453 para MX-04-69 com o número 4900218818
- ▶ Documento de medição de Km registado com o número 4010758.
- ▶ Documento de medição de combustível registado com o número 4010757.
- ▶ 55,0L de 9140MD0220713 de 4D316F5453 para MX-59-37 com o número 4900218819
- ▶ Documento de medição de Km registado com o número 4010760.
- ▶ Documento de medição de combustível registado com o número 4010759.
- ▶ 12,0L de 9140MD0220713 de 4D316F5453 para MX-44-45 com o número 4900218822
- ▶ Documento de medição de Km registado com o número 4010762.
- ▶ Documento de medição de combustível registado com o número 4010761.
- ▶ 35,0L de 9140MD0220713 de 4D316F5453 para MX-46-15 com o número 4900218823
- ▶ Documento de medição de Km registado com o número 4010764.
- ▶ Documento de medição de combustível registado com o número 4010763.

[Voltar](#)

Figure 8 - Correct input information

Movimentos de mercadorias



Foram registrados 6 movimentos de material.

- ▶ 30,0L de 9140MD0220713 de 4D316F5453 para MX-04-90 com o número 4900222432
- ▶ Documento de medição de Km registrado com o número 4011431.
- ▶ Documento de medição de combustível registrado com o número 4011430.
- ▶ 22,0L de 9140MD0220713 de 4D316F5453 para MX-64-15 com o número 4900222433
- ▶ Documento de medição de combustível registrado com o número 4011432.
- ▶ 38,0L de 9140MD0220713 de 4D316F5453 para MX-07-84 com o número 4900222435
- ▶ Documento de medição de Km registrado com o número 4011434.
- ▶ Documento de medição de combustível registrado com o número 4011433.
- ▶ 41,0L de 9140MD0220713 de 4D316F5453 para MX-41-55 com o número 4900222436
- ▶ Documento de medição de combustível registrado com o número 4011435.
- ▶ 31,0L de 9140MD0220713 de 4D316F5453 para MX-56-49 com o número 4900222437
- ▶ Documento de medição de Km registrado com o número 4011437.
- ▶ Documento de medição de combustível registrado com o número 4011436.
- ▶ 44,0L de 9140MD0220713 de 4D316F5453 para MX-55-08 com o número 4900222438
- ▶ Documento de medição de Km registrado com o número 4011439.
- ▶ Documento de medição de combustível registrado com o número 4011438.



O registro de entrada retomou os seguintes erros:

- ▶ Valor registrado inferior ao último Documento de Medição.
- ▶ Valor registrado inferior ao último Documento de Medição.
- ▶ Data/Hora anterior à Data/Hora da última medição.

Voltar

Figure 9 - Mix of correct and incorrect input information

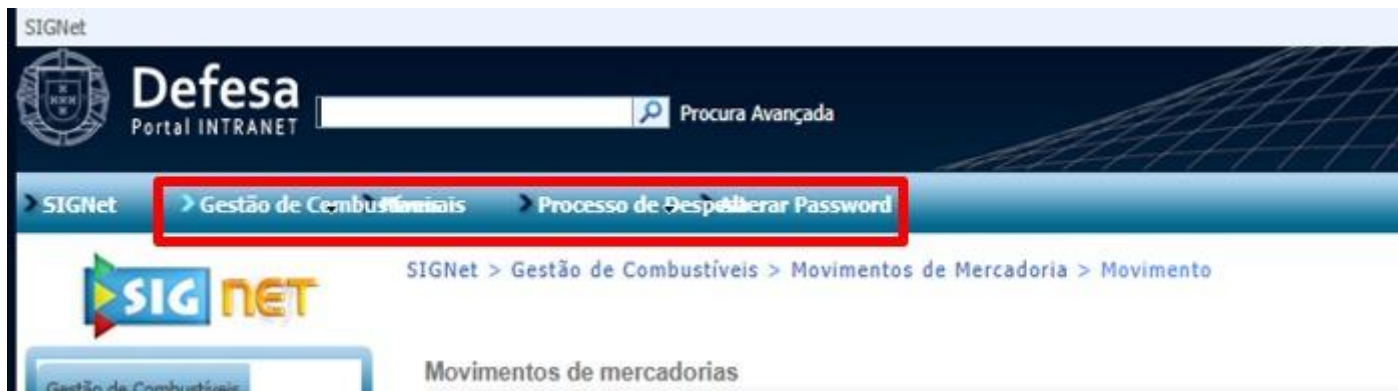


Figure 10 - Example of a bug occurring in SIGNet

APPENDIX E – FIELD-BASED WORKFLOW MAPPING

Macro processo de abastecimento de combustíveis e respetiva gestão informacional								
ATIVIDADE	LOCAL	QUEM	PROCESSO	Tempo despendido	FREQUÊNCIA	RISCOS	Frequência Relativa dos Riscos	DORES
Abastecimento de Combustível	Qualquer sitio	Condutor do Veículo a Abastecer	decide abastecer	*	10x Dia útil em média			
			desloca-se ao Regimento	*				
	No Regimento	Condutor do Veículo a Abastecer	telefona para o telefone de serviço que é atendido pelo Praça de Serviço da AMG	1min				
			desloca-se à Bomba de Combustível	3min				
	Bombas de combustível	Praça de Serviço da CCS	destranca a bomba com chave que transporta consigo	5s				
			abastece o veículo manualmente	em média 4 minutos para veículos ligeiros e 10min pesados. 6 min 45s em média geral				
			tranca a bomba de combustível	5s				
			Verifica no ecrã da bomba quantos litros colocou	5s				
			Subtotal: 11min					
	Preenchimento do formulário com os dados do abastecimento	Gabinete ao lado das Bombas	Praça de Serviço da CCS	destranca a porta do gabinete com chave que transporta consigo		5s		
Deslocar ao gabinete das bombas, a 10m de distância				10s				
Pega no boletim				5s		E se acabaram os papeis?	1% - há sempre muitos papéis no gabinete	
Pega na Caneta				5s		E se não houver caneta?	1% - há sempre várias canetas no gabinete	
Preenche o papel com os dados(matrícula da viatura abastecida, kms da viatura, data, programa, ligeiro ou pesado, viatura externa ou interna)				1min 10s		Enganar no registo	5% das vezes	
Assina o boletim				5s				
Condutor do Veículo a Abastecer			Assina o boletim	10s				
Praça de Serviço da CCS			tranca a porta do gabinete com chave que transporta consigo	5s				
Subtotal: 2min								

Figure 11 - Field-based workflow mapping - part 1

ATIVIDADE	LOCAL	QUEM	PROCESSO	Tempo despendido	FREQUÊNCIA	RISCOS	Frequência Relativa dos Riscos	DORES
Preenchimento e Cálculos da Folha de Serviço Diária e sua entrega na Secção Logística	Gabinete ao lado das Bombas	Praça de Serviço da CCS	Cálculos e Preenchimento manual da Folha de serviço Diário (em papel)	6 min	1x dia útil			
	Entre as bombas e o Gabinete da logística		Deslocamento até ao gabinete da logística	4min				Diariamente os papeis do dia anterior são entregues na secção logística à Técnica civil da Secção Logística
	Gabinete da Secção Logística		Retirar cópia na impressora e entregar o documento original à Técnica civil da Secção Logística	2min				
	Entre as bombas e o Gabinete da logística		Deslocamento de retorno	3min				
				Subtotal:15min				
Colocação, reforço e recolha dos formulários	Bombas de combustível	Praça de Serviço da CCS	Quando necessário vai requisitar ao Pelotão de Reabastecimento da Unidade	10min	Quando necessário (média 1x mês)			
Colocação em SIGNet dos dados do boletim abastecimento	Gabinete da Secção Logística	Técnica civil da Secção Logística	Pega nos Papéis da sua secretária	10s	1x dia útil			
			Abre o SIGNet no Módulo necessário	20s				
			Copia do papel para o SIGNet	1min por boletim(10 em média)		Caligrafia não Legível	20% dos boletins	Difícil de ler o papel quando as letras não são bem legíveis, ter de telefonar frequentemente ao praça de serviço que efetuou o abastecimento para saber os valores corretos. Caso este não se lembre
			Resolução de problemas (Tefona ao Praça que realizou o abastecimento caso algo não seja legível. Procura num ficheiro no seu Computador as matrículas corretas quando vem no boletim a errada	nem todos os dias, média de 10 min por dia útil				Por vezes o condutores apenas têm informação da matrícula Civil e não da Militar que é necessaria inserir no SIGNet
			Guarda em SIGNet	30s				SIGNet muitas vezes é lento e demora para carregar e descarregar informação. Por vezes o sistema vai abaixo.
			Verifica se ficou concluído com sucesso	30s				
			Em caso de erro normalmente envia email para a DRT. Em alguns casos Corrige erros.	nem todos os dias, média de 5 min por dia útil		Enganar no registo	3% dos boletins	Em caso de erro no preenchimento em SIGNet, tem de enviar um email à DRT para que o corrigam, não pode ser a própria a efetuar a correção. As correções são centralizadas na DRT.
			Arquiva no seu computador os registos efetuados	2min 15s				
			Arquiva os documentos num dossier que existe para o efeito na sua área de trabalho e guarda-o	2min 15s				
				Subtotal: 30min				

Figure 12 - Field-based workflow mapping - part 2