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Intelligent Systems Applied to Management Control

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Master's in Business Administration

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Resumo

As constantes inovações tecnológicas e transformação digital estão a alterar os modelos de negócio e a cultura organizacional, tornando os sistemas inteligentes indispensáveis nas atividades profissionais. Consequentemente, há um interesse crescente em explorar a relação entre sistemas inteligentes e desempenho organizacional.

No controlo de gestão, os Sistemas Inteligentes têm o potencial de simplificar e melhorar processos, incluindo a tomada de decisões e o planeamento estratégico. Apesar deste potencial, existem poucos estudos sobre o tema, o que leva a uma compreensão limitada dos fatores e estratégias que influenciam a integração eficaz destes sistemas. Nesse sentido, a presente investigação tem como objetivo dar resposta a este pressuposto e explorar a implementação eficaz destes sistemas, com o objetivo de contribuir para a melhoria dos processos no controlo de gestão.

Para atingir os objetivos pré-definidos, adotou-se uma abordagem qualitativa. Realizaram-se 17 entrevistas para recolher informações sobre os benefícios, desafios, fatores-chave e estratégias que influenciam a eficácia dos sistemas inteligentes nos processos de controlo de gestão.

Os resultados desta investigação contribuem para o conhecimento existente acerca da aplicação de sistemas inteligentes no controlo de gestão, oferecendo um guia prático para as organizações que procuram integrar estes sistemas para melhorar a tomada de decisão e o planeamento estratégico. O estudo enfatiza a importância de seguir um método sistemático para tirar o máximo proveito do potencial destes sistemas. Ao adotar as estratégias e considerações recomendadas, as organizações podem beneficiar de decisões e planeamento mais informados, o que levará a melhores resultados e maior retorno sobre o investimento.

Palavras-chave: Sistemas Inteligentes, Inteligência Artificial, Controlo de Gestão, Tomada de Decisão, Planeamento Estratégico, Portugal

Classificação JEL:

M10 Administração de Empresas – Geral
M15 Administração de Empresas – IT Gestão

Abstract

The rapid pace of technological innovation and the ongoing digital transformation are changing business models and organizational culture, making intelligent systems indispensable in professional activities. Consequently, there is a growing interest in exploring the relationship between intelligent systems and organizational performance.

Within management control, Intelligent Systems have the potential to simplify and improve processes, including decision-making and strategic planning. Despite this potential, there is limited research and studies on this topic, contributing to a limited understanding of the factors and strategies that influence the effective integration of intelligent systems. Therefore, this research aims to bridge this gap and explore the successful implementation of intelligent systems to contribute to decision-making and strategic planning processes in management control.

A qualitative approach was adopted to achieve the predefined objectives, involving 17 interviews to collect information about the perceived benefits, challenges, key factors, and strategies influencing the effectiveness of intelligent systems in management control processes.

The findings of this research contribute to the existing knowledge of intelligent systems in management control, offering a practical guide for organizations seeking to integrate these systems to enhance decision-making and strategic planning. The study emphasizes the importance of following a well-planned and effectively integrated framework to fully benefit from the potential of intelligent systems in driving organizational success. By adopting the recommended strategies and considerations, organizations can benefit from more informed decisions and planning, ultimately leading to enhanced outcomes and higher returns on investment.

Key Words: Intelligent Systems, Artificial Intelligence, Management Control, Decision-Making, Strategic Planning, Portugal

JEL Classification:

M10 Business Administration – General

M15 Business Administration – It Management

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List of Abbreviations and Acronyms

AI	- Artificial Intelligence
BI	- Business Intelligence
DSS	- Decision Support Systems
ML	- Machine Learning
IDSS	- Intelligent Decision Support Systems
IS	- Intelligent Systems
IT	- Information Technology
KPI	- Key Performance Indicators
MCS	- Management Control Systems
MIS	- Management Intelligent Systems
ROI	- Return on Investment
RQ	- Research Question

CHAPTER 1 – Introduction

This chapter establishes the context of the dissertation by presenting the research problem and objectives, highlighting the study's relevance, and providing an outline of the dissertation structure.

1.1 Framework and Research Problem

In today's complex world, numerous problems and systems defy traditional mathematical models, as they are too uncertain to represent. The advances in Intelligent Systems (IS) present new opportunities and challenges in addressing these complex problems, offering autonomy and decision-making capabilities (Shin & Xu, 2017). While previous studies have explored the potential of IS in helping organizations address these challenges, there is a need for a deeper understanding of the processes through which organizations can get value (Trieu, 2017).

Expanding on Trieu's (2017) insights, Intelligent Systems and AI-based tools go beyond replacing tasks. They provide valuable data and relevant information that lead to better processes and complement human decision-making.

Several organizations have already adopted Intelligent Systems to enhance their business management control, leveraging the extensive data collected to improve customer management, supply chain optimization, and risk management, thereby gaining a competitive advantage. (Dehbi, Lamrani, Belgnaoui & Lafou, 2022).

However, despite the potential benefits of IS in enhancing management control processes, there is still little focus on its use due to the lack of understanding regarding its effective integration and the specific systems that can be developed or implemented. Therefore, this research aims to address this gap by studying how to integrate intelligent systems to enhance management control practices, including decision-making and strategic planning.

By investigating the impact of Intelligent Systems on management control, this dissertation aims to contribute to understanding their practical implementation and provide valuable insights for organizations seeking to implement IS.

1.2 Objectives and Research Questions

Due to organizations' complex and dynamic environment, there is a greater demand to use intelligent systems to improve strategic planning, decision-making processes, and organizational performance. Nevertheless, the successful integration of intelligent systems into management control frameworks represents several challenges, such as organizational resistance, technological constraints, and the need for a comprehensive understanding of how to use these systems effectively.

Therefore, this dissertation's main objectives are: (i) to explore practical strategies for the implementation of Intelligent Systems in management control; (ii) to analyze how intelligent systems can enhance decision-making processes and strategic planning; (iii) to develop a convincingly significant study that can support future improvements and recommendations on effectively integrating intelligent systems in management control.

To achieve the defined objectives, this research seeks to address the following key questions:

(RQ1) – What are the key factors contributing to the successful implementation of Intelligent Systems?

(RQ2) – What strategies and best practices can organizations adopt to ensure the efficient integration of IS in their management control processes?

(RQ3) – How do Intelligent Systems impact strategic planning and its effectiveness in improving organizational performance?

(RQ4) – How do Intelligent Systems enhance decision-making processes within organizations?

By examining these research questions, this study aims to offer valuable insights into the practical implementation of IS in management control and contribute to the existing knowledge in the area. The findings of this research will address the benefits, challenges, and strategies associated with integrating intelligent systems into management control practices. These findings might support organizations seeking to adopt IS, offering guidance and support through effective implementation.

1.3 Dissertation Structure

The present dissertation is divided into two main parts.

The first part focuses on reviewing existing relevant literature and research on intelligent systems and their application in management control. This provides an understanding of the current state of knowledge.

The literature review is further divided into three main topics, which are Intelligent Systems, Management Control, and the role of Intelligent Systems in management control. Throughout these topics, other themes including Types of intelligent systems, the Development of Intelligent Systems and Ai-based models for enhanced decision-making and organizational performance, the implementation of intelligent systems on management control, and benefits and challenges are also discussed.

The dissertation's second part consists of the empirical study, which is further divided into four chapters: Theoretical Approach, Methodology, Findings and Results, and Conclusions.

The Chapter 3, consisting of the Theoretical Approach, explains the connection between the literature review and the research questions, which will serve as a structure for the empirical study. The fourth chapter, Methodology, details the research model used in the study, including the research plan, data collection methods, and data analysis techniques. The fifth chapter, Findings and Discussion, includes an analysis and interpretation of the collected data in relation to the research questions and objectives defined in the study.

Finally, the last chapter of the study, Conclusions, draws conclusions based on the results and findings presented in the previous chapter. This section discusses the implications of the findings for management control and intelligent systems, emphasizing their significance and potential impact. Additionally, it identifies the limitations encountered during the study and proposes recommendations for future research. The practical implications of the research are also discussed.

By following this structure, the dissertation aims to provide a comprehensive understanding of the topic, including relevant literature, and present relevant findings that contribute to the field of intelligent systems in management control.

CHAPTER 2 – Literature review

This chapter explores the existing literature and research studies on intelligent systems and how they are applied in management control. The main themes, theories, and concepts are identified, offering insights into the current state of knowledge in the field.

2.1 Intelligent systems

In recent years, there has been an increase in the interest and use of different soft computing techniques. While traditional approaches have proven effective for mathematically well-defined problems with accurate models, they often lack autonomy and decision-making capabilities, limiting their effectiveness in uncertain environments. As Shin and Xu (2017) highlighted, Intelligent systems (IS) offer a new approach to addressing these challenging problems.

As described by Gretzel (2011), intelligence involves the ability to comprehend, learn from experience, acquire and retain knowledge, and respond quickly and effectively to new situations. Building on this understanding, Shin and Xu (2017) define IS as a broad term that refers to methods to design, optimize, and control various systems without relying solely on mathematical models, similar to how humans work. Therefore, Intelligent systems stand out from other approaches due to their remarkable capacity to learn from experiences and maximize success. IS can sense the environment, continuously evaluate responses, and learn from their actions to achieve specific goals, ultimately providing enhanced decision support through relevant data.

Nowadays, with technology advances, it is no longer sufficient for systems to operate solely in collaboration. According to Monte-Serrat and Cattani (2022), machines must now understand human language, process information, and build meaning. In other words, the system must comprehend how to process the provided data resources to replicate the essence of the human cognitive process.

Intelligent systems have the potential to offer valuable support to professionals in many areas by providing specialized knowledge, essential data, process automation, efficiency gains, and value creation, as indicated by Gretzel (2011). However, intelligent systems design presents technical challenges related to knowledge representation, reasoning, machine learning, and perception.

As Intelligent Systems continue to gain prevalence, building trust and acceptance becomes paramount for their continued progress and development. Siau and Wang (2018) emphasize that trust-building is a dynamic process reliant on performance,

purpose, and usage. To encourage continuous trust development, IS applications must prioritize user-friendliness, reliability, collaboration, seamless human-computer interaction, security, and privacy protection. Explaining conclusions or actions is also crucial to avoid a lack of clarity that may lead to distrust and hinder trust development. Buschek, Eiband, and Hussman (2022) further elaborate on the challenge posed by the opaque nature of some intelligent systems in terms of usability and human-computer interaction. Recent research emphasizes the need for transparency, intelligibility, interpretability, and explainability to support users in understanding intelligent systems and fostering trust in their outcomes.

2.1.1 Types of Intelligent Systems

This literature review focuses on four specific types of intelligent systems: Artificial Intelligence, Machine Learning, Decision Support Systems, and Business Intelligence. These selections were made based on their remarkable relevance and potential impact on management control. While acknowledging the existence of other systems, the rationale behind exploring these four lies in their significant automation capabilities and contributions to optimizing decision-making processes. Additionally, their potential to provide valuable insights into management control makes them essential subjects of investigation.

2.1.1.1 Artificial Intelligence

The technological revolution has introduced various devices and systems that help address the challenges encountered in daily life activities. Among these innovations, Artificial Intelligence (AI) is one of the most remarkable achievements highlighted by Kambur (2015). Expanding on this perspective, Berente, Gu, Recker, and Santhanam (2021) state, "AI marks the dawn of a new age of information technology."

According to the perspectives of Duan, Edwards, and Dwivedi (2019), there is no commonly accepted definition of AI. Typically, AI implies the ability of a machine to learn from experience, adjust to new inputs and perform human-like tasks. Kambur (2015) defines AI as a computer-based system that performs human-made tasks. Irabor-Ighedosa and Zeb-Obipi (2022) further elaborate that AI involves exploring problem-solving behavior and creating intelligent computer systems. Therefore, the purpose of AI is not to imitate Intelligence but to make the program intelligent.

Berente et al. (2021) emphasize that AI involves communicating, leading, coordinating, and controlling a continuously evolving frontier of computational advancements that draw upon human Intelligence to address increasingly complex decision-making problems.

As noted by Kambur (2015), the applicability of AI spans various fields, demonstrating its impact on improving work productivity and its significant economic outcomes and potential for progress. In harmony with this view, Berente et al. (2021) highlight that, especially in the business context, AI provides unprecedented opportunities for designing intelligent products, devising novel service offerings, and inventing new business models and organizational forms.

According to the findings of Berente et al. (2021), machine learning technologies, which are at the core of contemporary AI, have enhanced autonomy, increased learning capacity, and are more inscrutable than any previous intelligent information technology. Current AI technologies, including robots and autonomous vehicles, facial recognition, natural language processing, and virtual agents of all kinds, are being implemented to solve challenges across a wide range of problem domains. Some estimations suggest that more than half of enterprises were implementing some form of these advanced technologies in 2020, with their deployment continuing to grow remarkably.

However, as underlined by Berente et al. (2021), it is essential to note that AI is not a technological panacea. Alongside its new possibilities, there are emerging, and complex challenges related to business strategies, human–AI interfaces, data management, privacy, security, ethics, labor, and human rights, among others.

Kambur (2015) also pointed out that diverse subcategories of AI have also been widely used, in recent years, including data mining, predictive modeling, data analytics, and big data. These new advanced forms of AI have the potential to revolutionize business operations.

2.1.1.2 Machine Learning

Machine Learning (ML) is one of the most impactful technologies in today's era, shaping the future of work in many industries, as stated by Irabor-Ighedosa and Zeb-Obipi (2022). Shinde and Shah (2018) define ML as an intelligent mechanism that perceives its environment and takes actions to maximize the likelihood of successfully achieving its goals. Additionally, Zhong, Salehi, and Johnson (2022) explain that ML employs computer algorithms to perform specific tasks based on experience and data automatically.

Machine learning involves learning patterns and making predictions based on data. Alpaydin (2021) highlights its technical benefits, as the system can detect and adapt to changes without requiring the designer to predict and present solutions for all possible scenarios.

However, despite the growing prevalence of ML, there remains a concern among end users regarding trust due to a need for more understanding and familiarity with its methods, as highlighted by Chase, Harrison, Burke, Lackmann, and McGovern (2022). Therefore, to enhance the reliability of ML, recent studies suggest the importance of creating articles that explain ML concepts using plain language discussion and examples.

Moreover, using ML carries unknown and possible side effects that must be detected and addressed. Alpaydin (2021) emphasizes that the success of ML solutions heavily relies on the availability of high-quality data, as biased or corrupt data can lead to flawed decisions. Therefore, individuals' willingness to share information can help ML products or services' learning process and development. Therefore, data privacy and security are crucial considerations. Data collection, storage, and processing of data must prioritize confidentiality, instilling confidence in users that the system respects their privacy rights, makes lawful and responsible decisions, and exhibits fairness and transparency in decision-making, ultimately enhancing trust in ML.

Based on the findings of Alpaydin (2021), automated decision-making, increasingly reliant on ML, is expanding due to improved accuracy and decreasing automation costs. However, the benefits of automation and ML come with drawbacks. Over-reliance on automation can pose risks, and ML algorithms, while proficient at establishing correlations, can also detect erroneous correlations, especially when the data set is small, highlighting the need for explainability.

2.1.1.3 Intelligent Decision-Support Systems

Over the past few decades, significant advancements in Information Technology applications have transformed decision-making processes and problem-solving activities. Tariq and Rafi (2012) mention that these advancements have led to the development of various types of Decision Support Systems (DSS), including Intelligent Decision Support Systems (IDSS).

As defined by Ada and Ghaffarzadeh (2015), DSS are information systems designed to provide analytical modeling and information to support and enhance managerial decision-making processes. These systems are designed to be user-friendly and convenient, requiring no advanced computer skills to generate reports. However, as

Tariq and Rafi (2012) mention, it is essential to note that DSS does not replace human decision-makers but assists them in making better and more consistent decisions.

As described by Ada and Ghaffarzadeh (2015), the critical characteristics of DSS include adaptability to semi-structured and unstructured decision contexts, continuous support for decision-makers throughout the different phases of the process, reliance on underlying data and models, and an interactive decision aid. Tariq and Rafi (2012) further elaborate that an effective DSS should provide access to a knowledge repository, offer an infrastructure for interpreting and classifying new knowledge, and distinguish between verified and unverified data.

Organizations are increasingly implementing DSS to gain advantages such as speed, productivity, support, decision quality, and a competitive edge, as mentioned by Tariq and Rafi (2012).

Recently, significant improvements have been noticed in the DSS field due to the integration of AI techniques and methods, such as knowledge bases, fuzzy logic, multi-agent systems, natural language, genetic algorithms, neural networks, and more, as indicated by Tariq and Rafi (2012). This integration of AI technologies into DSS, resulting in IDSS, aims to develop computer-based systems that mimic human qualities, like approximation, reasoning, intuition, and common sense. This integration enhances the ability of operators and decision-makers to perform their duties more effectively and collaboratively.

As Tariq and Rafi (2012) state, IDSS includes domain knowledge, modeling, and analysis systems that provide users with intelligent assistance. IDSS is a powerful tool incorporating a knowledge management component, allowing it to store and manage a new class of emerging AI tools, such as machine learning and case-based reasoning. These tools extract knowledge from previous data and decisions, enabling IDSS to support repetitive, complex real-time decision-making. So, IDSS can capture, refine, store, and apply knowledge to support effective decision-making.

2.1.1.4 Business Intelligent Systems

Business Intelligence (BI) has emerged as a crucial IT investment area within organizations worldwide. Arnott, Lizama, and Song (2017) emphasize its prominent position as a top technology priority that has remained consistent for years.

Sabanovic and Søylen (2012) define BI as a multifaceted term encompassing various techniques, processes, and tools that enable faster and more effective decision-making in business enterprises. These BI systems assist decision-makers in making better and more efficient decisions and contribute to improving the entire organization's

Return on Investment (ROI), attracting new customers, suppliers, and employees, and enhancing overall satisfaction.

Popovič, Hackney, Coelho, and Jaklič (2012) further support this perspective, describing BI as computerized processes and methods that transform data into valuable information and knowledge crucial for aiding business decision-making, particularly in highly competitive environments. In alignment with this standpoint, Péjic, Čeljo, and Zoroja (2016) further describe BI as software platforms that support retrieving valuable information and knowledge to enhance decision-making efficiency.

In today's highly competitive world, where modern organizations generate massive amounts of information, timely and relevant data is critical in supporting strategic decision-making and gaining a competitive advantage. Gauzelin and Bentz (2017) highlight the benefits of BI systems in this process, as they possess tools that facilitate the transformation of data into valuable information. One popular technique within BI is data mining methodology, enabling organizations to analyze large datasets, extract meaningful patterns, and make predictions.

Gauzelin and Bentz (2017) categorize four significant types of BI used in businesses: reporting, analysis, monitoring, and prediction tools. Reporting systems focus on developing business documents containing valuable information about past events. Analysis systems use spreadsheet analysis, ad-hoc query, and visualization tools to provide insights into the reasons behind these events. Monitoring tools allow businesses to track real-time data and receive timely reports through dashboards, key performance indicators, and business performance management. Prediction systems use data mining and predictive modeling tools to forecast future business trends and outcomes. Since prediction systems are often complex, businesses may seek third-party services or use automation software to implement them.

As Gauzelin and Bentz (2017) pointed out, BI systems significantly enhance decision-making and provide valuable benefits by offering quality information that supports timely and effective decision-making, empowering organizations to make informed choices and take appropriate actions. The innovative thinking, planning, prediction, and problem-solving capabilities of BIS contribute to advancing business goals and overcoming potential disruptions. Additionally, BI systems profoundly impact the entire organization, leading to improved ROI, attracting new customers and suppliers, and facilitating the recruitment of top employees. Adopting BI aims to enhance overall company performance, shaping the organization's operations and influencing its strategic decision-making. Thus, BI systems play an instrumental role in shaping the overall performance of an organization.

2.1.2 Development of Intelligent Systems and AI-Based Models for enhanced Decision-Making and Organizational Performance.

Artificial Intelligence, a leading technology integrating human behavior and Intelligence into machines and systems, plays a crucial role in developing automated, intelligent, and smart systems that cater to the needs of today's organizations. According to Sarker (2022), different types of AI, such as analytical, functional, interactive, textual, and Visual AI, have significant potential to enhance the Intelligence and capabilities of diverse applications. However, developing effective AI-based models presents challenges due to the dynamic nature and diversity of real-world problems and data.

Based on Sarker's (2022) viewpoint, three key terms have emerged as fundamental criteria for designing applications and systems in every sector: automation, Intelligence, and intelligent computing. Automation aims to reduce human involvement in operations. Intelligence focuses on extracting insights and usable knowledge from data, and intelligent computing involves self-monitoring, analysis, and reporting, commonly known as self-awareness. As the world increasingly relies on technology, adopting modern innovative technologies enables quicker and more informed decision-making, enhancing productivity and profitability in business processes.

When it comes to building Intelligent systems and AI-based models, AI techniques can be classified into ten categories, as outlined by Sarker (2022): (1) machine learning; (2) neural networks and deep learning; (3) data mining, knowledge discovery, and advanced analytics; (4) rule-based modeling and decision-making; (5) fuzzy logic-based approach; (6) knowledge representation, uncertainty reasoning, and expert system modeling; (7) case-based reasoning; (8) text mining and natural language processing; (9) visual analytics, computer vision, and pattern recognition; (10) hybridization, searching, and Optimization. Understanding the relevance and applicability of these techniques across various real-world scenarios is essential for revolutionizing management practices and driving business success.

Managers can also leverage the benefits of Intelligent Systems and enhance decision-making processes by proactively exploring and proposing innovative ways to incorporate AI into their operations, as Mikalef, Parida, Singh, and Altwaijrt (2023) suggested. Training managers on recent advancements in AI and sharing successful usage cases can further support this process. Additionally, allocating sufficient financial resources and allowing freedom and time for experimentation are crucial factors to consider.

Following the perspectives of Mikalef et al. (2023), IS plays a crucial role in various aspects of decision-making and organizational performance. They are

instrumental in processing large volumes of data, enabling quick decision-making, and providing valuable insights. Additionally, IS have the potential to revolutionize conventional activities by automating manual processes, thereby enhancing operational efficiency.

According to Hočevár and Jaklič (2010), managers seeking to maintain the competitiveness of their enterprises must recognize that relying solely on intuition is insufficient. Effective decision-making requires well-supported information about internal events within the organization and its external environment. Organizations require reliable information systems that grant analysts and managers access to the necessary information to enable quality and effective decision-making. Regardless of the type of data processed by an information system and the methods employed, the fundamental objectives remain consistent: the information delivered by the system must be of high quality, characterized by accuracy, timeliness, and clarity. The ability to promptly transform vast and complex data into useful information is crucial in establishing a solid foundation for making informed business decisions and achieving a competitive advantage.

The impact of IS on decision-making is further emphasized by Agrawal, Gans, and Goldfarb (2018), who highlight the advanced prediction capabilities of these systems. These capabilities offer new possibilities for improving outcomes and complement human judgment by providing valuable data and information. As a result, decision-makers are empowered with enhanced capabilities, enabling them to optimize their decision-making processes and make better, more nuanced decisions.

However, as highlighted by Mikalef et al. (2023), many organizations still struggle to effectively implement their AI investments due to the need for careful alignment of AI with organizational operations and a limited understanding of how to strategically develop AI as an asset to gain a competitive advantage. Nevertheless, given the increasing complexity and pace of markets, leveraging AI applications becomes essential for organizations to navigate a rapidly evolving business environment. Early and continuous investment in IS enables the development of distinct competencies that outperform the competition. Embracing the development of intelligent systems and AI-based models empowers organizations to unlock new opportunities and improve overall performance in dynamic and competitive markets.

2.2 Management control

In literature, management has been defined in different ways. However, most definitions focus on organizing resources and managing operations to achieve

organizational goals, as Merchant and Van der Stede (2017) indicated. Sun & Firmin (2012) further emphasize that management involves planning, organizing, leading, and controlling, thereby involving decision-making, negotiation, and resource allocation.

Management control, on the other hand, is perceived differently by authors. Dehbi, Lamrani, Belganoui, and Lafou (2022) view management control as a critical function that includes a set of controls managers must lead to achieving the predetermined organization goals. They highlight the importance of managers addressing external difficulties and challenges while ensuring objective alignment with the organization's strategy.

Other perspectives focus more on behavioral control. For example, Merchant and Van der Stede (2017) suggest managers aim to influence employee behavior through Management Control Systems (MCS). According to their viewpoint, well-designed MCSs positively impact employee behavior, increasing the likelihood of goal achievement. Therefore, the primary function of management control is to encourage positive behaviors.

Zimmerman (1997, 2001, as cited in Malmi & Brown, 2008) proposes that managers may use systems to support their decision-making processes or facilitate employee decision-making. However, without mechanisms to monitor goal alignment and employee behavior, these systems become decision-support or information systems rather than control systems. Hence, managers can make a difference in the organization by making decisions or influencing their employees.

In line with these perspectives, Malmi and Brown (2008) suggest that management control comprehends both the systems managers use to influence employee behavior and systems created to facilitate efficient decision-making, either by themselves or at employees' levels.

In today's digital era, organizations are undergoing significant transformations due to the vast amount of data collected, as supported by Dehbi et al. (2022). As a result, managers frequently face the challenge of handling a large volume of data and generating meaningful insights to sustain a competitive advantage. The digital era has brought about a rapid pace of change, continuous transformations, and an unpredictable business environment, requiring companies to be adaptable and flexible to survive. To cope with these challenges, managers increasingly rely on new technologies to enhance their business management control.

2.3 The role of Intelligent Systems in Management Control

Digital transformation reshapes business models and organizational culture, making intelligent systems indispensable in professional activities. As indicated by Wamba-Taguimdje, Wamba, Robert, and Tchatchouang (2020), this transformation has led to significant changes at the managerial level, impacting all core processes and operations. As a result, there has been a growing interest in exploring the relationship between IS and organizational performance. This heightened interest has been driven by the rapid pace of innovation in this field, prompting recent scientific studies that aim to analyze and comprehend this relationship.

Research findings reported by Wamba-Taguimdje et al. (2020) have highlighted the positive impact of Intelligent Systems on organizational operations. With the exponential growth in processing power and the abundance of available data, organizations are increasingly drawn to the potential of intelligent systems.

Building upon the information above, a new concept that integrates management and intelligent systems, known as Management Intelligent Systems (MIS), has emerged. Sun and Firmin (2012) mention that MIS is a new research area focused on applying AI and Intelligent Systems in management. However, there is ongoing debate regarding integrating intelligent systems with management, mainly due to the limited focus on managerial functions and decision-making processes that IS influences.

Sun and Firmin (2012) emphasize intelligent systems' crucial role in enhancing operational, tactical, and strategic management processes. Managers increasingly rely on these systems to identify problems, analyze information, and make informed decisions. Thus, developing intelligent systems and technology over the past decades has significantly improved managers' planning, organizing, leading, and controlling skills.

As an applied field of artificial intelligence, Intelligent Systems encompasses the principles, methodologies, techniques, and processes of applying AI to real-world problem-solving. Sun and Firmin (2012) further explain that by leveraging IS, managers gain the ability to capture and create knowledge and find solutions to various management functions and decision-making processes. This, in turn, automates business activities, streamlines processes, and enhances human-machine interactions.

2.3.1 Implementation of Intelligent Systems on Management Control

Implementing Intelligent Systems in management control has gained significant momentum within top corporations due to the rapid advancement of Big Data

technologies and the emergence of AI. Duan et al. (2019) noted that this powerful combination has unlocked new possibilities for data-driven insights and predictions, leading corporations to recognize the value of investing in AI to enhance their business processes and decision-making.

Nonetheless, the adoption of Intelligent Systems is influenced by various factors. Research by Rouhani, Ashrafi, Zaravasan, and Afshari (2018) highlights critical factors such as business size, organizational readiness, organizational strategy, perceived benefits, perceived complexity, and environmental attributes.

Rouhani et al. (2018) indicate that organizational attributes, such as size, play a role in the decision to implement IS. Larger firms have more capabilities and financial and technological resources, enabling them to allocate adequate budgets and employ IT innovations, which increases the likelihood of adopting IS extensively. On the other hand, smaller organizations face resource constraints, such as financial limitations and lack of expertise, making them less likely to adopt innovations. Additionally, larger organizations with multiple levels of decision-making value the faster decision-making processes facilitated by these systems.

The adoption of IS is also influenced by organizational readiness, which includes financial and technological capabilities. Rouhani et al. (2018) explain that higher readiness levels increase the likelihood of adopting IS, with financial readiness referring to the organization's investment capability and technological readiness focusing on expertise and technological sophistication.

Another influential factor in the adoption decision is the organization's strategy. Rouhani et al. (2018) elaborate that prospector organizations, prioritizing continuous innovation and competitive positioning, tend to be more inclined to adopt IS. These organizations invest significantly in research and development and quickly respond to new opportunities.

Following the perspectives of Rouhani et al. (2018), it is also essential to consider perceived benefits and perceived complexity. Recent studies have found that organizations prioritize intangible benefits, such as improved strategies, efficient processes, and employee satisfaction, over immediate benefits like cost and time savings. This suggests that organizations prioritize long-term strategic benefits over immediate gains. However, perceived complexity negatively affects the adoption decision, with low understanding and lack of knowledge posing barriers to adoption.

Rouhani et al. (2018) state that environmental attributes, particularly in highly competitive industries, also increase the likelihood of adoption as organizations rely on IS for real-time information and decision-making to stay competitive.

According to a technology trend survey conducted by Gartner in 2018, and as stated by Duan et al. (2019), it was found that 59% of organizations were in the process of gathering information to develop their AI strategies, highlighting their recognition of the potential of AI and their active exploration of its possibilities for their operations. However, despite this recognition, very limited academic research papers focus on understanding the use and impact of the new generation of AI systems from the technology application perspective.

To achieve successful implementation of IS, following a systematic approach is crucial. Building upon Merchant and Van der Stede's (2017) work, four key steps can guide this process: defining the desired outcomes, assessing likely outcomes, selecting the appropriate set of controls, and determining the level of control.

Defining desired outcomes involves establishing clear organizational objectives and performance targets aligned with the mission, vision, and strategic goals. Critical success factors, performance metrics, and desired outcomes can be identified across various areas, such as financial targets, operational efficiency, customer satisfaction, or employee engagement. On the other hand, assessing likely outcomes requires analyzing internal and external factors that influence organizational performance, considering the current business environment, market conditions, industry trends, and organizational capabilities. Merchant and Van der Stede (2017) point out that techniques like SWOT analysis, market research, and competitive intelligence can help identify potential risks, opportunities, and challenges.

Merchant and Van der Stede (2017) indicate that selecting the appropriate controls involves choosing suitable mechanisms, such as financial, operational, behavioral, and technological controls, to bridge the gaps between desired and likely outcomes. The choice of controls should consider the organization's nature, industry, and specific objectives. Lastly, determining the level of control is crucial to strike the right balance between autonomy and accountability. Optimal control intensity depends on factors such as risk appetite, operational complexity, and employee trust and competence.

2.3.2 Benefits and Challenges

2.3.2.1 Benefits

The implementation of Intelligent Systems brings forth a multitude of benefits for organizations, including improved stakeholder satisfaction, the creation of advantageous

opportunities, enhanced organizational performance measurement, and the attainment of competitive advantage (Rouhani et al., 2018)

According to Rouhani et al. (2018), Intelligent systems also significantly and positively influence profit margin, revenue, and internal processes. By leveraging the power of intelligent systems, organizations can reduce costs, ultimately leading to increased profitability. For instance, Business Intelligence systems (BI) enable businesses to identify areas of cost savings, optimize resource allocation, and enhance operational efficiency. Moreover, these systems provide real-time data, offering timely and accurate insights crucial for informed decision-making. Consequently, businesses can adapt quickly to changing market conditions, capitalize on emerging opportunities, and make data-driven strategic decisions.

Arnott, Lizama, and Song (2017) highlight the crucial role of Intelligent Systems in managerial decision-making processes, contributing to strategic and operational aspects. These systems serve as valuable tools, assisting managers at various levels and providing the necessary inputs to make informed decisions. Senior managers rely on Intelligent Systems for strategic and tactical insights, while lower-level managers benefit from their support in day-to-day operations. Furthermore, Rouhani et al. (2018) mention the notable benefits of decision-making processes. By consolidating and analyzing vast amounts of data, organizations gain a deeper understanding of their operations, customers, and market trends. This comprehensive knowledge empowers them to make better-informed decisions, develop more effective strategies, and streamline processes to achieve optimal outcomes. Therefore, as Arnott et al. (2017) stated, Intelligent Systems effectively support achieving strategic business objectives, enhancing overall organizational performance.

Recent studies, as indicated by Wamba-Taguimdje et al. (2020), emphasize the positive impact of Intelligent Systems on organizational operations. These systems have a massive potential for enhancing strategic planning, investment decision-making, coordination, and control in management. They improve processes, enhance performance, reduce costs, and facilitate activity tracking through their informational, automation, and transformational effects. So, alongside the exponential growth in processing power and the abundance of available data, organizations are increasingly drawn to the potential of intelligent systems.

As the recognition of the value of investing in AI and machine learning algorithms grows, corporations are increasingly embracing these technologies to improve their business processes and facilitate decision-making. Perifanis and Kitsios (2023) explain that companies actively implement AI-based systems to automate operations, boost productivity, reduce costs, and gain a competitive advantage.

As noted by Agrawal, Gans & Goldfarb (2018) apud Duan et al. (2019), AI systems are transforming businesses by enhancing an organization's ability to use data to make predictions while reducing the associated costs. Therefore, and as supported by Merchant and Van der Stede (2017), managers are increasingly using computers, robots, expert systems, and other ways of automation to mitigate control problems. These automated devices can be programmed to perform tasks accurately and consistently, outperforming humans regarding consistency. Computers operate reliably and without ulterior motives by eliminating issues related to inaccuracy, inconsistency, and lack of motivation.

2.3.2.2 Challenges

In line with Merchant and Van der Stede's (2017) perspectives, it is crucial to acknowledge the challenges and limitations managers face when implementing intelligent systems in management control, as they play a significant role in ensuring the successful integration of these systems into the organizational processes.

One common challenge is resistance to change, as employees may be reluctant to adopt new control practices. Merchant and Van der Stede (2017) outlined that effective change management strategies, including clear communication, employee involvement, and training programs, can help overcome resistance and facilitate a smooth transition.

Another challenge is related to the availability and quality of information, as supported by Merchant and Van der Stede (2017). Intelligent systems rely on accurate and timely data to support decision-making and monitoring. Therefore, managers must ensure data sources and reporting systems are in place, considering data integrity and reliability.

Furthermore, Merchant and Van der Stede (2017) also mention the challenge of balancing flexibility and standardization, which are vital for adequate control, and require careful design and ongoing evaluation of the management control systems.

Based on Merchant and Van der Stede's (2017) findings, alignment with the organization's strategy is another critical aspect of achieving success. Intelligent systems should align with the strategic objectives, establishing a clear link between performance measures, system targets, and the organization's broader goals.

Merchant and Van der Stede (2017) emphasize continuous improvement as essential to keep intelligent systems relevant and effective. Regular monitoring and evaluation enable managers to identify gaps and make necessary adaptations. This ongoing improvement process ensures that the systems remain aligned with the organization's changing requirements.

Additionally, it is essential to acknowledge the limitations of automation in management control. Machines and decision models may struggle to replicate humans' complex and intuitive judgments. Furthermore, there are regulatory constraints and cost considerations to be mindful of, as implementing automation requires significant investments that tangible improvements in productivity and control must justify. Merchant and Van der Stede (2017) noted that automation may also introduce new control issues, such as obscuring the audit trail or increasing security risks.

Hočevár and Jaklič (2010) mention the challenge of justifying investments in implementing IS. Business executives often seek to determine whether the investment is financially viable and economically justified. Various evaluation methods can be employed to address this question, such as classic ROI calculation, cost-benefit analysis, net present value method, the internal rate of return, and other quantitative approaches. However, in evaluating investments in intelligent systems, relying solely on these quantitative methods may prove inadequate, insufficient, or impractical. Hence, more appropriate methods are those based primarily on a qualitative approach, such as case studies, empirical analyses, and other qualitative measures that can be employed independently or to complement quantitative approaches. As there is no universal approach, it is necessary to approach each case differently, considering the specific circumstances and objectives of the evaluation.

CHAPTER 3 – Theoretical Approach

The Chapter 3 links the literature review with the research questions, presenting the theoretical framework for further analysis and investigation.

3.1 Objectives and Research Questions

This chapter includes the theoretical framework that serves as the basis for the research. This dissertation will draw upon relevant theories and concepts from management control and intelligent systems.

As reviewed in Chapter II, the literature emphasizes a growing interest among organizations in investing in intelligent systems to improve business processes, automate operations and gain a competitive advantage, as Perifanis and Kitsios (2023) stated. Building upon this context, the primary goal of this study is to examine the impact of intelligent systems on management control processes. The aim is to explore the potential benefits and challenges associated with their implementation, ultimately providing a comprehensive understanding of their role in enhancing organizational performance and strategic planning.

To accomplish these objectives, research questions emerged to guide the investigation and provide valuable insights into the role and effectiveness of intelligent systems within management control.

(RQ1) – What are the key factors contributing to the successful implementation of Intelligent Systems?

When investigating the implementation of Intelligent Systems, Rouhani et al. (2018) identified several influencing factors, such as business size, organizational readiness, organizational strategy, perceived benefits, perceived complexity, and environmental attributes. While these findings mention important information, there remains a limited understanding of the critical factors leading to IS's successful implementation. Thus, the first research question of this study aims to explore these key factors.

(RQ2) – What strategies and best practices can organizations adopt to ensure the efficient integration of IS in their management control processes?

Based on a technology trend survey conducted by Gartner in 2018 and findings from Duan et al. (2019), it was revealed that 59% of organizations were actively gathering information to develop their Intelligent Systems strategies, indicating their recognition of AI's potential and their proactive exploration of its applications in their operations. Despite this recognition, there is a need for more academic research papers focused on understanding the usage and impact of the new generation of AI systems from a technology application perspective. Mikalef et al. (2023) further emphasized that many organizations face challenges in effectively leveraging their AI investments, as it requires careful alignment of AI with organizational operations and an understanding of how to strategically develop IS as an asset to gain a competitive advantage. It is within this context that the second research question arises.

(RQ3) – How do Intelligent Systems impact strategic planning and its effectiveness in improving organizational performance?

Research by Arnott et al. (2017), Wamba-Taguimdje et al. (2020), and Sun and Firmin (2012) highlight the positive influence of Intelligent Systems on strategic planning and other managerial processes. Implementing Intelligent Systems yields numerous benefits, such as improved stakeholder satisfaction, the creation of advantageous opportunities, enhanced organizational performance measurement, and competitive advantage (Rouhani et al., 2018). To further comprehend and validate these claims, the research question (RQ3) arose to investigate how Intelligent Systems influence strategic planning and contribute to enhancing overall organizational performance in management control.

(RQ4) – How do Intelligent Systems enhance decision-making processes within organizations?

The critical role of Intelligent Systems in decision-making processes and organizational performance is underlined in studies conducted by Mikalef et al. (2023), Hočevár and Jaklič (2010), and Agrawal, Gans, and Goldfarb (2018). These studies highlight how IS efficiently processes vast data, resulting in quicker decision-making, valuable insights, and advanced prediction capabilities. As a result of these findings, the research question (RQ4) emerges, aiming to understand how IS influences decision-making practices comprehensively. The goal is to provide valuable insights for organizations seeking to leverage these systems to enhance their performance and competitiveness.

The following Table 1 shows the relation between the objective of this study, the research questions, and the literature review,

Table 1 - Relation between Literature Review, Objectives and Research Questions

INTELLIGENT SYSTEMS APPLIED TO MANAGEMENT CONTROL		
OBJECTIVE	RESEARCH QUESTION	REFERENCES
Explore and analyze effective strategies for implementing Intelligent Systems in Management Control	(RQ1) What are the key factors contributing to the successful implementation of Intelligent Systems?	Merchant & Van der Stede (2017) Rouhani, Ashrafi, Zareravasan & Afshari (2018)
	(RQ2) What strategies and best practices can organizations adopt to ensure the efficient integration of IS in their management control processes?	Duan et al. (2019) Merchant & Van der Stede (2017) Mikalef et al. (2023)
Understand how Intelligent Systems can be implemented to enhance decision-making processes and strategic planning	(RQ3) How do Intelligent Systems impact strategic planning and its effectiveness in improving organizational performance?	Arnott, Lizama, and Song (2017) Perifanis & Kitsios (2023) Rouhani et al. (2018) Sun & Firmin (2012) Wamba-Taguimdje et al. (2020)
	(RQ4) How do Intelligent Systems enhance decision-making processes within organizations?	Hočevar and Jaklič (2010) Mikalef et al. (2023) Agrawal, Gans, & Goldfarb (2018) Arnott, Lizama, and Song (2017) Gauzelin and Bentz (2017) Malmi and Brown (2008)

Author's Elaboration

Chapter 4 – Methodology

This chapter provides a detailed explanation of the research methodology used in this study. It presents the data collection methods and techniques and offers an overview of the sample description, ensuring transparency and reliability.

4.1 Research Model

The present investigation used convenience sampling, which involves selecting participants based on their easy accessibility to the researcher (Bhardwaj, 2019). This sampling method offers advantages such as simplicity of implementation, low cost of creating samples, and fast data collection. However, it is essential to note that convenience sampling may introduce sampling errors.

For data collection, 17 semi-structured interviews were conducted, constituting a non-probability sample. This methodology was deemed the most appropriate for achieving the defined objective: analyze the impact of intelligent systems on management control and gain valuable insights to enhance the associated benefits.

4.2 Data Collection Methods

Regarding the data collection methods, this study employed the interview technique. Interviews are powerful tools in qualitative data collection, as they deal with words rather than numbers. As explained by Paradis, O'Brien, Nimmon, Bandiera, and Martimianakis (2016), interviews serve as a valuable approach to gathering information directly from individuals on a one-on-one basis, providing valuable insights into participant's perspectives and experiences, contributing to a comprehensive understanding of the research topic. Therefore, interviews can be a valuable addition to research studies seeking to explore and interpret complex human behaviors and experiences.

This technique involves using a set of predetermined questions or a loosely defined set of interest areas. During interviews, participants' responses are recorded and transcribed, allowing researchers to analyze the data later carefully. Interviews can take various forms, as described by Paradis et al. (2016). In the context of this dissertation, the development of semi-structured interviews allowed to adapt the questions according

to the participants' answers and the course of the conversation, enabling a better exploration of the participant's perceptions regarding specific themes.

Interviews are highly valuable for generating themes, theories, and models based on the qualitative data obtained. Compared to surveys, interviews generally provide richer and more in-depth data, making them ideal for exploring complex and nuanced research questions. (Paradis et al., 2016)

Regarding the selection of the interviewees, the method used was convenience sampling, a non-probability form of sampling. It constituted a purposeful sample, as the researcher directly selected participants. Convenience sampling is widespread because it is not as costly, not as time-consuming as other sampling strategies, and is simple (Stratton, 2021).

In the context of this study, the participant selection process involved using LinkedIn, a professional networking platform, as a strategic means to connect with potential participants. During this process, ensuring that the invitations were targeted and aligned with the research objectives was essential. Therefore, the participants invited were those who demonstrated experience in the field of study.

The potential participants were contacted through personalized messages, with an invitation to participate in the research and a clear explanation of the objectives and relevance of the study. Using LinkedIn made it possible to establish connections with individuals with relevant perspectives and knowledge for this research.

4.3 Data Analysis techniques

The data analysis technique used in this study involves content analysis, a helpful method for identifying themes and categories that emerge from the data. Burnard, Gill, Stewart, Treasure, and Chadwick (2008) detailed that analyzing qualitative data starts with discovering themes in the interview transcripts. Therefore, each transcript is carefully reviewed as the researcher adds notes in the margins, identifying keywords, theories, or short phrases that summarize the content. This process is known as open coding, and the aim is to offer a summary statement or word for each element discussed in the transcript.

After identifying the main themes, the initially identified codes are collected, and duplicates are eliminated, reducing the number of categories. The researcher then proceeds to identify potential overlaps or similarities among the remaining categories, allowing for further refinement and grouping based on analytical and theoretical ideas.

The coding framework used in this research is structured around several categories, including programs mentioned by interviewees, perceived benefits of IS on management control, main challenges of implementing IS on management control, critical factors for successful implementation, and organizational readiness for IS adoption.

By analyzing the interview transcripts and organizing the data into these categories, it is possible to gain valuable insights into the recurring themes and patterns emerging from the participants' responses.

This content analysis method helps verify, confirm, and qualify the identified themes, contributing to a comprehensive understanding of the impact of Intelligent Systems on management control within organizations. The final list of categories allows to draw meaningful conclusions and make informed interpretations based on the data collected.

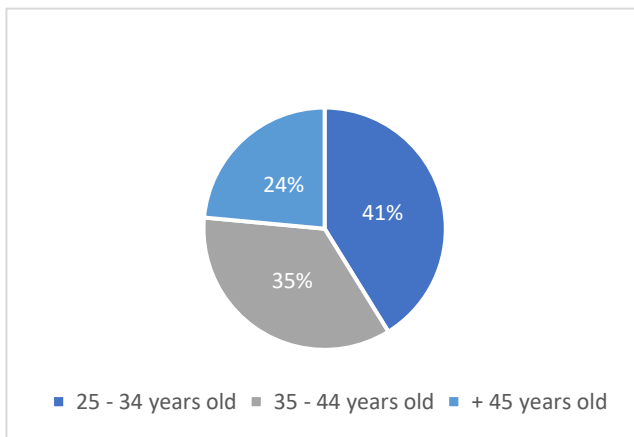
4.4 Sample Description

This study collected data through interviews with 17 individuals working in different organizations in Portugal. The sample was further categorized based on the participant's demographics, educational background, and the industry they operate. The following sections will provide an overview of the sample size and the variables analyzed to understand the role of intelligent systems in diverse organizational contexts.

4.4.1 Sample Size and Demographics:

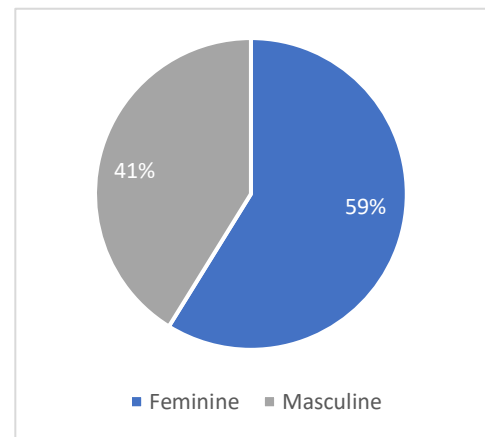
The study included 17 participants, offering a balanced representation of individuals across different age groups and gender. Among the participants, and as represented in the figures below, 41% were between 25 and 34 years old, 35% fell within the age range of 35 to 44, and 24% were above 45. Regarding gender distribution, 59% of the interviewees identified as female, and 41% identified as male.

Figure 2 – Age Distribution of Interviewees



Author's Elaboration

Figure 1 - Gender Distribution of Interviewees

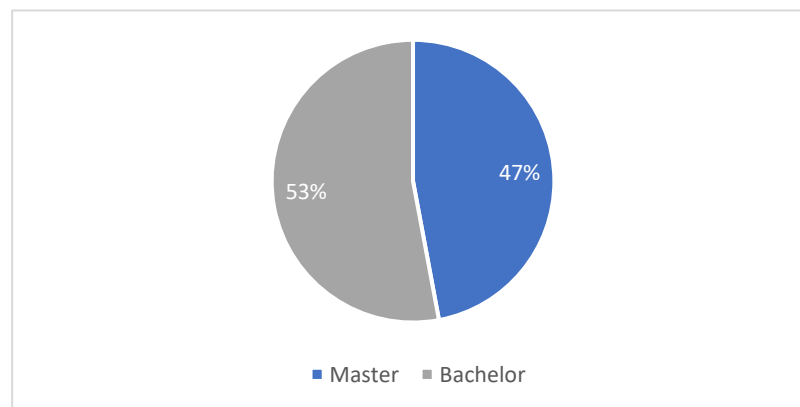


Author's Elaboration

4.4.2 Educational background:

All participants in this study had superior educational qualifications. Of the sample, 53% held a bachelor's degree, while the remaining 47% had a master's degree. This level of education ensures that the information acquired from the interviews was from a knowledgeable and well-educated group of professionals.

Figure 3 - Level of education of Interviewees



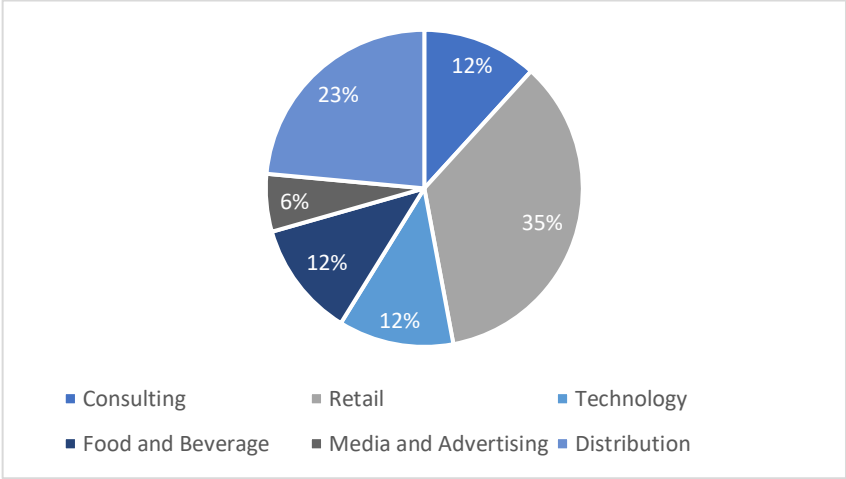
Author's Elaboration

4.4.3 Type of Industry

The data collected for this study came from individuals representing various industries, highlighting diverse experiences and perspectives. The responses obtained covered companies from different sectors, showcasing the relevance of intelligent systems across diverse business landscapes. Notably, most firms in the study had prior

experience with some type of intelligent system in their operations. This suggests a growing trend of incorporating advanced technologies into business processes to enhance performance.

Figure 4 - Distribution of Industries in which interviewees operate



Author's Elaboration

This study's sample of 17 participants provided valuable insights into using IS in different industries. The participants' diverse backgrounds contribute to the strength and reliability of the findings.

Most interviewees reported prior experience with IS, underscoring the significance of these technologies in contemporary business operations. However, it is essential to acknowledge that the study's limitations include the small sample size and the potential for response bias. Nonetheless, the results offer a compelling foundation for further exploration and understanding of the role of intelligent systems.

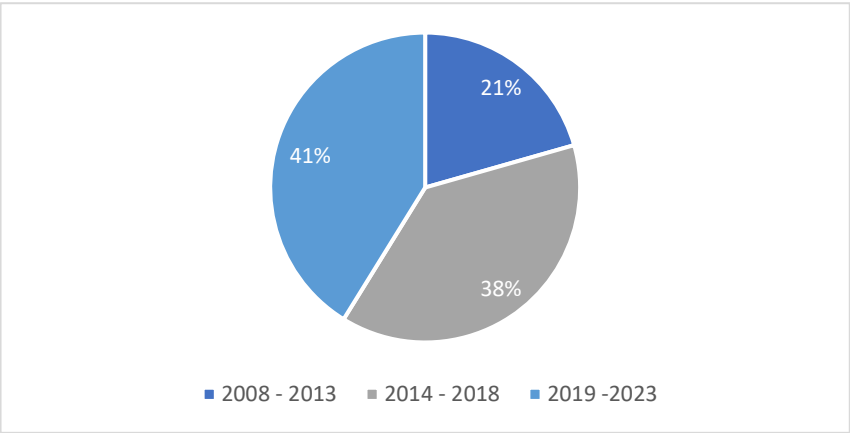
4.5 Relevance and up-do-date insights: Distribution of Articles published by year

A key focus and concern throughout the study was ensuring the findings were relevant and aligned with the current knowledge of intelligent systems. To achieve this, meticulous effort was made to gather the most up-to-date information and findings that reflect the latest perspectives and ideas regarding intelligent systems. The literature review extensively utilized recent articles and research papers, ensuring that the study's insights and conclusions were based on the latest knowledge available.

By prioritizing current and relevant sources, the study aimed to provide accurate and timely insights into the dynamic field of intelligent systems. This approach enhances the credibility and applicability of the study's findings.

The figure below illustrates the distribution of article publications used in the study based on their publication year. 41% of the articles used were published within the last five years, between 2019 and 2023. 38% of the articles were published between 2014 and 2018, and only 21% were published from 2008 to 2013. This distribution strongly emphasizes recent research, reflecting the study's commitment to staying current with the most current perspectives and ideas regarding intelligent systems.

Figure 5 - Distribution of Articles published by year



Author's Elaboration

Chapter 5 – Findings and Discussion

Chapter 5 presents the research findings. It includes an interpretation of the results after analyzing the data in relation to the research objectives and literature review. It also covers the impact, benefits, and challenges of implementing intelligent systems for enhancing management control practices.

5.1 Result discussion

In addition to the study's research questions, it was possible to identify variables that provide deeper insights into the research outcomes. These variables include various aspects, such as the perceived key functionalities of IS in management control, the influence of organizational culture and readiness for IS adoption, employee perception and acceptance, and the specific systems mentioned by interviewees. By considering these variables, we can better understand the study's findings and their implications for the successful integration of IS in management control.

Participants emphasized several essential aspects when discussing the key functionalities of Intelligent Systems to support management control. These functionalities include real-time monitoring, data analysis, predictive modeling, a user-friendly interface, and integration with multiple tools.

Table 2 - Perceived Key Functionalities of IS on Management Control

Perceived Key functionalities of Intelligent Systems on Management Control			
Key functionalities	Perceived Importance	Total of References	Relative frequency
Data analysis	- Access to faster and more reliable information - More efficient use of data	12 (I1, I2, I3, I4, I7, I8, I10, I11, I12, I13, I15, I9)	17,6%
Automation	- Simpler processes - Optimization of time - Reduce operational tasks - Allocating resources more efficiently - Bigger focus on strategic aspects, fostering organizational growth	10 (I2, I3, I4, I7, I8, I9, I12, I13, I15, I16)	14,7%
Visual and Intuitive Data	- Possibility of creating interactive and visually appealing dashboards, graphs, charts, and other visual representations of data - Reduce the time and effort required for data analysis	9 (I1, I3, I4, I5, I8, I11, I12, I13, I16)	13,2%
Predictive modeling	- Use of historical data - Enables managers to forecast future trends and outcomes - Improved accuracy - improved planning, allowing more informed decisions	9 (I2, I4, I5, I6, I7, I10, I11, I15, I17)	13,2%
Real-time monitoring	- Capacity to provide up to date data - Use of accurate data - Allows managers to make timely and informed decisions	7 (I1, I6, I7, I9, I11, I16, I17)	10,3%
Integration with other tools	- Connecting different programs and software's - Optimize data access - Enhance efficiency in management control processes	7 (I1, I3, I4, I5, I8, I11, I12)	10,3%
User-friendly interface	- Allows managers to interact and interpret data more effectively - Enhances control processes.	6 (I5, I6, I10, I13, I15, I17)	8,8%
Accessibility and Collaboration	- Promote efficient teamwork - Simpler to communicate insights - Aligns teams towards common goals - Optimizes management control processes	5 (I1, I6, I9, I15, I17)	7,4%
Key Performance Indicators (KPI)	- Monitor and measure performance in real-time - Assess how well the organization is meeting its goals - Identify areas for improvement	3 (I1, I2, I14)	4,4%
Total		68	100%

Author's Elaboration

As shown in the table above, the key functionalities most frequently mentioned by interviewees are data analysis, automation, predictive modeling, and visual and intuitive data. Organizations can optimize their management control processes by recognizing and incorporating these key functionalities into Intelligent Systems according to the interviewees' views. The ability to make well-informed decisions based on real-time data, predictive insights, and user-friendly interfaces significantly contributes to the successful integration and effectiveness of Intelligent Systems in supporting management control processes.

Furthermore, several of these functionalities align with the perspectives of authors studied in the literature review. For instance, Gretzel (2011) also emphasizes the valuable support that specialized knowledge, essential data analysis, and process automation offer professionals. Similarly, Sarker (2022) highlights that automation is a fundamental criterion for applications and systems in every sector. Adopting modern innovative technologies enables quicker and more informed decision-making, enhancing productivity and profitability in business processes.

These shared viewpoints reinforce the importance of integrating intelligent systems with specific functionalities, such as automation and predictive modeling, into organizational practices to enhance management control processes, make strategic decisions, and achieve better outcomes.

Furthermore, during the interviews, participants highlighted specific programs they use to make the processes more efficient. These programs proved instrumental in streamlining data access, improving data analysis, and enhancing decision-making capabilities. By leveraging these programs, interviewees stated that the organizations achieved greater operational efficiency and effectiveness.

Table 3 - Programs mentioned by Interviewees.

Programs mentioned by Interviewees			
Mentioned Programs	Perceived Benefits	Total of References	Relative Frequency
Power BI	- Allows to create interactive and visually appealing dashboards, enabling easy and quick analysis of complex data - Provides real-time insights, allowing managers to make timely decisions. - Offers predictive modeling capabilities, enabling organizations to forecast trends and make data-driven decisions.	9 (I1, I2, I3, I4, I7, I8, I9, I10, I17)	56,3%
SAP BTP	- Automate tasks - Process and analyze large volumes of data in real-time - Predictive modeling	3 (I3, I8, I12)	18,8%
Power Automate	- Automates repetitive tasks - Integrates with other Microsoft products, extending automation capabilities across various platforms and services.	1 (I4)	6,3%
SAS	- Predictive modeling - Data analysing and interactive dashboards	1 (I15)	6,3%
Tableau	- Intuitive and interactive data visualization - Process large amounts of data	1 (I11)	6,3%
Open Pricer	- Pricing optimization software that uses AI and machine learning to help companies optimize their pricing strategies and maximize revenue	1 (I2)	6,3%
Total		16	100%

Author's Elaboration

As evident from the information in the table above, Power BI stands out as the most mentioned and favored tool control managers use to support their processes. The prominence of Power BI among the interviewees indicates its widespread adoption and effectiveness in providing valuable insights into management control.

Throughout this research, one observation that stands out is the interviewees' limited awareness or exposure to various tools or programs related to management control. This finding raises the question of whether control managers in Portugal have sufficient information about the various tools available in the market or if there is a lack of comprehensive solutions in control management. It is also possible that the preference for familiar and established solutions has contributed to the dominance of specific tools, such as Power BI, in the responses. Either way, it presents an intriguing and valuable opportunity for further investigation and exploration.

The potential lack of awareness regarding intelligent systems for management control also highlights the possibility of undiscovered potential in exploring a broader range of tools. As the field of intelligent systems continues to evolve rapidly, it becomes

increasingly essential for control managers to stay updated on the latest advancements and new technologies. By seeking new advancements, managers can identify and adopt solutions that align best with their organization's needs and requirements, leading to more effective and efficient management control processes.

However, there is a shared consensus on the ongoing implementation of such systems when it comes to the interviewees operating in organizations without any implemented systems or tools or with limited systems, where manual processes are predominantly used. Interviewees 2, 5, 6, 13, 14, and 16 highlighted factors that have delayed this implementation. The main factors mentioned align with the viewpoints of Hočevar and Jaklič (2010), who emphasized the challenge of justifying investments in the implementation of IS. The concern of determining the investment's financial viability and economic justification resonates with the interviewees' challenges regarding the associated costs and the need for a return on investment. Indeed, as stated by interviewees, financial investment proved to be a significant barrier to timely implementation.

Additionally, the lack of knowledge and expertise regarding implementing these systems and challenges related to the complexity and unfamiliarity with the technology hindered a smooth integration into existing processes. This aligns with the perspectives of Rouhani et al. (2018), who highlighted that organizations may face resource constraints, such as financial limitations and lack of expertise, making them less likely to adopt innovations like IS.

Rouhani et al. (2018) further emphasized that the adoption of IS is influenced by organizational readiness, including financial and technological capabilities. As indicated, higher readiness levels increase the likelihood of adopting IS, with financial readiness referring to the organization's investment capability and technological readiness focusing on expertise and technological sophistication. Accordingly, the perspectives of Interviewees 2, 5, 6, 13, 14, and 16 indicated that their companies faced delays in adopting these technologies due to the organizations' lower likelihood of embracing innovations. However, they also mentioned that this situation is changing in their respective companies.

Despite these challenges, these organizations recognize the importance of transitioning from manual processes to automated systems for improved management control. Therefore, they are actively working towards overcoming these barriers to benefit from implementing advanced tools and streamline their operations effectively. This proactive approach reflects their understanding of the potential benefits of intelligent systems in enhancing management control processes and driving organizational success.

Interviewee 2 also shared valuable insights based on her experience of transitioning from a highly advanced organization, considered one of the pioneers in Portugal for implementing advanced technology, to a company at the initial stages of implementing such technologies. This shift highlighted the significant differences in investment and capabilities between an established pioneer and a starting company.

Having worked in both settings, interviewee 2 emphasized the importance of an early and continuous investment in Intelligent systems, which aligns with the perspectives of Mikalef et al. (2023). The research by Mikalef et al. (2023) reveals that such investments facilitate the development of distinct competencies that outperform the competition, enabling organizations to improve overall performance and stay competitive in dynamic and competitive markets.

In her current role, interviewee two actively implements these new technologies in the starting company. This hands-on experience has reinforced her understanding of the benefits of leveraging intelligent systems to improve company performance and processes. It has allowed her to witness firsthand how advanced systems drive organizational efficiency and effectiveness.

Through her perspective, Interviewee 2 underlines the significance of adopting intelligent systems in organizations at any stage of their development, recognizing that early investment and commitment are pivotal for long-term success. Her insights shed light on how advanced systems drive performance and further confirm the ideas defended by Mikalef et al. (2023.)

Interviewee 2's experience offers valuable lessons for organizations looking to integrate intelligent systems into their management control processes. By understanding the transformative potential of these systems and investing proactively in their adoption, organizations can harness their power to achieve greater operational efficiency and stay competitive.

5.1.1 (RQ1) – What are the key factors that contribute to the successful implementation of Intelligent Systems?

Upon analyzing the interview data, several key factors emerged as crucial to successfully implementing Intelligent Systems in diverse organizations, optimizing management control processes, and retrieving maximum value from Intelligent Systems.

Firstly, organizations need to identify the areas where Intelligent Systems can add value, as interviewees 4, 12, 15, and 17 highlighted. As mentioned, understanding the opportunities for implementation and improvement is critical for selecting the right

solutions that align with the organization's needs and objectives. This supports the findings of Merchant and Van der Stede (2017), who emphasized the importance of aligning IS with the organization's strategy. By establishing a clear link between performance measures, system targets, and organizational goals, IS become more effective tools for decision-making and performance management.

Furthermore, interviewees 2, 4, 7, 10, and 16 also emphasized the need for clear objectives aligning with the organization's strategic goals. Understanding how the systems contribute to business success ensures that the implementation is directed toward achieving specific outcomes. It also reflects the ideas of Merchant and Van der Stede (2017), who stressed the importance of defining desired outcomes to select appropriate control mechanisms and bridge the gap between desired and likely outcomes.

Another crucial factor is allocating sufficient resources, as interviewees 2, 4, and 11 highlighted. Adequate resources, such as budget allocation and skilled IT teams, are essential for successful implementation. This is compatible with the thoughts of Hočevar and Jaklič (2010), who mentioned to address this challenge, organizations must evaluate the financial viability and economic justification of investment, using methods like ROI calculation, cost-benefit analysis, and net present value.

Defining key performance indicators (KPIs) is vital for measuring the success of the implementation of Intelligent Systems, as stated by Interviewees 1, 2, and 14. Continuously monitoring performance based on KPIs allows organizations to make timely adjustments, guarantee that the system is effective, and remain aligned with business objectives.

As highlighted by interviewees 2, 3, 8, and 11, a solid database is also essential. Ensuring data is sourced from reliable sources, accurate, and organized correctly is crucial to obtain reliable and meaningful insights. This aligns with Merchant and Van der Stede's (2017) perspectives, which emphasize the importance of ensuring data sources and reporting systems are in place, considering factors such as data integrity and reliability in effective control.

Promoting a culture of shared knowledge, as referenced by interviewees 1, 6, and 9, fosters continuous learning and innovation. It also ensures that knowledge is retained within the organization, even when employees leave, enhancing overall competence and adaptability. This is consistent with Merchant and Van der Stede's (2017) views, who mentioned that maintaining consistency and standardization is vital for adequate control.

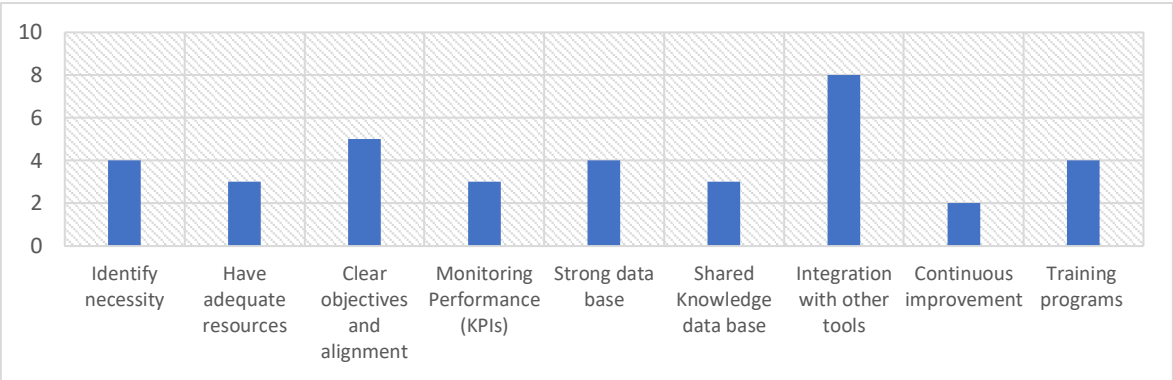
Seamless integration of IS with existing software and platforms within the organizations, as referred by Interviewees (I1, I3, I4, I5, I7, I8, I11, I12), enables

standardization of information and promotes transparency in processes. As stressed by Interviewee 1, this integration facilitates a transversal way of working, as everyone can access the same information.

Interviewees 7 and 10 mentioned that continuous improvement and innovation are essential. As emphasized by Merchant and Van der Stede (2017), this is fundamental to keeping intelligent systems relevant and effective. Regular monitoring and evaluation enable managers to identify gaps and make necessary adaptations, ensuring the system remains aligned with the organization's changing requirements.

Finally, Interviewees 2, 3, 8, and 12 emphasized the importance of preparing all workers to handle eventual problems. Basic knowledge and the ability to address minor technical issues can enhance the benefits of the implementation. Merchant and Van der Stede (2017) mentioned that clear communication, employee involvement, and training programs can help enable a smooth transition. Interviewee 3 also addressed the importance of having reliable technical support to help address more complex issues and make necessary adjustments.

Figure 6 - Key factors for IS Success



Author's Elaboration

On the other hand, Interviewees 1, 11, and 15 pointed out that several factors can significantly affect the success of IS. As mentioned, some limitations include the system's complexity and resistance to change from employees. These findings indicate that some employees may be hesitant to adopt new technologies, affecting the successful integration of these tools. This aligns with Merchant and Van der Stede (2017) perspectives, who also identified resistance to change as a common challenge in IS implementation.

To overcome these barriers and ensure the successful implementation of IS, interviewees I3, I10, I11, and I13 emphasized the need for adequate employee training and skill development. This aligns well with Merchant and Van der Stede (2017)

viewpoints, highlighting the significance of employee involvement and comprehensive training programs to overcome resistance and ensure effective change management strategies.

Overall, the perspectives shared by the interviewees are well aligned with the existing research. The interview findings corroborate the importance of prioritizing key factors and addressing the mentioned limitations to foster a positive and receptive environment and ensure more effective implementation of IS, obtaining more value from these systems.

5.1.2 (RQ2) – What strategies and best practices can organizations adopt to ensure the efficient integration of IS in their management control processes?

Through the analysis of interview data, several strategies and best practices emerged as crucial for ensuring the efficient integration of Intelligent Systems (IS) in management control processes.

Merchant and Van der Stede (2017) mentioned that to achieve the efficient integration of IS in management control processes, it is fundamental to follow a systematic approach, and identified four key steps to guide the process: Defining the desired outcomes, assessing likely outcomes, selecting the appropriate set of controls and determining the level of control.

The perspectives and experiences shared during the interviews helped to further understand the steps required to successfully guide the implementation of intelligent systems. Therefore, to help organizations conduct this process systematically, a guide was developed, combining the perspectives and experiences shared during the interviews with the existing literature review, highlighting the best practices for IS implementation:

First step – Identify the needs, evaluate the requirements and define the desired outcomes.

Merchant and Van der Stede (2017) mention that defining desired outcomes involves establishing clear organizational objectives and performance targets aligned with the mission, vision, and strategic goals. Therefore, it is important to identify critical success factors, performance metrics, and desired outcomes across various areas, such as financial targets, operational efficiency, customer satisfaction, or employee engagement.

Regarding this topic, Interviewees highlighted that it is crucial to identify the needs, evaluate the requirements, and justify the investment (I3, I4, I8, I11, I12). A thorough analysis of the organization's needs and requirements is critical to identify the most suitable intelligent systems. It is also essential to justify the investment in implementing the IS by determining the financial viability and economic justification.

Second step – Assessing likely outcomes.

Merchant and Van der Stede (2017) highlight the importance of assessing likely outcomes, which requires analyzing internal and external factors that influence organizational performance, considering the current business environment, market conditions, industry trends, and organizational capabilities. They point out techniques like SWOT analysis and market research can help identify potential risks, opportunities, and challenges.

Interviewees also mentioned the need to set short-term goals for the tool's implementation and to define periodic objectives (I7, I13). By setting new objectives to be achieved every two weeks, it is easier to track progress.

Third step - Selecting the appropriate set of controls.

Merchant and Van der Stede (2017) indicate that selecting the appropriate controls involves choosing suitable mechanisms, such as financial, operational, behavioral, and technological controls, to bridge the gaps between desired and likely outcomes. The choice of controls should consider the organization's nature, industry, and specific objectives.

Interviewee 7 also refer the importance of designing a project. It is fundamental to create a detailed plan with all implementation phases, ensuring a clear strategy that guides all actions and decisions. I7 mentions that organizations must prepare a comprehensive document that clearly describes the purpose of implementing the tool, its advantages and disadvantages, and sets clear objectives that align with the organization's expectations. Interviewees 7 and 11 also mention the importance of evaluating the compatibility with existing systems and data sources. Organizations must determine whether it is possible to integrate these systems with the current infrastructure or if it is needed to invest in new technology.

Step 4 - Determining the level of control.

Lastly, as indicated by Merchant and Van der Stede (2017), determining the level of control is crucial to strike the right balance between autonomy and accountability. Optimal control intensity depends on factors such as risk appetite, operational complexity, and employee trust and competence.

Interviewees mentioned few practices that ensure a smoother integration of new systems:

- Offer practical training (I3, I4, I6, I7, I8, I12): Provide practical training to users to teach them how to effectively use the tool and ensure they understand how it fits into their work processes. Regular communication and training sessions can address concerns and promote user engagement.
- Guaranteeing specialized knowledge and project management capabilities (I2, I4, I7, I17). It is vital to have a team responsible for the tool's implementation that possesses specialized knowledge of the relevant technologies and concepts involved. Additionally, strong management skills are essential to coordinate the implementation phases efficiently.
- Communicate with users (I2, I7, I15): Involve end-users from the beginning and hold meetings when the tool is ready for delivery to explain its purpose, reason for implementation, and impact on company processes. Ensuring user acceptance and engagement is crucial for successful implementation.

Step 5 - Continuous tracking and improvement

Interviewees 2 and 7 highlighted the importance of continuous monitoring. They mentioned the need of regular assessments and evaluation of the tool's effectiveness in achieving the set objectives by using relevant Key Performance Indicators (KPIs) that align with business goals. This enables timely adjustments to optimize the tool's functionality and ensures its alignment with strategic goals and evolving business needs, maximizing its long-term value and benefits.

By following these practices, organizations can successfully integrate Intelligent Systems into their management control processes and maximize these powerful tools' long-term value and benefits.

Regarding this topic, it is essential to note that the limited number of studies focusing on effective ways to implement IS in management control presents a challenge when comparing the insights gathered from the participants with the current literature review. As a result, the findings from this study may provide perspectives that might not fully align with the existing literature review. However, this inconsistency can also be

seen as an opportunity to contribute to the field by exploring or identifying new aspects that can lead to further investigation. This point highlights the need to strengthen the knowledge surrounding the successful integration of IS in management control.

5.1.3 (RQ3) – What is the impact of Intelligent Systems on strategic planning and its effectiveness in improving organizational performance?

The data analysis revealed that Intelligent Systems (IS) significantly impact strategic planning in organizations. The findings reflected how IS can positively influence organizational performance, including time optimization, simpler processes, complement to work, enhanced productivity, retainment of knowledge, and consistency in operations.

Regarding time optimization, nine interviewees mentioned that by automating specific tasks and processes, organizations can reduce the time spent on operational activities, freeing up more time for employees to focus on strategic thinking. Interviewees 5 and 7 further emphasized how the integration of IS has allowed them to allocate more resources to crucial strategic planning, ultimately enhancing the effectiveness of long-term strategies.

The introduction of automated processes also improves operations. Participants I1, I4 and I6 emphasized how automation led to cost-effectiveness. Compared to traditional models, it resulted in simpler and more efficient processes.

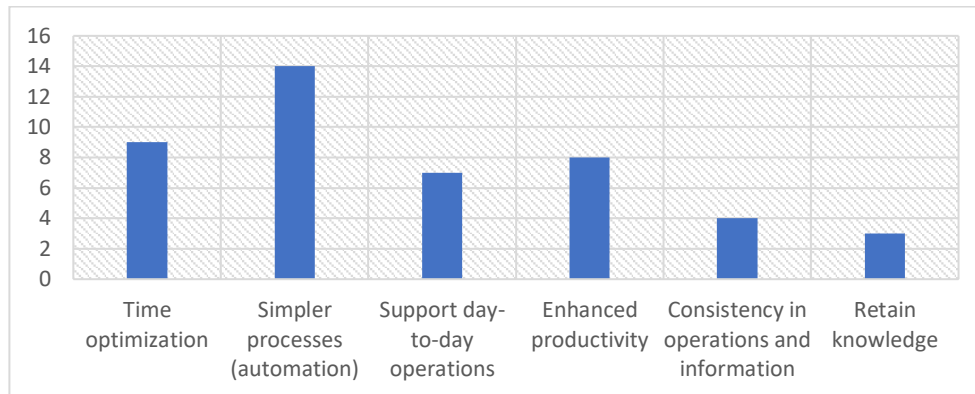
Several interviewees (I1, I2, I4, I6, I7, I10 and I15) mentioned the vital role of IS in complementing employees' work and providing valuable support in day-to-day operations. They view IS as a complement rather than a substitute for human work. This support empowers employees to handle complex tasks efficiently, faster, and more accurately, contributing to overall performance.

Interviewees also experienced increases in productivity with the implementation of intelligent tools. Interviewees 2, 4, 6, 7 and 10 stated that automating specific processes allowed organizations to give employees more time to focus on critical tasks, increasing productivity and efficiency.

Some interviewees (I1, I6 and I10) also mentioned how IS facilitates knowledge sharing, fostering consistency in operations and information across organizations. By centralizing data and providing access to real-time insights, IS ensures that employees have consistent and accurate information on which to base their strategic planning decisions. This knowledge retention also contributes to organizational learning and continuous improvement. Also, as mentioned before, it allows knowledge to stay within the company, even when employees leave.

The figure below illustrates the key findings described above.

Figure 7 - Perceived impact of IS on organizational performance



Author's Elaboration

These findings reflect IS's impact on strategic planning and organizational performance. Furthermore, they coincide with the viewpoints of Wamba-Taguimdje et al. (2020), who highlighted the positive impact of Intelligent Systems on various aspects of organizational operations, including process and performance enhancement, cost reduction, and activity tracking using informational, automation, and transformational effects.

The perspectives shared by the interviewees further support and complement this viewpoint. The adoption of IS not only optimizes operational time but also simplifies complex processes, leading to an overall enhancement in efficiency. Additionally, it serves as a valuable support in day-to-day operations, enabling employees to handle tasks more efficiently, thereby contributing to overall performance improvement.

5.1.4 (RQ4) – How do Intelligent Systems contribute to enhancing decision-making processes within organizations?

The data analysis revealed that Intelligent Systems (IS) are crucial in enhancing decision-making processes within organizations. The key findings demonstrate many implications of IS in decision-making, including reduced errors compared to human decision-making, the ability to create scenario forecasts, improved data quality, consistency in decision-making, intuitive data visualization, and enhanced accuracy and speed of information.

One significant advantage of IS in decision-making is its capacity to minimize errors compared to traditional human decision-making processes, as highlighted by

interviewee 7. IS can process vast amounts of data quickly and accurately, reducing the likelihood of human errors arising due to fatigue, biases, or information overload.

Moreover, IS allows organizations to create scenario forecasts, enabling decision-makers to evaluate potential outcomes under different conditions. This feature enables organizations to make more informed decisions and develop detailed plans based on different future scenarios, thereby mitigating risks and uncertainties (I2, I4, I5, I6, I7, I10, I11, I15, I17).

Implementing IS also improves data quality, as these systems can handle and analyze data with greater precision and consistency. As mentioned by Interviewees 1, 3, 4 and 12, by ensuring the availability of high-quality data, decision-makers can have more confidence in their conclusions, leading to more effective and rational decisions.

Consistency in decision-making is another critical advantage offered by IS (I7). These systems ensure that decisions are made consistently across different situations and avoid biases in human decision-making.

IS also provides intuitive data visualization, presenting information visually appealing and easily understandable (I1, I3, I4, I5, I8, I11, I12, I13, I16). This visual representation enhances decision-makers ability to acknowledge complex information quickly and identifies patterns and trends, ultimately supporting better decision-making.

Lastly, IS enhances the accuracy and speed of information available to decision-makers. By swiftly processing and analyzing data, these systems enable real-time decision-making, which is especially valuable in dynamic and fast-paced business environments (I1, I2, I4, I7, I15 and I19).

In the literature review, Merchant and Van der Stede (2017) highlight the need to ensure the availability and quality of information to support decision-making and monitoring processes. This aligns with the key findings, emphasizing how IS improves data quality. IS can handle and analyze data with greater precision and consistency, ensuring the availability of high-quality data for decision-makers. Additionally, as mentioned before, it is also essential for managers to guarantee that databases and reporting systems are reliable and contain relevant and up-to-date information.

Additionally, Rouhani et al. (2018) emphasize the positive influence of intelligent systems on profit margins, revenue, and internal processes. This aligns with the findings, where it is mentioned that IS implementation leads to enhanced accuracy and speed of information available to decision-makers, enabling real-time decision-making and quick adaptation to different conditions. This timely and accurate data is crucial for informed decision-making, reducing costs, and increasing profitability.

Overall, the literature review and the findings from this study highlight the role of intelligent systems in enhancing decision-making processes. IS offers valuable support

to decision-makers by minimizing errors, providing scenario forecasts, improving data quality, ensuring consistency, and enabling real-time decision-making. By leveraging the power of intelligent systems, organizations can make more informed and efficient decisions, leading to enhanced performance and competitiveness in today's dynamic business landscape.

Chapter 6 – Conclusions

This chapter summarizes the key findings of the research, highlighting the theoretical and practical implications for organizations aiming to leverage the benefits of intelligent systems in their management control processes. It also acknowledges the limitations of the study and provides recommendations for future research.

6.1 Final Considerations

This dissertation explores the practical implementation of IS in management control and its impact on organizational performance. Combining the information from the literature review with the perspectives and experiences shared by the interviewees made it possible to develop a deeper understanding of the factors and strategies that influence the successful integration of IS and its potential benefits and challenges.

The literature review offered a more comprehensive understanding of the current state of knowledge in the field, covering topics such as the types of IS, the development of IS and AI-based models for decision-making, and the role of IS in management control. This knowledge served as a basis for the empirical study, significantly influencing the definition of the research questions and objectives.

The study involved interviews with 17 professionals from diverse organizations in Portugal, representing various industries and backgrounds. The data analysis revealed essential strategies for the practical applications of IS in management control, highlighting the importance of specialized knowledge, clear objectives, and strategic planning in the implementation process. Additionally, the study emphasized the importance of continuous monitoring and evaluation to ensure alignment with organizational goals and evolving requirements.

The research showed that the dominant usage of specific tools, such as Power BI, in the Portuguese context may suggest limited awareness of alternative management control solutions. This raises questions about the accessibility and availability of diverse tools in the market, warranting further investigation and potential opportunities for improvement.

These findings contribute to the existing knowledge base regarding IS in management control and offer practical guidance for organizations seeking to incorporate IS into their processes to improve their decision-making and strategic planning. By understanding the critical factors and strategies that influence successful

implementation and acknowledging the potential challenges and benefits, organizations can benefit from more informed decisions, ultimately leading to enhanced outcomes and higher returns on investment.

In conclusion, this research serves as a basis for future investigations into intelligent systems in management control. Given the topic's relevance and timeliness, this study will likely stimulate continued interest in ongoing research. As technological advancements evolve and the interest in adopting intelligent solutions grows, there is an increasing need to understand the processes associated with this implementation fully.

By exploiting the potential of IS in management control, organizations can unlock more efficiency, productivity, and overall success. The path ahead is full of possibilities, as continuous researches in the field can lead to remarkable advancements.

6.2 Theoretical and Practical Implications

The findings of this research have theoretical implications that contribute to the existing literature on IS in management control.

By identifying key factors influencing the effective implementation of IS, this study deepens the understanding of how organizations can effectively integrate intelligent technologies into their decision-making, strategic planning, and control practices.

Regarding practical implications, this research identifies the best practices in implementing IS, such as evaluating requirements, setting clear objectives, and establishing short-term goals, providing a practical road map for effective implementation. This roadmap offers guidance for organizations seeking to implement IS in their management control processes.

6.3 Limitations

Despite the findings of this research, it is essential to acknowledge the limitations of this study, which may impact the generalizability and depth of the findings.

One of the limitations of this study is the small sample size of participants. The limited number of participants may restrict the broader applicability of the results. A more extensive and diverse sample could have provided a more representative view of IS implementation in management control across different industries and organizational sizes.

Another noteworthy limitation is the nonexistence of micro-companies in the sample. As a result, this research does not consider the challenges smaller organizations

face when implementing IS in their processes, as micro-companies have different resource constraints and financial capabilities.

Furthermore, the research was conducted exclusively in Portugal, and the organizations represented were assumed to have sufficient financial resources and favorable conditions for IS implementation. Consequently, the effects and outcomes identified may need to be validated in countries with different economic and technological contexts.

Despite these limitations, this research offers valuable insights into the successful implementation of Intelligent Systems in management control processes in the context of Portugal.

6.4 Suggestions for future research

While this research has provided valuable insights into the implementation of IS in management control processes, it was possible to identify opportunities for future research.

One exciting area for future research would be to develop a comparative study across different countries to explore how contextual factors influence the implementation of IS in management control. Factors such as economic development and technological advancements may significantly impact the adoption and effectiveness of IS. Examining IS adoption practices in diverse settings could provide a more comprehensive understanding of its global implications.

Another intriguing area for future exploration is the limited awareness or exposure to various tools or programs related to management control among the interviewees of this study. This finding raises questions about whether control managers in Portugal have sufficient information about the various tools available in the market or if there is a lack of solutions in control management. Investigating the factors contributing to this limited awareness can provide valuable insights into adopting innovative technologies in the management control domain.

Lastly, it would be interesting to research which techniques are most suitable for different control tasks and how they can guide organizations in selecting the most appropriate intelligent systems for their needs.

By pursuing these research areas, scholars and practitioners can deepen their knowledge of IS implementation in management control and contribute to the continued advancement and optimization of intelligent systems in organizations.

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Appendices

Appendices 1 – Interview Script

Part I – Introduction

Name	
Company	
Age	
Education level	

Interviewer: Good morning/afternoon. First, I would like to thank you for taking the time to participate in this interview. As I explained by message, my name is Mafalda Aniceto, and I am a student at ISCTE Business School. I am currently enrolled in the Master of Business Administration. As part of my master's thesis on "Intelligent Systems Applied to Management Control", I would like to gain some insights based on your experience.

The purpose of this interview is to understand how intelligent systems can be integrated to improve management control and decision-making processes.

Before we get into the questions, I want to clarify that within the scope of my study, Intelligent systems refer to the use of advanced technologies such as Artificial Intelligence and Machine Learning, and other technologies that can perform complex tasks and learn from data.

Note that all the information shared will be kept confidential.

Part II - Background

1. Could you briefly describe your role and responsibilities within the company?
2. How long have you been working in this role and what are the main challenges you have faced?
3. Can you briefly explain what management control processes and systems are currently in place in your organization?

Part III – Intelligent Systems

1. In your opinion, is there any specific area or challenge where you believe intelligent systems can have the greatest impact?
2. How do you see the potential of these systems in improving the company's processes?
3. Are you familiar with any specific intelligent tool, software or program that can improve the company's decision-making process and/or strategic planning? If so, please provide some examples.

Part IV – Benefits and Challenges

1. What do you consider to be the main benefits of integrating intelligent systems and tools?
2. Do you identify any concerns or challenges that may arise in the process of implementing intelligent systems?

Part V - Implementation of Intelligent Systems

1. From your perspective, what features or functionalities are most valuable in these tools to improve decision-making processes and for strategic planning?
2. What kind of data do you consider crucial for these intelligent systems to effectively support decision-making in management control? (e.g. is it more important internal data of the organization? or external market? or partners? ...)
3. In your opinion, what would be the necessary steps to successfully implement intelligent systems in the organization? Do you think there are important resources, specific capabilities or strategies to consider to effectively implement intelligent systems?

Part VI – Organizational Processes

1. The implementation of intelligent systems often requires change management and user acceptance. How do you assess your organization's readiness to adopt new tools, software, and intelligent programs?

Part VII - End

1. Do you have any suggestions you would like to share or additional perspectives you think would be valuable for my study?

We concluded the interview. Thank you for your valuable insights and contribution to this interview. If I have any other questions or need any further clarification, would it be possible to contact you by email?