Master

Management and Industrial Strategy

Master´s Final Work

Dissertation

Open Innovation Implementation
An empirical analysis on Portuguese firms

Diogo Luís Santos Sanches

June-2025

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Supervision:

Professor Sara Martins Gonçalves

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Abstract

The implementation of Open Innovation practices is becoming increasingly important for firms seeking to stay competitive in today's fast-paced business environment. The aim of this study is to understand the degree of Open Innovation Implementation in Portuguese firms.

This research adopted a descriptive-exploratory design and mono-method quantitative approach, relying on a single data collection method and applying quantitative techniques for data analysis. An online survey was used to collect data, which was sent to a random sample of Portuguese firms, resulting in a total of 199 valid responses.

The first finding reveals a moderate degree of Open Innovation Implementation among the sample of Portuguese firms. In particular, the findings reveal a higher implementation of Open Innovation in larger firms. The second finding reveals and partially confirms a statistically positive relationship between Open Innovation Implementation and firm size. This underlines the advantages large firms have in terms of resource availability, formalization and absorptive capacity in accordance with current literature. The third finding reveals and statistically rejects a relationship between Open Innovation Implementation and industry, within the sample. This may suggest that Open Innovation may represent a strategic imperative across the business landscape, regardless of industry-specific characteristics.

In the study, practical and policy recommendations can be acknowledged by managers and policy makers, emphasizing the importance of understanding that organizational, managerial, technological, and contextual factors foster successful Open Innovation Implementation. The absence of significant industry effects in Open Innovation Implementation also implies that Open Innovation strategies and policies can be developed in a cross-sectoral manner, rather than tailored strictly by industry.

This research contributes to the characterization of Open Innovation Implementation in Portuguese firms and with understanding if and how demographic characteristics, such as firm size and industry, are related with the implementation of Open Innovation in Portuguese firms.

Keywords: Open Innovation, Open Innovation Implementation, Organizational Archetype, Knowledge Management, Technology Transfer, Collaborative Networks

Resumo

A implementação de práticas de Inovação Aberta está a tornar-se cada vez mais importante para as empresas que procuram manter-se competitivas no ambiente empresarial atual acelerado. O objetivo deste estudo é compreender o grau de Implementação de Inovação Aberta nas empresas portuguesas.

Esta investigação adotou um delineamento descritivo-exploratório e uma abordagem quantitativa mono-método, baseando-se num único método de recolha de dados e aplicando técnicas quantitativas para a análise de dados. Foi utilizado um questionário online para recolher dados, que foram enviados para uma amostra aleatória de empresas portuguesas, resultando num total de 199 respostas válidas.

A primeira descoberta revela um grau moderado de Implementação de Inovação Aberta entre a amostra das empresas portuguesas. Em particular, os resultados revelam uma maior Implementação de Inovação Aberta nas empresas de maior dimensão. A segunda descoberta revela e confirma parcialmente uma relação estatisticamente positiva entre a Implementação de Inovação Aberta e a dimensão da empresa. Isto sublinha as vantagens que as grandes empresas têm em termos de disponibilidade de recursos, formalização e capacidade de absorção, de acordo com a literatura atual. A terceira descoberta revela e rejeita estatisticamente uma relação entre a Implementação de Inovação Aberta e a indústria, entre a amostra. Isto pode sugerir que a Inovação Aberta pode representar um imperativo estratégico em todo o panorama empresarial, independentemente das características específicas do setor.

No estudo, recomendações práticas e políticas podem ser reconhecidas pelos gestores e decisores políticos, enfatizando a importância de compreender que os fatores organizacionais, de gestão, tecnológicos e contextuais promovem o sucesso da Implementação de Inovação Aberta. A ausência de efeitos significativos relativos à indústria na Implementação de Inovação Aberta implica também que as estratégias e políticas de Inovação Aberta podem ser desenvolvidas de forma intersectorial, em vez de serem adaptadas estritamente por indústria.

Esta investigação contribui para a caracterização da Implementação de Inovação Aberta nas empresas portuguesas e para a compreensão de se e como as características demográficas, como a dimensão da empresa e a indústria, estão relacionadas com a Implementação de Inovação Aberta nas empresas portuguesas.

Palavras-chave: Inovação Aberta, Implementação de Inovação Aberta, Modelo Organizacional, Gestão de Conhecimento, Transferência de Tecnologia, Redes Colaborativas

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Table of contents

List of tables

List of figures

Chapter 1 – Introduction

1.1 Context and Scope of the Research

The importance of Open Innovation (OI) has grown due to the rapid pace of globalization and the exponential growth of technological capabilities (Obradovicet et al., 2021; Toroslu et al., 2023). Moreover, the concept of Open Innovation has been recognized as an essential element of the United Nations' Sustainable Development Goals (SDGs) for 2030, as it emphasizes the role of collaborative partnerships in attaining a sustainable path (Huang, 2023; UN General Assembly, 2015).

As firms navigate in increasingly constrained economic and environmental conditions, the ability to maximize existing resources through openness and external collaboration in innovation processes has emerged as an essential strategy (Chesbrough & Garman, 2009). Although theoretical foundations of Open Innovation have matured over the past two decades, important questions remain regarding the specific mechanisms through which firms implement Open Innovation practices. The organizational transformation process that firms undergo in shifting from a closed to an Open Innovation model is an area that still requires empirical exploration (Chiaroni et al., 2010).

Some researchers have investigated the role of firm-level and managerial factors in shaping Open Innovation Implementation (OII). These include internal systemic adjustments (Bianchi et al., 2009; Lopes & De Carvalho, 2018), managerial drivers (Boscherini et al., 2010), such as top management's allocation of decision-making rights (Naqshbandi & Jasimuddin, 2022), establishment of dedicated business units, knowledge management systems, venture development mechanisms, and evaluation of technology capabilities (Rush et al., 2007). However, while these factors are often emphasized as facilitators of Open Innovation Implementation, other researchers argue that these factors alone may not be sufficient to explain why some firms succeed in implementing Open Innovation more effectively than others and should be assessed together (Srisathan et al., 2023).

Although much attention has been given to organizational and managerial dimensions, there is ongoing debate regarding the actual extent to which these factors contribute to successful Open Innovation Implementation. Chiaroni et al. (2010, 2011) finds that changes in organizational and management systems have a beneficial impact on the environment in which Open Innovation takes place. Similarly, Naruetharadhol et

al. (2020) demonstrates the importance of evaluating managerial and organizational readiness in fostering Open Innovation practices. However, critics argue that neither of these studies incorporated Technology Transfer into their research models, thus leaving an important aspect of Open Innovation unaddressed. Addressing this gap, Chiu and Lin (2022) emphasizes the role of knowledge creation processes, governance mechanisms, and technological infrastructure in building Open Innovation capability, arguing that these factors may be even more decisive to the success of Open Innovation Implementation.

Building on Chiu and Lin (2022), Srisathan et al. (2023) proposes that Open Innovation Implementation is the degree to which firms internally implement Open Innovation, particularly in the terms of Organizational Archetype, Knowledge Management, Technology Transfer and Collaborative Networks.

The scope of this study focuses on Portuguese firms, offering a national lens into the implementation of Open Innovation.

1.2 Research Objectives of the Study

This study aims to:

1. Characterize Open Innovation Implementation and its dimensions (i.e., Organizational Archetype, Knowledge Management, Technology Transfer and Collaborative Networks) across Portuguese firms;

2. Understand the relationship between the dimensions of Open Innovation Implementation and firm size;

3. Understand the relationship between the dimensions of Open Innovation Implementation and industry.

1.3 Methodology

To address the research objectives, this study adopted a descriptive-exploratory design and mono-method quantitative approach, relying on a single data collection method (survey) and applying quantitative techniques for data analysis. (Saunders et al., 2023).

The questionnaire was developed in the Qualtrics web-based software and was sent to a random sample of active Portuguese firms, obtained from Orbis Europe database for

private firms. The data was treated and analysed using IBM SPSS Statistics software. A total of 199 responses were considered valid and used in the research.

1.4 Relevance of the Research

While Open Innovation has been widely discussed in the literature, much of the focus remains theoretical. This study is based on and inspired by the work of Srisathan et al. (2023), that emphasizes the need to better understand how firms implement Open Innovation across multiple dimensions.

Prior research has noted persistent challenges in implementing Open Innovation, despite growing awareness of its strategic value (Lopes & De Carvalho, 2018). By examining four key dimensions (i.e., Organizational Archetype, Knowledge Management, Technology Transfer, and Collaborative Networks), this research contributes to fill that gap and responds to recent academic calls for multidimensional frameworks of Open Innovation Implementation (Chiu & Lin, 2022; Chiaroni et al., 2010).

In addition, by analysing how firm size and industry affect Open Innovation Implementation, the study offers practical value for managers and policy-makers seeking to design more tailored and effective innovation strategies.

1.5 Structure of the Document

After Introduction, the remaining document contains: Literature Review, Methodology, Data Analysis and Discussion and Conclusion.

The Literature Review details existing knowledge regarding the research topic and the evolution of its main concepts. The conceptual framework that guides the study is also presented, as well as the conceptual model and the research hypotheses.

The Methodology chapter outlines the type of study, target population and sample, data collection methods and data analysis procedures. Data Analysis and Discussion summarizes the collected data and presents data analysis and the discussion of the findings. The final chapter contains the main findings, theoretical and practical contributions, limitations and future research suggestions.

Chapter 2 – Literature Review

This research addresses the implementation of Open Innovation. In the following sub-sections, the main definitions and dynamics of Open Innovation Implementation are presented and the relationship between Open Innovation Implementation and its dimensions is discussed.

2.1 Open Innovation

The origins of the Open Innovation concept can be traced to Chesbrough (2003), where it is argued that the essence of this concept lies in recognizing that useful knowledge is widely distributed and that firms should not solely rely on their internal R&D efforts, but instead leverage outside knowledge and technology to enhance their innovation processes. Basically, the author suggest that firms should seek for external collaborative approaches in order to maximize the potential of their innovations and that Open Innovation is a paradigm that encourages firms to utilize both external and internal ideas to advance their innovations.

Later, Chesbrough and Bogers (2014) defines Open Innovation as a process of sharing knowledge outside of the organization boundaries. The authors also argue that this process involves both the inflow and the outflow of knowledge and that Open Innovation is increasingly relevant but not uniformly adopted. This underlines the importance of structured interactions to facilitate innovation development and commercialization outside the organization boundaries.

The European Commission recognizes Open Innovation as an essential mechanism to accelerate innovation and transform research into tangible societal and economic value (UN General Assembly, 2015). This promotes Open Innovation 2.0, a new paradigm that fosters extensive networking, cross-sector collaboration among diverse stakeholders, and quick adoption of innovations (Curley and Salmelin, 2013; 2018). This approach goal is to break down traditional institutional silos, promote multidisciplinary experimentation and leverage digital technologies for sustainable and inclusive growth in Europe.

Hafkesbrink and Schroll (2011) describes a shift from traditional Open Innovation to Innovation 3.0, also defined as Embedded Innovation, which stresses innovation processes within communities rather than just managing inflows and outflows of knowledge.

In recent literature, Costa and Matias (2020) characterizes Open Innovation 4.0 as an evolution driven by digitalization and Industry 4.0, where advanced digital technologies and sustainability concerns also take part in innovations. Thus, Open Innovation 4.0, according to the authors, represents a shift towards a multi-actor, digitally-advanced ecosystem that supports the economic and sustainable innovation goals simultaneously.

Aquilani et al. (2020) also highlights that Open Innovation is evolving to actively address complex social challenges and driving to a human-centred and sustainable future, with value co-creation at its centre.

In order to understand the transition from closed to Open Innovation, Chiaroni et al. (2010, 2011), investigates managerial factors such as organization archetype, knowledge management systems, collaborative networks, and technology transfer.

Moreover, Huang (2023) finds that Open Innovation is considered a key component of the United Nations' 2030 Sustainable Development Goals, emphasizing the importance of collaborative partners in achieving sustainable development.

2.2 Open Innovation Implementation

Bianchi et al. (2011) proposes that larger firms tend to implement Open Innovation more intensively than smaller firms. This may indicate that larger firms have more and better resources, assets, market coverage and capacity than smaller firms which facilitate their more effective implementation of Open Innovation.

Following the same line of thought, Wynarczyk (2013) also claims that SMEs face distinctive challenges when compared to larger firms due to their limited resources and management capacity. This underscores the necessity of building internal capabilities and fostering external partnerships to effectively implement Open Innovation.

Recent literature notes that solid management and a good organizational structure help smaller firms implement Open Innovation, even if they lack larger technological resources (Naruetharadhol et al., 2020).

Besides the firm size factor, other aspects can influence the successful implementation of Open Innovation. Ahn et al. (2017) argues that top management psychological and behavioural traits are key drivers for Open Innovation Implementation.

Kratzer et al. (2017) also claims that the firms' internal innovation culture and openness play a crucial role. The authors propose that these factors are considered the most important factors influencing the success of Open Innovation Implementation.

Boscherini et al. (2010) presents a new factor of success for implementing Open Innovation. The authors describe the pilot project phase as a critical part of implementing Open Innovation, structured around three main steps: conception, realization, and transfer of project results. They argue that the pilot project phase reduces risks and enables firms to experiment alternative approaches. Finally, the authors conclude that firms adopting pilot projects have a better mechanism for managing the complex organizational changes required for Open Innovation, implying more successful implementation compared to a non-pilot project approach.

Lopes and De Carvalho (2018) draws attention to a set of interrelated factors. Nonetheless, the authors emphasize absorptive capacity as a particularly critical competence enabling Open Innovation. The authors also argue that although firms are more aware of the benefits of Open Innovation, they face difficulties, especially in more complex practices.

Technological capability is also point out as a crucial factor in implementing Open Innovation (Rush et al., 2007). The authors argue that developing technological capabilities is essential to manage technology, absorb external knowledge and leverage innovation in order to reach competitive advantages.

However, the literature is unsuccessful in presenting the most important factor when implementing Open Innovation. Naqshbandi and Jasimuddin (2022) highlights the interplay of factors such as the managerial ties and the absorptive capacity as crucial elements in implementing Open Innovation. The authors argue that both factors are essential and that their joint effect is essential to successfully implement Open Innovation.

Chiaroni et al. (2010,2011) points to the coordinated actions on social networks, organizational structure modifications, refined evaluation systems, robust knowledge management, and strong leadership for the successful implementation of Open Innovation.

Recently, Chiu and Lin (2022) identifies a significant research gap regarding the role of technology transfer in Open Innovation Implementation. The authors highlight governance structures, technology adoption, effective knowledge creation and exchange

processes, and strong inter-organizational relationships as critical factors for the success of Open Innovation Implementation.

Naruetharadhol et al. (2020) proposes that Open Innovation Implementation should be measured as a second-order construct, as it is a broad and abstract concept that cannot be measured directly. It is reflected by three first-order dimensions: (1) knowledge management, (2) organizational structure, and (3) networks.

Srisathan et al. (2023) defines Open Innovation Implementation as the degree to which firms internally implement Open Innovation, particularly in the terms of Organizational Archetype, Knowledge Management, Technology Transfer and Collaborative Networks.

2.3 Dimensions of Open Innovation Implementation

2.3.1 Organizational Archetype

Srisathan et al. (2023) defines Organizational Archetype as the structure, behaviour and operational features of a firm, with the aim of fostering innovation by investing in new ideas or technologies while maintaining efficiency within existing operations.

Quinn and Rohrbaugh (1983) identifies four organizational culture archetypes: group culture, developmental culture, hierarchical culture and rational culture. More recently, Rubio-Andres and Abril (2023) advocates for a more flexible framework, allowing for overlapping values and adding a fifth dimension, risk aversion, besides the conventional four archetypes.

Regarding the shaping of a firm's archetype, early studies argue that stable patterns of strategy, structure, and behaviour contribute to this shaping (Miller & Friesen, 1978; Miles et al., 1978). More recently, Perez-Luño et al. (2011) agrees and furthermore recognizes that innovation activities are embedded within organizational contexts, shaped by archetypes and culture, that influence firms' willingness to generate or adopt innovations.

Çakar and Ertürk (2010) reveals that small firms benefit from close-knit, family-like cultures that promote direct innovation involvement, while medium firms rely more on formal participative processes and empowerment mechanisms to facilitate innovation.

This finding shows that cultural dimensions differently shape innovation depending on firm size.

Kesting and Ulhøi (2010) defends that decentralizing decision-making supports innovation initiated by employees. However, Liao et al. (2011) recognizes complexities in how centralization versus decentralization manifests in organizations under uncertainty.

Chiaroni et al. (2010) stresses that Open Innovation necessitates a reconfiguration of organizational structures and the promotion of a culture that prioritizes openness, external collaboration, and new ways of evaluating and managing innovation, together with clear leadership roles and efforts to overcome cultural resistance.

Moreover, Naruetharadhol et al. (2020) highlights the critical role of organizational design, through flexible, decentralized structures and collaboration mechanisms.

Organizational Archetype influences innovation by shaping how a firm structures, formalizes, and governs its external technology commercialization efforts (Lichtenthaler and Ernst, 2007).

Finally, Ter Wal et al. (2017) advocates that organizational structures and practices significantly influence how individuals perform in the gatekeeper and shepherd roles, which the authors emphasize as crucial to absorb external knowledge and driving innovation.

2.3.2 Knowledge Management

Innovation is a result of and a driver for effective knowledge management (Gold et al., 2001). This suggests that organizations that manage their knowledge assets effectively are better positioned to successfully innovate.

Liao et al. (2011) points out Knowledge Management as a critical capability that supports knowledge creation, dissemination and utilization, which, in turn, facilitate organizational adaptation and improve decision making.

Lopes et al. (2017) extends the importance of Knowledge Management, arguing that Knowledge Management is a strategic asset not only to support and promote innovation but also sustainability.

Naqshbandi and Jasimuddin (2018) also emphasizes that Knowledge Management capabilities are pivotal strategic resources that support the successful implementation of Open Innovation by enabling efficient knowledge acquisition, sharing, and use, particularly under the guidance of knowledge-oriented leadership.

More recently, Knowledge Management has been defined as a dynamic, collaborative, and Information and Communication Technology (ICT) supported process critical to enhancing both strategic and operational innovation capabilities (Adamides & Karacapilidis, 2020).

Srisathan et al. (2023) finds that Knowledge Management is a crucial process that involves creating, sharing, utilizing and retaining knowledge within an organization to foster firms' innovation capabilities.

2.3.3 Technology Transfer

Drivas et al. (2018) finds that, on the one hand, timely disclosure of invention information, particularly through patent application publication, significantly accelerates Technology Transfer by facilitating licensing. On the other hand, confirmation of patent grant plays a much smaller role due to contractual mechanisms addressing uncertainty.

Recent studies define Technology Transfer as a multifaceted process involving the creation, mobilization, exchange, and application of knowledge and skills from one context to another. The authors also consider technology transfer a vital vehicle of innovation (Rambe & Khaola, 2021; Scarrà & Piccaluga, 2022).

Huang et al. (2010) proposes that Technology Transfer requires some characteristics, such as effective intellectual property management, inventor engagement and/or involvement, market orientation and supportive administrative structures.

Hess and Siegwart (2013) identifies that large firms face internal barriers for breakthrough innovation. However, their resources and market power make them essential players in successful technology transfer. The authors also suggest that R&D Venturing (i.e., collaborative technology transfer and innovation development) forms a promising model, combining internal strengths with external innovation to accelerate and de-risk breakthrough technology development and commercialization.

The literature also suggests that external technology exploitation, such as licensing, joint development, and active participation in technology markets is as a core dimension of Open Innovation. (Hung & Chou, 2013).

Adamides and Karacapilidis (2020) highlights that while Technology Transfer is a crucial component of Open Innovation, its effectiveness can be negatively impacted by technological limitations and organizational constraints.

In a study involving three Korean industries, Yun et al. (2018) finds that Open Innovation leads to more active and effective Technology Transfer in industries with less concentration of large firms, like robotics, while the effect is weaker or limited in more consolidated industries, like automotive and aviation.

Lastly, Srisathan et al. (2023) finds that Technology Transfer is a critical factor when implementing Open Innovation and defines it as the movement of know-how or technology from one firm environment to another.

2.3.4 Collaborative Networks

Srisathan et al. (2023) finds Collaborative Networks to be the interconnected relationships among various stakeholders, such as, industry, research institutions, universities, suppliers, customers and users that firms establish to search for new ideas and technologies.

Rosenkopf and Nerkar (2001) claims that Collaborative Networks are crucial for exploration beyond local search, enhancing innovation impact by providing access to external knowledge and enabling firms to integrate diverse expertise across organizational boundaries.

Moreover, Chiaroni et al. (2010) argues that Collaborative Networks are fundamental managerial levers for implementing Open Innovation as they facilitate knowledge inflow, stimulate innovation opportunities, and are integral to organizational transformation processes.

Chiaroni et al. (2011) adds that Collaborative Networks are dynamic and multidimensional, requiring intentional development and management to successfully implement Open Innovation.

Ahuja (2000) highlights that a firm's innovation benefits from Collaborative Networks through a mix of direct and indirect ties. However, structural holes in such networks can undermine innovation due to reduced trust and collaboration effectiveness.

Accordingly, Laursen and Salter (2014) acknowledges risks when engaging in Collaborative Networks, arguing that it requires firms to pay attention to appropriability mechanisms to prevent knowledge spillovers, that might harm the organization especially when collaborating with competitors. Thus, the authors conclude that the management of Collaborative Networks is critical in handling the paradox of openness (i.e., the need to be open for innovation but protected enough to appropriate value from those innovations).

In the same line of thought, Ferreras-Méndez et al. (2016) argues that Collaborative Networks are essential but require strategic management to optimize absorptive capacity and learning outcomes.

Lee et al. (2010) notes that different collaboration modes involve diverse partnerships, such as outsourcing, strategic alliances, R&D partnerships, joint ventures, and networks with other organizations or institutions like universities.

Later, Yun and Liu (2019) adds the sustainability factor into the discussion and argues that firms should engage with several key networks to enhance Open Innovation and promote sustainability: (1) university networks; (2) government networks; (3) industry networks; (4) societal networks; and (5) intermediary networks.

While Nieto and Santamaría (2007) underscores the relevance of technological collaboration networks as a key driver of innovation, Perkmann and Walsh (2007) emphasizes the role of university-industry relationships proposing that this relationship is vital for Open Innovation as they provide more dynamic, relationship-intensive pathways for knowledge exchange and innovation co-development beyond mere intellectual property transfer. West and Lakhani (2008) also underscores a different actor from the past two, when they argue that communities promote innovation through voluntary, collaborative, user-driven processes that are less hierarchical, more open in knowledge sharing, and often motivated by personal or social utility rather than solely financial returns.

In a study on Nokia, Dittrich and Duyster (2007) acknowledges that Collaborative Networks are vital means for firms to pursue innovation-driven strategy changes,

enabling them to sustain global leadership by transitioning effectively between exploitation and exploration (March, 1991), in R&D alliances.

According to Laursen and Salter (2006) firms embedded in rich, benefit-producing networks tend to have better innovation outcomes because such networks facilitate access to diverse knowledge and resources.

2.4 Conceptual Framework and Model

This study aims to:

1. Characterize Open Innovation Implementation and its dimensions (i.e., Organizational Archetype, Knowledge Management, Technology Transfer and Collaborative Networks) across Portuguese firms;
2. Understand the relationship between the dimensions of Open Innovation Implementation and firm size;
3. Understand the relationship between the dimensions of Open Innovation Implementation and industry.

To address the research objectives, the conceptual framework present in Table I is used.

To address research objective 1, the concepts Open Innovation Implementation (OII), Organizational Archetype (OA), Knowledge Management (KM), Technology Transfer (TT) and Collaborative Networks (CN) are considered.

The literature suggests that larger firms are more likely to implement Open Innovation practices (Bianchi et al., 2011; Hess & Siegwart, 2013; Wynarczyk, 2013). Yet, there is a gap in the literature regarding the relationship between industry type and OII.

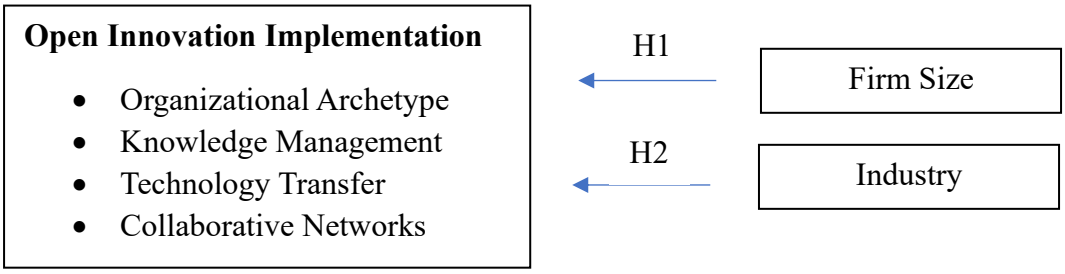
Therefore, the conceptual model (Figure 1) and hypotheses regarding research objectives 2 and 3 are proposed (Table II).

Table I. Conceptual Framework

Concept	Definition	Reference
Open Innovation Implementation	The degree to which firms internally implement open innovation, particularly in the terms of organizational archetype, knowledge management, technology transfer and collaborative networks.	Srisathan et al. (2023)
Dimensions of Open Innovation Implementation:		
Organizational Archetype	The structure, behaviour and operational features of a firm, with the aim of fostering innovation by investing in new ideas or technologies while maintaining efficiency within existing operations.	Srisathan et al. (2023)
Knowledge Management	Process that involves creating, sharing, utilizing and retaining knowledge within an organization to foster firms' innovation capabilities.	Srisathan et al. (2023)
Technology Transfer	The movement of know-how or technology from one firm environment to another.	Srisathan et al. (2023)
Collaborative Networks	Interconnected relationships among various stakeholders that firms establish to search for new ideas and technologies.	Srisathan et al. (2023)

Source: Own work

Figure 1. Conceptual Model



Source: Own work

Table II. Research Hypothesis

H1: There is a positive relationship between Open Innovation Implementation and Firm Size
H2: There is a relationship between Open Innovation Implementation and Industry

Source: Own work

Chapter 3 – Methodology

3.1 Type of Study

This study was based on a positivist approach, which means it focused on studying reality as something objective and independent of personal opinions, relying on observable and measurable facts to create and test hypotheses (Saunders et al., 2023). The objective was to stay neutral and detached throughout the research process, so the results were not influenced in any way (Saunders et al., 2023).

Regarding the research approach, a deductive method was chosen which means that the study started with a theory based on existing literature, which was then tested (Saunders et al., 2023). Depending on the results, the theory can either be confirmed, adjusted or rejected, depending on whether the findings match the original assumptions (Saunders et al., 2023).

This study takes an exploratory-descriptive approach with the goal to explore and describe a specific topic, offering in-depth understanding and highlighting patterns or connections that could guide future research (Saunders et al., 2023).

The mono-method quantitative approach chosen for this study was the survey method that was used to collect quantitative data. This method is adequate to collect quantitative data in a consistent way from a sample (Saunders et al., 2023).

The same research strategy is also found in other researches, particularly in Srisathan et al. (2023).

The study was done in a cross-sectional time horizon, as it focused in a particular moment in time with a single period of time for data collection (Saunders et al., 2023).

3.2 Population and Sample

The target population of the study consisted of Portuguese firms. Because of practical constraints, only a part of the population was included, known as target-sample (Malhotra & Birks, 2007).

Firms were sampled using a random probability technique, in which all cases had an equal chance of being chosen, enabling statistical conclusions to be drawn about the target population (Saunders et al., 2023).

The sample was obtained from the Orbis Europe database for private firms. All firms with active status, located in Portugal and with a valid email address were considered and a proportional random sample based on industry was selected. More than 29000 firms were contacted and 286 responses were elicited, of which 199 were complete answers.

3.3 Data Collection

Primary data collection was conducted through an online questionnaire designed with the Qualtrics web-based software.

The questionnaire was elaborated based in Srisathan et al. (2023). To ensure the questions were appropriate for the target respondents, they were carefully translated into Portuguese and linguistically adapted for better understanding.

At the beginning of the questionnaire, a cover letter was presented explaining the objectives and importance of the study, as well as specifying the appropriate respondents within the firm, namely the head of innovation or the general manager. This was followed by 4 characterization questions designed to profile the respondents, utilizing nominal and ordinal scales, also based on Srisathan et al. (2023).

The following sections were composed by 17 questions measuring the variable, Open Innovation Implementation, adopted from Srisathan et al. (2023), particularly in within the dimensions of Organizational Archetype, Knowledge Management, Technology Transfer, and Collaborative Networks (one section for each dimension). The first section, regarding the Organizational Archetype dimension, was used to measure firms' behaviour emphasizing (1) new product or service introductions, (2) integrating a knowledge network, (3) creating a gatekeeping role and (4) being open to change. The second section, concerning Knowledge Management, was used to assess firm activities such as (1) creating new knowledge to improve the firm's level of innovation, (2) sharing useful knowledge both within firm boundaries and with external partners, (3) engaging in knowledge utilization processes to develop scalable solutions and (4) maintaining a knowledge database within firm boundaries. The third section, relating to the Technology Transfer dimension, was used to analyse firm activities such as (1) the evaluation process of technological knowledge acquisition and licensing (e.g., patents, industrial design rights, copyrights) for creating or improving (new) innovations based on existing resources, (2) preparing for intellectual property registration, (3) evaluating knowledge

assets for commercialization in the market and (4) implementing an IT skill base and IT infrastructure. The fourth and final section, concerning to Collaborative Networks, was used to examine collaborations, including (1) competitors and firms from the same industry or business group, (2) clients or customers, (3) suppliers, (4) investigation centres or higher education institutions and (5) public institutions.

For these last four sections, the measures were assessed based on a 7-point Likert scale (1- "Totally disagree" to 7- "Totally agree"), as it is the most accurate and representative reflection of a participant's assessment (Finstad, 2010).

A pre-test of the survey was conducted to assess the validity, suitability and reliability of the proposed questions and scales and to identify any potential issues in the survey's design and content (Saunders et al., 2023). To achieve this, the initial version of the questionnaire was distributed to a sample of 15 colleagues and personal contacts. Based on the feedback received, several modifications were made, including naming all the Likert scale scores instead of naming only number 1 and 7, modifying unclear terms or expressions and making the overall format easier to follow. The final distributed version of the questionnaire can be consulted on Annex 1.

The final version of the questionnaire was then distributed in the 7th of May 2025 and in the 14th to May 2025 to the target sample of respondents using Qualtrics' built-in email invitation function as well as through an email service provider (Brevo).

3.4 Data Analysis

The collected data, corresponding to the 199 valid answers, was processed and analysed using IBM SPSS Statistics software.

Firstly, the development of synthetic indexes to represent the variables described in the conceptual model was carried. In total, 4 synthetic indexes were created, corresponding to the following variables: Organizational Archetype (OA), Knowledge Management (KM), Technology Transfer (TT) and Collaborative Networks (CN). These indexes were obtained by calculating the mean values of their corresponding items. The respective descriptive statistics are shown in Annex 2. Also, a composite index, Open Innovation Implementation (OII), was created by calculating the means of the 4 synthetic indexes previously mentioned (Hair et al., 2019), in order to add depth and clarity to the research (Booysen, 2002).

Then, Cronbach's Alpha coefficient (α) tests were employed in order to analyse the reliability and internal consistency of the indexes (Saunders et al., 2023).

Additionally, in order to characterize the sample, the indexes and the relationship between both, descriptive statistics were applied, with the calculation of means and standard deviations.

Lastly, in order to assess the research hypotheses two different approaches were taken.

Based on the literature suggesting that larger firms are more likely to implement Open Innovation practices (Bianchi et al., 2011; Hess & Siegwart, 2013; Wynarczyk, 2013), Hypothesis 1 was formulated as directional. As such, linear regression approach was used to test for a positive relationship between firm size and Open Innovation Implementation (Keith 2019).

For Hypothesis 2, since the literature does not point to a clear directional expectation, a non-directional hypothesis was formulated. Thus, one-way ANOVAs were employed to assess whether Open Innovation Implementation levels differ across industry (Field 2024).

To test H1, five separate regression analyses were conducted with firm size as the independent variable and each Open Innovation Implementation dimensions (OA, KM, TT, CN) as well as the composite index (OII) as the dependent variables.

To include categorical variables in the regression analysis, dummy variables were created. This was necessary because linear regression models require independent variables to be numerical and the variable "firm size" was categorical with four levels (micro, small, medium, and large) (Field 2024).

Since the literature claims that larger firms implement Open Innovation more intensively, large firms were set as the reference category (i.e., no dummy variable was created for it) (Field 2024). As such, negative standardized coefficients for micro, small, and medium-sized firms indicate that these groups exhibit lower levels of Open Innovation Implementation compared to large firms (Keith 2019).

To test H2, five one-way ANOVAs were run with industry group as the independent variable and each Open Innovation Implementation dimension as well as the composite index as the dependent variables.

The original industry variable included 18 distinct categories, several of which had very few or no responses. To ensure adequate group sizes and meaningful statistical comparison, the original industry responses were recoded into six broader categories (Pallant, 2020; Field, 2024) based on industry similarity: Primary (e.g., agriculture, extractive industries), Industry (e.g., manufacturing, construction), Commerce (e.g., wholesale, transportation), Technology (e.g., IT, consultancy, scientific activities), Services (e.g., finance, real estate, administrative support), and Public/Nonprofit (e.g., education, health, arts, and social services).

To provide both detailed and summarized perspectives, each Open Innovation Implementation dimension as well as the composite index were analysed individually.

Chapter 4 – Data Analysis and Discussion

4.1 Reliability and Internal Consistency Analysis

To assess the reliability and internal consistency of the Open Innovation Implementation dimensions, the Cronbach's Alpha coefficient (α) was employed. This indicates how closely related a set of items are as a group. It ranges from 0 to 1, with values above 0.7 considered acceptable (Saunders et al., 2023).

As shown in Table III, all the dimensions indexes present acceptable alpha coefficient values, ranging from 0.701 to 0.865, with the lowest for the Organizational Archetype dimension and the highest for the Technology Transfer dimension. Therefore, the alpha value for each construct was above the recommended value of 0.70, which is considered satisfactory for exploratory research (Saunders et al., 2023).

Table III. Summary of the Reliability and Internal consistency Analysis

Indexes	Cronbach's Alpha (α)
Organizational Archetype	0,701
Knowledge Management	0,771
Technology Transfer	0,865
Collaborative Networks	0,843

4.2 Characterization of the Sample

The sample is constituted by 199 Portuguese firms. In Tables IV, V and VI, the descriptive data of the firms is displayed, according to the geographical location, firm size (i.e., number of employees) and industry, respectively. Additionally, tables V and VI contain national statistical information regarding Portuguese firms in 2023, allowing a comparison with the corresponding population of the sample (INE, 2023).

Table IV. Profile of the respondents in the sample by location

Geographic Location	N	% of the sample
Açores	3	1,5%
Aveiro	15	7,5%
Beja	1	0,5%
Braga	12	6,0%
Bragança	0	0,0%
Castelo Branco	4	2,0%
Coimbra	3	1,5%
Évora	2	1,0%
Faro	11	5,5%
Guarda	2	1,0%
Leiria	9	4,5%
Lisboa	63	31,7%
Madeira	5	2,5%
Portalegre	6	3,0%
Porto	35	17,6%
Santarém	4	2,0%
Setúbal	16	8,0%
Viana do Castelo	1	0,5%
Vila Real	5	2,5%
Viseu	2	1,0%
Total	199	100%

N= Number of answers

Table V. Profile of the respondents in the sample by firm size

No. Of employees	N	% of the sample	% of the population*
0-10	134	67,3%	96,3%
11-50	46	23,2%	3,1%
51-250	13	6,5%	0,5%
Over250	6	3,0%	0,1%
Total	199	100%	100,0%

*Data from 2023 (**Source**: INE)

Regarding to the location, Lisbon is the most represented region of the sample (31.7%), followed by Porto (17.6%), Setúbal (8.0%) and Aveiro (7.5%). The region of Bragança is not represented in the sample.

In terms of firm size, 67.3% of the sample are micro-firms, having 10 or fewer employees, 23.2% are small-sized firms, with 11 to 50 employees, 6.5% are medium-sized firms, with 51 to 250 employees, and the remaining (3.0%) are large firms with more than 250 employees.

Regarding industry, overall, we can see a fit between the data in the sample and the population. The discrepancies are mainly in 6 industries: the industries “Wholesale and retail trade”, “Administrative and support services” and “Education” are underrepresented in the sample while the industries “Water collection, treatment and distribution; sanitation, waste management and pollution control”, “Financial and

insurance activities" and "Other service activities" are overrepresented. Moreover, the industries "Extractive industries" and "Arts, entertainment, and recreation" are not represented.

The most represented industry in the sample is "Other service activities" (22.1%), followed by "Consultancy, scientific, technical, and similar activities" (13.1%), "Construction" (11.1 %), "Wholesale and retail trade" (8.1%) and "Accommodation and food service" (7.5%) (Table VI).

Table VI. Profile of the respondents in the sample by industry

Industry	N	% of the sample	% of the population*
Agriculture, forestry, and fishing	12	6,0%	7,96%
Extractive industries	0	0%	0,07%
Manufacturing	10	5,1%	4,56%
Electricity, gas, steam, and air conditioning	1	0,5%	0,35%
Water collection, treatment and distribution; sanitation, waste management and pollution control	3	1,5%	0,08%
Construction	22	11,1%	7,12%
Wholesale and retail trade	16	8,1%	14,35%
Transportation and storage	4	2,0%	3,57%
Accommodation and food service	15	7,5%	8,29%
Information and communication	6	3,0%	2,24%
Financial and insurance activities	8	4,0%	0,33%
Real estate activities	14	7,0%	4,28%
Consultancy, scientific, technical, and similar activities	26	13,1%	10,30%
Administrative and support services	4	2,0%	16,16%
Education	3	1,5%	4,36%
Human health and social activities	11	5,5%	7,82%
Arts, entertainment, and recreation	0	0%	3,13%
Other service activities	44	22,1%	5,02%
Total	199	100%	100,00%

N= Number of answers

*Data from 2023 (**Source**: INE)

4.3 Characterization of Open Innovation Implementation across Portuguese Firms

The dimensions outlined in the conceptual framework were analysed based on their mean values and standard deviations (Table VII), interpreted in accordance with their respective measurement scales. A detailed breakdown of each variable is available in Annex 2. Each dimension was analysed individually using descriptive statistics.

Observing the indexes referring to the dimensions of Open Innovation Implementation, the highest mean value corresponds to Knowledge Management (5.37) while the lowest is Technology Transfer (3.81). Organizational Archetype has a mean value of 5.16 and Collaborative Networks has a mean value of 4.70.

Regarding the standard deviation, Technology Transfer has the highest value (1.70) and Knowledge Management has the lowest (1.13). Organizational Archetype has a standard deviation of 1.18 and Collaborative Networks has a standard deviation of 1.39.

Table VII. Descriptive statistics of the indexes referring to the dimensions of OII of the conceptual framework

Variable	Minimum	Maximum	Mean	Std. Deviation
Organizational Archetype	1.00	7.00	5.16	1.18
Knowledge Management	1.00	7.00	5.37	1.13
Technology Transfer	1.00	7.00	3.81	1.70
Collaborative Networks	1.00	7.00	4.70	1.39

The descriptive statistics distributed through the demographic characteristics of the firms (firm size and industry) are displayed in Table VIII and Table IX.

Organizational Archetype has the highest mean value in large firms (5.75) and the lowest mean value in small firms (4.88). “Administrative and support services” is the industry with the highest mean value for the OA dimension (5.88) and “Electricity, gas, steam, and air conditioning” is the industry with the lowest mean value (4.75).

Large firms record the highest mean value for the Knowledge Management dimension (5.71) while small firms record the lowest (4.99). The highest mean value regarding industries is recorded by “Administrative and support services” (6.44) and the lowest by

"Water collection, treatment and distribution; sanitation, waste management and pollution control" (4.83).

Technology Transfer has its peak mean value in firms with more than 250 employees (4.96) and the lowest in firms that have between 11 and 50 employees (3.46). "Education" is the industry with the highest mean value for the TT dimension (5.33) and "Water collection, treatment and distribution; sanitation, waste management and pollution control" registers the lowest (1.75).

Mean scores for Collaborative Networks are greatest in large firms (5.20) and reach its minimum in small firms (4.30). Across industries, the highest value is seen in "Water collection, treatment and distribution; sanitation, waste management and pollution control" (5.67) and the lowest in "Wholesale and retail trade" (4.34).

Table VIII. Distribution of variables by firm size

No. Of employees	N		Indexes			
			OA	KM	TT	CN
10 or less	134	Mean	5,22	5,49	3,85	4,80
		Std. Deviation	1,20	1,14	1,78	1,43
Between 11 and 50	46	Mean	4,88	4,99	3,46	4,30
		Std. Deviation	1,14	1,07	1,44	1,30
Between 51 and 250	13	Mean	5,17	5,23	4,12	4,85
		Std. Deviation	1,21	1,11	1,71	1,14
More than 250	6	Mean	5,75	5,71	4,96	5,20
		Std. Deviation	0,72	0,81	1,13	1,18
Total	199	Mean	5,16	5,37	3,81	4,70
		Std. Deviation	1,18	1,13	1,70	1,39

Table IX. Distribution of variables by industry

Industry	N		Indexes			
			OA	KM	TT	CN
Agriculture, forestry, and fishing	12	Mean	5,15	5,35	3,75	5,17
		Std. Dev	0,72	0,75	1,33	0,95
Extractive industries	0	Mean	-	-	-	-
		Std. Dev	-	-	-	-
Manufacturing	10	Mean	5,50	5,58	4,78	4,96
		Std. Dev	0,96	1,04	1,71	0,85
Electricity, gas, steam, and air conditioning	1	Mean	4,75	5,75	2,00	4,60
		Std. Dev	-	-	-	-
Water collection, treatment and distribution; sanitation, waste management and pollution control	3	Mean	5,08	4,83	1,75	5,67
		Std. Dev	0,52	1,28	1,09	1,40
Construction	22	Mean	5,26	5,43	4,09	4,95
		Std. Dev	1,19	1,23	1,71	1,29
Wholesale and retail trade	16	Mean	4,94	5,00	3,14	4,34
		Std. Dev	1,16	1,48	1,73	1,49
Transportation and storage	4	Mean	4,94	5,00	3,19	5,10
		Std. Dev	1,14	0,74	1,25	1,72

Accommodation and food service	15	Mean	5,02	4,93	3,52	4,37
		Std. Dev	0,98	0,76	1,60	1,31
Information and communication	6	Mean	5,13	5,67	4,04	4,60
		Std. Dev	1,73	1,27	2,11	2,02
Financial and insurance activities	8	Mean	4,88	5,56	3,13	4,35
		Std. Dev	1,01	1,16	1,53	0,77
Real estate activities	14	Mean	5,50	5,45	4,84	5,26
		Std. Dev	1,39	1,07	1,75	1,33
Consultancy, scientific, technical, and similar activities	26	Mean	5,43	5,65	4,10	4,63
		Std. Dev	1,08	0,99	1,60	1,34
Administrative and support services	4	Mean	5,88	6,44	4,19	5,10
		Std. Dev	1,36	0,66	1,20	1,83
Education	3	Mean	5,42	5,33	5,33	4,93
		Std. Dev	1,01	0,95	1,53	0,61
Human health and social activities	11	Mean	5,07	5,30	3,52	4,69
		Std. Dev	1,26	1,60	1,83	1,70
Arts, entertainment, and recreation	0	Mean	-	-	-	-
		Std. Dev	-	-	-	-
Other service activities	44	Mean	4,91	5,28	3,60	4,41
		Std. Dev	1,39	1,17	1,71	1,58
Total	199	Mean	5,16	5,37	3,81	4,70
		Std. Dev	1,18	1,13	1,70	1,39

OA= Organizational Archetype; KM= Knowledge Management; TT= Technology Transfer; CN= Collaborative Networks; Std. Dev= Standard Deviation.

Also, one composite index was created, Open Innovation Implementation (OII), which was calculated through the mean of the OA, KM, TT and CN synthetic indexes (Hair et al., 2019; Booysen, 2022).

The mean value for this composite index is 4.76 and its standard deviation has the value of 1.15 (Table X).

Table X. Descriptive statistics of the composite index OII

Variable	Minimum	Maximum	Mean	Std. Deviation
OII	1.00	7.00	4.76	1.15

OII= Open Innovation Implementation.

4.4 Relationship between Open Innovation Implementation and Firm Size

In order to assess the second research objective and test Hypothesis 1, which suggests a positive relationship between Open Innovation Implementation and firm size, five Linear Regressions were carried out. The results of which are detailed in Table XI and XII.

The dependent variables in this analysis were the dimensions of Open Innovation Implementation (i.e., Organizational Archetype, Knowledge Management, Technology Transfer, Collaborative Networks) and the composite index of the four (OII) and the independent variables were firm size (Micro, Small and Medium). Since the literature claims that larger firms implement Open Innovation more intensively, large firms were set as the reference category (i.e., no dummy variable was created for it) (Field 2024). Since large firms served as the reference category, negative coefficients indicate lower Open Innovation Implementation levels among smaller firms (Keith 2019).

Assumption tests for linear regression were performed (Field 2024) on the model using the composite index OII as the dependent variable. Since all regression models used the same predictor variables and similarly constructed dependent indexes, it was assumed that the underlying statistical assumptions, (normality, independence, residual and multicollinearity) held for the other models as well (Field, 2024) (Annex 3).

As shown on Table XI, the regression analyses conducted to test the relationship between firm size and the four dimensions of Open Innovation Implementation (OA, KM, TT and CN) reveal a consistent trend of negative associations between smaller firm categories and Open Innovation Implementation when compared to large firms. Although the models generally exhibited low explanatory power, with adjusted R^2 values ranging from 0.007 to 0.024, they still offer relevant insights (Cohen, 2013).

The most notable result emerges in the Technology Transfer dimension, where small firms demonstrate a statistically significant negative effect ($\beta = -0.372$, one-tailed $p = 0.022$), indicating lower implementation relative to large firms. A similar but marginally significant result is found in the Organizational Archetype dimension for small firms ($\beta = -0.311$, one-tailed $p = 0.046$). Across all dimensions, micro and medium-sized firms also show negative beta values, though these relationships did not reach statistical significance, as the one-tailed p values are > 0.05 (Field, 2024).

Overall, these findings provide partial support for Hypothesis 1, suggesting that smaller firms, particularly those in the small-size category, may face more difficulties in implementing Open Innovation practices compared to larger firms. This trend is most evident in the dimensions of Technology Transfer and Organizational Archetype.

The last regression analysis was conducted using the composite OII index as the dependent variable to assess the overall relationship between firm size and Open

Innovation Implementation (Table XII). The model shows a small but notable explanatory power, with an R^2 of 0.035 and an Adjusted R^2 of 0.020 (Cohen, 2013).

Small firms demonstrate a statistically significant negative association with Open Innovation Implementation compared to large firms (β = -0.365, one-tailed p = 0.023). Micro (β = -0.229) and medium-sized firms (β = -0.121) also show negative coefficients, though these were not statistically significant (one-tailed p > 0.05) (Field, 2024).

These findings further support Hypothesis 1 by reinforcing the trend that smaller firms, particularly small-sized, are less likely to implement Open Innovation practices to the same extent as large firms.

Table XI. Summary of the Linear Regression Analysis: Variables and Firm Size

Dependent Variable	Firm Size	Standardized Coefficient (β)	R^2	Adjusted R^2	F	p-value (2-tailed)	p-value (1-tailed)
Organizational Archetype	Micro	-0,210	0,022	0,007	1,486	0,285	0,143
	Small	-0,311				0,091	0,046
	Medium	-0,121				0,323	0,162
Knowledge Management	Micro	-0,089	0,038	0,024	2,590	0,647	0,324
	Small	-0,269				0,139	0,070
	Medium	-0,105				0,387	0,194
Technology Transfer	Micro	-0,305	0,026	0,011	1,741	0,120	0,060
	Small	-0,372				0,043	0,022
	Medium	-0,123				0,314	0,157
Collaborative Networks	Micro	-0,137	0,027	0,012	1,810	0,484	0,242
	Small	-0,274				0,135	0,068
	Medium	-0,063				0,604	0,302

Table XII. Summary of the Linear Regression Analysis: Composite index (OII) and Firm Size

Dependent Variable	Firm size	Standardized Coefficient (β)	R^2	Adjusted R^2	F	p-value (2-tailed)	p-value (1-tailed)
OII	Micro	-0,229	0,035	0,020	2,346	0,239	0,120
	Small	-0,365				0,046	0,023
	Medium	-0,121				0,319	0,160

OII= Open Innovation Implementation.

4.5 Relationship between Open Innovation Implementation and Industry

In order to assess the third research objective and test Hypothesis 2, which suggests a relationship between Open Innovation Implementation and industry, a series of One-Way ANOVAs were conducted. The results of which are detailed in Table XIII.

The dependent variables in this analysis were Organizational Archetype, Knowledge Management, Technology Transfer, Collaborative Networks and the composite index OII and the independent variable was Industry, which were grouped in six different groups as explained in chapter 3.

Assumptions of homogeneity of variances were tested using Levene's test for each ANOVA (Field 2024). As all p-values exceeded the 0.05 threshold, the assumption of equal variances was met in all cases (Field 2024). Tukey's HSD test was used as the post hoc method where applicable (Field 2024) (Annex 6).

As shown on Table XIII, results indicate that none of the models reached statistical significance, with p-values ranging from 0.324 (KM) to 0.878 (OA) (Pallant, 2020; Field, 2024). Correspondingly, the effect sizes are small across all models, as reflected in the eta-squared (η^2) values: 0.009 for OA, 0.029 for KM, 0.025 for both TT and CN, and 0.022 for OII (Cohen, 2013; Lakens, 2013). These values suggest that industry accounts for only a small proportion of the variance in Open Innovation Implementation.

Given these findings, Hypothesis 2 is not supported, as no significant differences in Open Innovation Implementation practices are observed across industries.

Table XIII. Summary of the One-Way ANOVAs analysis: Variables and Industry Group

Dependent Variable	F	df (Between, Within)	p-value (ANOVA)	Eta-Squared (η^2)
OA	0,356	(5, 193)	0,878	0,009
KM	1,173	(5, 193)	0,324	0,029
TT	0,977	(5, 193)	0,433	0,025
CN	0,970	(5, 193)	0,437	0,025
OII	0,866	(5, 193)	0,505	0,022

OA= Organizational Archetype; KM= Knowledge Management; TT= Technology Transfer; CN= Collaborative Networks; OII= Open Innovation Implementation.

Table XIV. Summary of the assessment of the research hypothesis

H1: There is a positive relationship between Open Innovation Implementation and Firm Size	Partially Supported
H2: There is a relationship between Open Innovation Implementation and Industry	Not Supported

Source: Own work

4.6 Discussion of Results

Regarding the characterization of Open Innovation Implementation across Portuguese firms the results of the survey indicate a moderate degree of Open Innovation Implementation among Portuguese firms. The mean scores across the four dimensions (Organizational Archetype, Knowledge Management, Technology Transfer, and Collaborative Networks) range from 3.81 to 5.37 and the OII composite index scores a mean value of 4.76 on a 7-point Likert, revealing that while firms are implementing Open Innovation practices, the extent of that implementation varies across dimensions. This is consistent with Chesbrough and Bogers (2014), that frames Open Innovation as a strategic model that is increasingly relevant but not uniformly implemented. The highest average scores are observed in Knowledge Management and Organizational Archetype, suggesting that the Portuguese firms in the sample are relatively more developed in internal innovation processes and in structuring mechanisms that support openness. These elements are foundational to more advanced OII strategies, as emphasized in Chiaroni et al. (2010). On the other hand, Technology Transfer and Collaborative Networks record lower mean values, indicating that externally oriented or formalized Open Innovation Implementation dimensions are comparatively less developed. This finding supports Lopes and de Carvalho (2018), that highlights that although firms are increasingly aware of the benefits of Open Innovation, they face difficulties in implementing more complex practices. Overall, these results suggest that while Open Innovation is being pursued to a meaningful extent, its maturity varies considerably across dimensions, aligning with global observations of gradual and uneven implementation (Chesbrough and Bogers, 2014).

Larger firms report higher scores across all dimensions and comparing with SMEs Technology Transfer and Organizational Archetype have the highest differences. These results reflect prior studies emphasizing the advantages large firms possess in structuring

formal innovation processes, including resource availability and internal capabilities (Bianchi et al., 2011; Hess & Siegwart, 2013; Wynarczyk, 2013).

Industry shows modest variation. This suggests that Open Innovation is becoming increasingly widespread and less dependent on specific industry dynamics. Organizational Archetype has its highest mean value in "Administrative and support services" (5.88) and the lowest in "Electricity, gas, steam, and air conditioning" (4.75). The Knowledge Management dimension also has its highest mean value in "Administrative and support services" (6.44) and the lowest in "Water collection, treatment and distribution; sanitation, waste management and pollution control" (4.83). Regarding the Technology Transfer dimension, the highest mean value is recorded in "Education" (5.33) and the lowest in "Water collection, treatment and distribution; sanitation, waste management and pollution control" registered the lowest (1.75). Finally, concerning the dimension of Collaborative Networks, the peak value is recorded in "Water collection, treatment and distribution; sanitation, waste management and pollution control" (5.67) and the lowest in "Wholesale and retail trade" (4.34). However, differences were not significant.

Concerning the relationship between the dimensions of Open Innovation Implementation and firm size, Hypothesis 1 is built as directional as it is grounded in literature that emphasizes the advantages large firms have in terms of resource availability, formalization, and absorptive capacity (Bianchi et al., 2011; Hess & Siegwart, 2013; Wynarczyk, 2013). The regression analysis provide partial support for this hypothesis.

Across all four dimensions, as well as the composite OII index, negative coefficients are consistently observed for micro, small, and medium-sized firms, indicating lower levels of Open Innovation Implementation compared to large firms. This finding aligns with Chiaroni et al. (2010), that finds that formalized structures and dedicated innovation teams are essential and with Bianchi et al. (2011); Hess & Siegwart (2013); Wynarczyk (2013) that claims that these structures and resources are more prevalent in large firms.

Technology Transfer yields the strongest result, with a significant negative coefficient for small firms ($\beta = -0.372$, $p = 0.022$), while a marginally significant result is also observed in Organizational Archetype ($\beta = -0.311$, $p = 0.046$). These findings suggest that implementing structured, process-heavy OII dimensions may be more challenging for smaller firms. Similar conclusions are drawn in Adamides and Karacapilidis (2020), that

stress that technological limitations and organizational constrains can negatively impact the effectiveness of Open Innovation Implementation, particularly in the Technology Transfer dimension.

Although KM and CN do not yield statistically significant results, their negative trends reinforce the broader pattern. The composite OII index shows a significant negative result for small firms ($\beta = -0.365$, $p = 0.023$), further confirming that firm size plays a role in Open Innovation Implementation. These outcomes partially confirm Hypothesis 1.

Lastly, regarding the relationship between the dimensions of Open Innovation Implementation and industry, Hypothesis 2 proposes a non-directional relationship, with the objective to explore if certain industry contexts might support or inhibit Open Innovation Implementation. The ANOVA results show no significant differences in Open Innovation Implementation scores across the six grouped industry sectors.

All four dimensions (OA, KM, TT, CN), and the composite index (OII), yield p-values well above the 0.05 threshold, with small effect sizes ($\eta^2 < 0.03$). This suggests that Open Innovation Implementation practices may be adopted with similar intensity across industries, particularly as firms increasingly integrate digital platforms, shared tools, and collaborative models promoted by frameworks like Open Innovation 2.0 (Curley & Salmelin, 2018).

The results do not support Hypothesis 2, indicating that industry is not a significant determinant of Open Innovation Implementation among the sample of Portuguese firms.

Taken together, the results suggest that firm-level characteristics, particularly firm size, exert more influence on the implementation of Open Innovation than the broader industry context. This reinforces findings in Naqshbandi and Jasimuddin (2022), that emphasizes the importance of internal capabilities and managerial commitment in fostering Open Innovation Implementation. Larger firms appear better equipped to manage structured and resource-intensive dimensions such as Technology Transfer, while smaller firms may struggle due to limited resources and structure (Bianchi et al., 2011; Hess & Siegwart, 2013; Wynarczyk, 2013).

The uniformity of Open Innovation Implementation across industry, suggests that Open Innovation may represent a strategic imperative across the business landscape, independent of industry-specific characteristics.

Chapter 5 - Conclusion

5.1 Main Findings

This study aims to:

1. Characterize Open Innovation Implementation and its dimensions (i.e., Organizational Archetype, Knowledge Management, Technology Transfer and Collaborative Networks) across Portuguese firms;
2. Understand the relationship between the dimensions of Open Innovation Implementation and firm size;
3. Understand the relationship between the dimensions of Open Innovation Implementation and industry.

Utilizing data from 199 valid survey responses and a quantitative analysis using SPSS, the findings provide several relevant insights.

Regarding the first research objective, the overall results suggest a moderate degree of Open Innovation Implementation across the sample of Portuguese firms, with mean scores across the four dimensions ranging from 3.81 to 5.37 on a 7-point Likert scale. On the one hand, Knowledge Management and Organizational Archetype present the highest average scores, indicating that internal processes related to knowledge sharing and structural support for innovation are relatively well developed. On the other hand, Technology Transfer and Collaborative Networks have slightly lower scores, suggesting that firms may still face challenges in adopting more externally oriented or formalized Open Innovation mechanisms.

Regarding the second research objective, the analysis reveal that firm size has influence on the level of Open Innovation Implementation. Small firms (11-50 employees) show significantly lower scores in the Technology Transfer and Organizational Archetype dimensions when compared to large firms, confirming partial support for Hypothesis 1. These results are consistent with the literature emphasizing that smaller firms often lack the resources and capabilities to implement Open Innovation compared to larger firms.

Concerning the third research objective, the results show no statistically significant differences in Open Innovation Implementation across industries. This finding suggests

that Open Innovation is implemented across diverse industries regardless of their traditional innovation profiles. As such, Hypothesis 2 was not supported.

5.2 Theoretical and Practical Contributions

From a theoretical point of view, this research contributes to the ongoing academic discussion on Open Innovation, specifically on the implementation of Open Innovation, by providing empirical evidence from a Portuguese context. It extends prior studies by analysing multiple dimensions of Open Innovation Implementation and testing their relationship with firm size and industry. The findings support existing frameworks that argue that smaller firms face bigger challenges when implementing Open Innovation and also support the literature that highlights the role of internal capabilities and organizational structure in implementing Open Innovation, especially for smaller firms.

The study also offers valuable insights for managers and policymakers. The partial confirmation of Hypothesis 1 indicates that larger firms are generally better positioned to implement Open Innovation. This suggests that SMEs may benefit from targeted support programs, training, or policy incentives that help them build the structural and relational capacities needed for effective Open Innovation Implementation. The absence of significant industry effects also implies that Open Innovation Implementation strategies and policies can be developed in a cross-sectoral manner, rather than tailored strictly by industry.

5.3 Limitations

While the findings are meaningful, several limitations can be acknowledged. The first limitation refers to the non-representativeness of the sample, which does not allow for the generalization of the results. Second, not all regions and industries in the population are represented in the sample. Third, the study relies on self-reported survey data, which may be subject to response bias, given that some respondents can consistently choose certain points of the scale.

5.4 Future Research Suggestions

Future studies could build on these findings by exploring additional variables that may or may not influence Open Innovation Implementation, such as firm age, innovation intensity, leadership style, or digital maturity.

Moreover, incorporating qualitative methods, such as interviews, could provide richer insights into the processes and barriers involved in implementing Open Innovation.

Additionally, comparative studies between different countries, regional innovation ecosystems or, for instance, exploring the relationship between the Open Innovation Implementation dimensions and the geographical location of the firms could help contextualize the role of national policies and cultural factors in shaping Open Innovation Implementation.

Furthermore, future studies could explore the relationship between Open Innovation Implementation and innovation outcomes, in Portugal.

Finally, future research could also integrate sustainability-related dimensions to explore how Open Innovation Implementation is linked to sustainable value creation.

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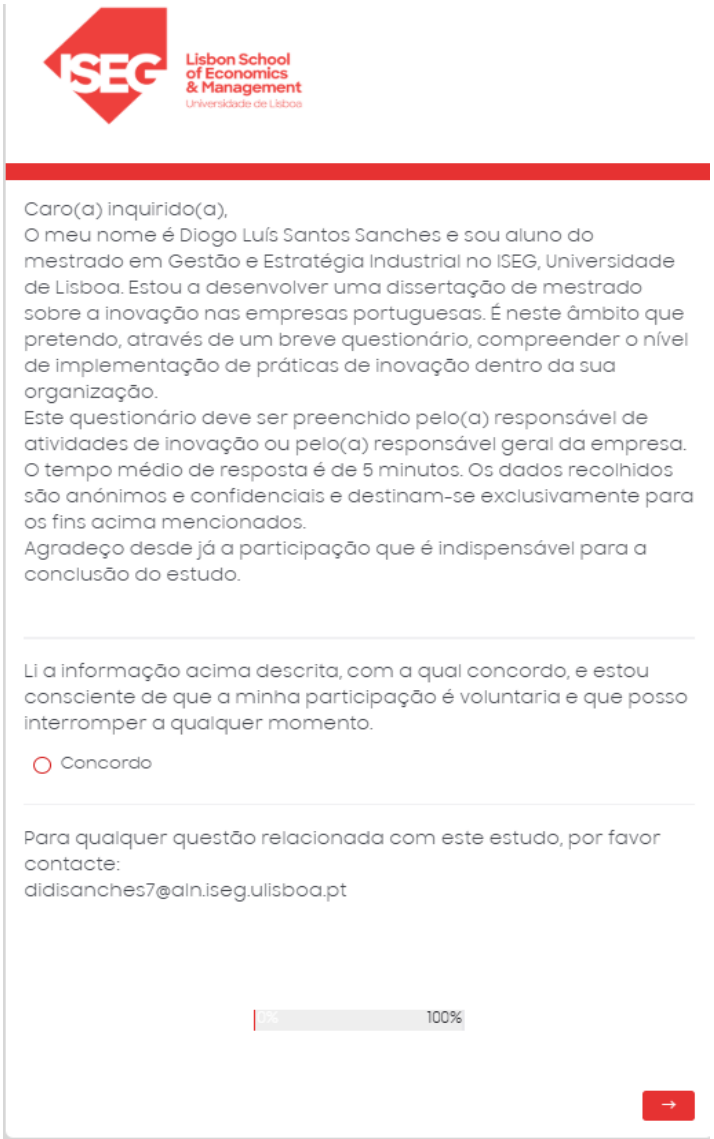
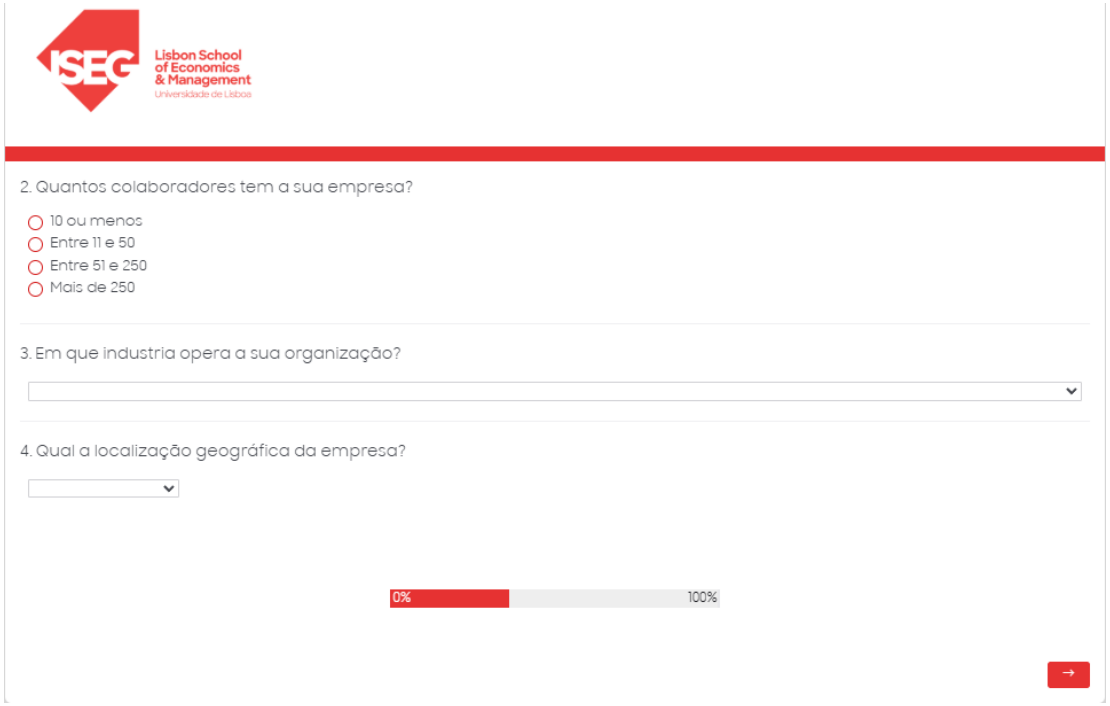
Annex

Annex 1. Final version of the survey




ISEG
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of Economics
& Management
Universidade de Lisboa
2. Quantos colaboradores tem a sua empresa?
10 ou menos
Entre 11 e 50
Entre 51 e 250
Mais de 250
3. Em que industria opera a sua organização?
4. Qual a localização geográfica da empresa?
0%
100%
→

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5. Em que medida concorda com as seguintes afirmações relativamente à sua empresa:

	Discordo totalmente	Discordo fortemente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo fortemente	Concordo totalmente
A. A empresa dá particular importância à introdução de novos produtos ou serviços no mercado.	○	○	○	○	○	○	○
B. A empresa integra uma rede colaborativa de partilha de conhecimento com outras empresas ou organizações.	○	○	○	○	○	○	○
C. A empresa tem uma unidade ou função interna responsável por controlar, gerir e partilhar os conhecimentos, ideias e informações subjacentes à inovação	○	○	○	○	○	○	○
D. A empresa tem uma postura aberta em relação à mudança.	○	○	○	○	○	○	○

0% 100%

→

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Universidade de Lisboa

6. Em que medida concorda com as seguintes afirmações relativamente à gestão do conhecimento na sua empresa:

	Discordo totalmente	Discordo fortemente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo fortemente	Concordo totalmente
A. A empresa cria novo conhecimento com o objetivo de melhorar a sua capacidade de inovação.	○	○	○	○	○	○	○
B. A empresa partilha conhecimento útil, tanto dentro como com parceiros externos.	○	○	○	○	○	○	○
C. A empresa envolve-se em processos de utilização de conhecimento para o desenvolvimento de soluções escaláveis para diferentes contextos e situações.	○	○	○	○	○	○	○
D. A empresa mantém uma base de dados de conhecimento dentro da empresa.	○	○	○	○	○	○	○

0% 100%

→

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Universidade de Lisboa

7. Em que medida concorda com as seguintes afirmações relativamente a atividades de transferência de tecnologia na sua empresa:

	Discordo totalmente	Discordo fortemente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo fortemente	Concordo totalmente
A. A empresa tem um processo de avaliação da aquisição e licenciamento de conhecimento tecnológico (por exemplo, patentes, direitos de desenho industrial, direitos de autor) para criar ou melhorar (novas) inovações com base nos recursos existentes.	○	○	○	○	○	○	○
B. A empresa tem um processo interno de preparação para o registo de propriedade intelectual.	○	○	○	○	○	○	○
C. A empresa avalia o conhecimento existente dentro da empresa com vista à sua comercialização no mercado.	○	○	○	○	○	○	○
D. A empresa tem implementada uma base de competências de Tecnologias de Informação e uma infraestrutura de Tecnologias de Informação.	○	○	○	○	○	○	○

0% 100%

→

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8. Em que medida concorda com as seguintes afirmações relativamente aos parceiros de inovação da sua empresa:

	Discordo totalmente	Discordo fortemente	Discordo parcialmente	Não concordo nem discordo	Concordo parcialmente	Concordo fortemente	Concordo totalmente
A. A empresa interage com concorrentes ou empresas da mesma indústria na busca por novas ideias e novas tecnologias para inovar.	○	○	○	○	○	○	○
B. A empresa interage com clientes ou consumidores na procura de novas ideias e novas tecnologias para inovar.	○	○	○	○	○	○	○
C. A empresa interage com fornecedores na procura de novas ideias e novas tecnologias para inovar.	○	○	○	○	○	○	○
D. A empresa interage com centros de investigação ou instituições de ensino superior na procura de novas ideias e novas tecnologias para inovar.	○	○	○	○	○	○	○
E. A empresa interage com instituições publicas na procura de novas ideias e novas tecnologias para inovar.	○	○	○	○	○	○	○

0% 100%

→

Annex 2. Descriptive statistics of the indexes and their respective items

Indexes	Items	N	Mean		Standard Deviation	
			Item	Index	Item	Index
Organizational Archetype	OA1	199	5,56	5,16	1,416	1,18
	OA2	199	4,85		1,782	
	OA3	199	4,24		2,006	
	OA4	199	5,96		1,195	
Knowledge Management	KM1	199	5,56	5,37	1,413	1,13
	KM2	199	5,40		1,337	
	KM3	199	5,27		1,530	
	KM4	199	5,24		1,579	
Technology Transfer	TT1	199	3,34	3,81	2,033	1,70
	TT2	199	3,23		2,064	
	TT3	199	4,39		1,984	
	TT4	199	4,30		1,982	
Collaborative Networks	CN1	199	4,73	4,70	1,788	1,39
	CN2	199	5,50		1,517	
	CN3	199	5,69		1,334	
	CN4	199	3,83		2,066	
	CN5	199	3,73		2,039	

Annex 3. Assumptions of the Linear Regressions

Test of Normality (1)	Independence of errors (2)	Residual statistics (3)	Firm Size	Collinearity Statistics (4)	
K-S Sig	Durbin-Watson (d)	Residual Mean		Tolerance	VIF
0,200	1,925	0,00000000	Micro	0,131	7,621
			Small	0,150	6,663
			Medium	0,338	2,960

Independent Variable: Firm Size

Dependent Variable: Composite Index "OII"

(1) According to the analysis, the residuals do not significantly differ from a normal distribution (p=0,200; sig> 0.05), allowing us to conclude that the model variables are normally distributed (Saunders et al., 2023; Field 2024).

(2) With the Durbin-Watson test, the assumption of the independence of errors has been validated, since the test value is close to 2 (1.925) (Saunders et al., 2023).

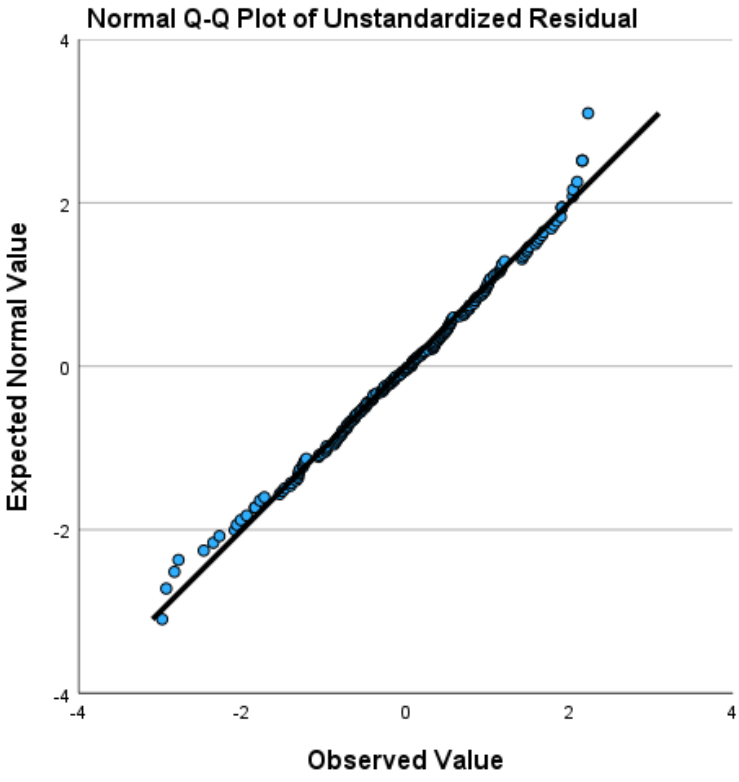
(3) With regards to residual statistics, the assumption of the nullity of the residual value is validated, given that the residual mean is 0.00000000 (Saunders et al., 2023).

(4) The model confirms the inexistence of collinearity, considering that the Tolerance value is superior to 0,1 for all firm sizes and the VIF value is inferior to 10 for all firm sizes (Saunders et al., 2023).

Annex 4. Residual distribution assumption of the Linear Regressions

Q-Q Plot of Unstandardized Residual

Dependent Variable: Composite Index "OII"

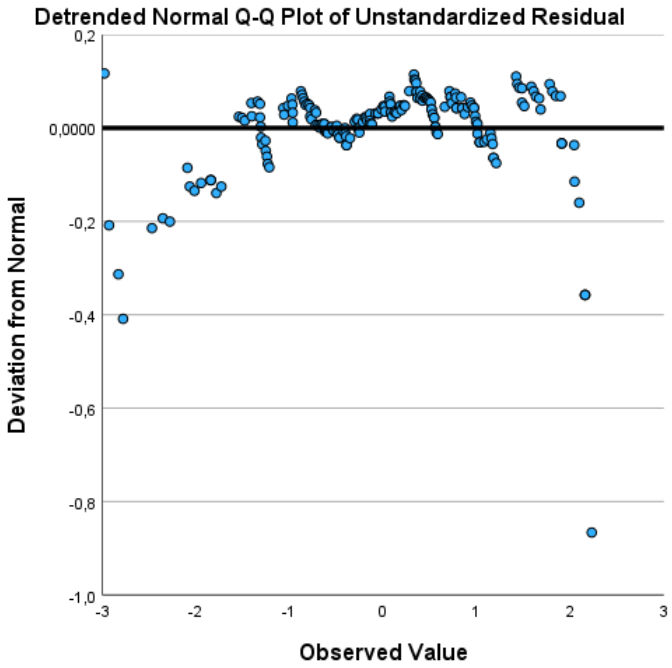


(5) The graph shows that the errors are well distributed along the diagonal, satisfying the assumption of normality of the residuals.

Annex 5. Assumption of Homogeneity of Residual variance of the Linear Regressions

Detrended normal Q-Q plot of unstandardized residual

Dependent Variable: Composite Index "OII"



(6) As we can see through the graph, the vast majority of the residuals are fixated around the value 0, satisfying the assumption.

Annex 6. Assumptions of the ANOVAs

Dependent Variable	Levene's Test	Equal Variances Assumed?	Post Hoc Test Used
OA	0,081	Yes	Tukey
KM	0,328	Yes	Tukey
TT	0,717	Yes	Tukey
CN	0,356	Yes	Tukey
OI	0,498	Yes	Tukey

Equal variances are assumed for all variables, since all p-values are greater than 0.05 (Field 2024).