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Analysis of Open Innovation Inefficiency: How Should Open Innovation 4.0 Be Modeled to Transform Large Corporations

Florianópolis
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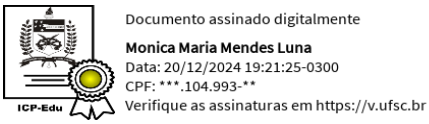

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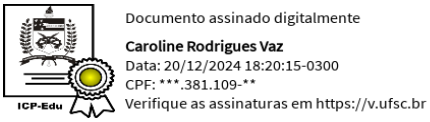

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“He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may cast.”

– Leonardo da Vinci

ABSTRACT

This study analyzes the challenges faced by large corporations while adopting open innovation (OI), a strategical approach that has been used for the last two decades to connect external solutions with corporate innovation needs and accelerate innovation cycles to a fast-changing market. The primary objective of this research is to analyze the impact of emerging technologies, such as artificial intelligence (AI) and big data, on improving open innovation processes effectivity for the stakeholders involved (large corporations, startups and innovation consultancies) and develop a framework to implement the technologies for each level of maturity in OI. The methodology involved a combination of qualitative and quantitative research methods including semi-structured interviews with corporate leaders, innovation consultants, and experts from the innovation ecosystem, which aimed to capture insights into the challenges associated with open innovation and the strategic value it provides and develop thematic analysis, word cloud visualizations, and comparative coding. From that, key themes were identified, enabling an exploration of the factors impacting open innovation effectiveness. Quantitative data was collected to analyze patterns, trends, and correlations among different sectors. The combined analysis focused on organizational challenges, technology integration, and the effects of collaboration models on innovation outcomes, that revealed recurring themes where open innovation faces the greatest inefficiencies, such as cultural resistance, limited absorptive capacity, and strategic organizational inertia. It has been found that by incorporating AI and big data into the open innovation framework, companies can make data-driven decisions, optimize partner selection, and improve the efficiency of collaborative projects, therefore, integrating these technologies into open innovation can streamline processes and create more impactful outcomes. The primary academic contribution of this study lies in expanding the existing body of knowledge on open innovation by integrating digital tools and data analytics into the framework and provides a theoretical foundation for future research, emphasizing the need for continuous adaptation of open innovation models to incorporate technological advancements. The findings enrich our understanding of how large corporations can better align open innovation practices with emerging digital strategies, thereby bridging the gap between theory and application in organizational innovation research. On the business side, this research offers actionable insights for industry leaders seeking to enhance their companies' competitive edge through open innovation, it also provides a roadmap for corporations to adopt more agile and adaptive approaches to innovation. These practices include leveraging AI to automate routine innovation tasks, applying big data analytics to support strategic decision-making, and refining partner selection processes, that not only promise to improve operational efficiency and reduce time-to-market but also foster a culture of continuous learning and collaboration, which is essential for long-term success in a dynamic market. In conclusion, this study establishes that integrating emerging technologies into open innovation is more than necessary for large corporations aiming to maintain a competitive advantage, it serves as a foundation for them to reevaluate their innovation strategies, adopting a more holistic approach that combines technological capabilities with effective open innovation practices. This research contributes both theoretically and practically by outlining a structured, technology-enhanced model for open innovation, which is essential for companies navigating the complexities of today's global market.

Keywords: Open Innovation; Innovation Ecosystem; Corporative Competitiveness.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACATE	Technology Association of Santa Catarina
CPSI	Contract for Innovative Solutions
EMAS	Eco-Management and Audit Scheme
ETA	External technology acquisition
EIF	European Investment Fund
GII	Global Innovation Index
IP	Intellectual Property
LGPD	General Data Protection Law
OI	Open Innovation
POCs	Proofs of Concept
R&D	research and development
ROI	Return on Investment
SEIS	Seed Enterprise Investment Scheme

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1 CONTEXTUALIZATION AND RESEARCH PROBLEM

Crafting connections between technologies inside a system is necessary to manage the tremendous complexity of modern-day products and services. As challenging as that is, it is only a portion of the task of the innovating firm (Chesbrough, 2003). Traditional business strategies have often struggled to keep pace with swift market changes, leading to the downfall of once-dominant companies like Blockbuster, Kodak, and BlackBerry. Blockbuster failed to adapt to the digital streaming revolution, Kodak lost its leadership in the photography market due to its resistance to digital transformation, and BlackBerry could not compete with the rise of touchscreen smartphones.

Chesbrough (2003), describes shows open innovation (OI) as the necessity of letting ideas both flow out of the corporation to find better sites for their monetization, and flow into the corporation as new offerings and new business models. Through the connection of startups, universities research projects, spinoffs, and other partnerships, corporations can access new technologies, accelerate development to meet market demands, reduce costs, and mitigate internal risks.

The Frascati Manual by OECD (2015) highlights that significant R&D investment often correlates with the capacity and willingness to engage in collaborative innovation models. By examining R&D investment, we gain insights into the broader innovation landscape and understand the commitment of different regions to fostering technological advancement and economic growth.

According to the Global Innovation Index (GII) 2022, Europe continues to lead in innovation, as it can be seen in Table 1, with Switzerland ranking as the most innovative country globally, followed closely by Sweden and the United Kingdom. In the continent, the average investment in research and development (R&D) is approximately 2.2% of GDP, which is higher than the global average of 1.7%. For instance, Germany and Finland exceed this average, investing over 3.2% of their GDP in R&D. In UK, innovation strategy further emphasizes collaboration between universities, research institutions, and the private sector, driving technological advancements in key areas such as artificial intelligence, clean energy, and biotechnology. Approximately 65% of UK companies engage in some form of open innovation, highlighting the nation's robust integration of external and internal innovation efforts (Global Innovation Index, 2022).

Table 1 - Global Innovation Index 2022

GII rank	Economy	Score	Income group rank	Region rank
1	Switzerland	64.6	1	1
2	United States	61.8	2	1
3	Sweden	61.6	3	2
4	United Kingdom	59.7	4	3
5	Netherlands	58.0	5	4
6	Republic of Korea	57.8	6	1
7	Singapore	57.3	7	2
8	Germany	57.2	8	5
9	Finland	56.9	9	6
10	Denmark	55.9	10	7
11	China	55.3	1	3
54	Brazil	32.5	9	2

Source: Global Innovation Index Database. WIPO (2022)

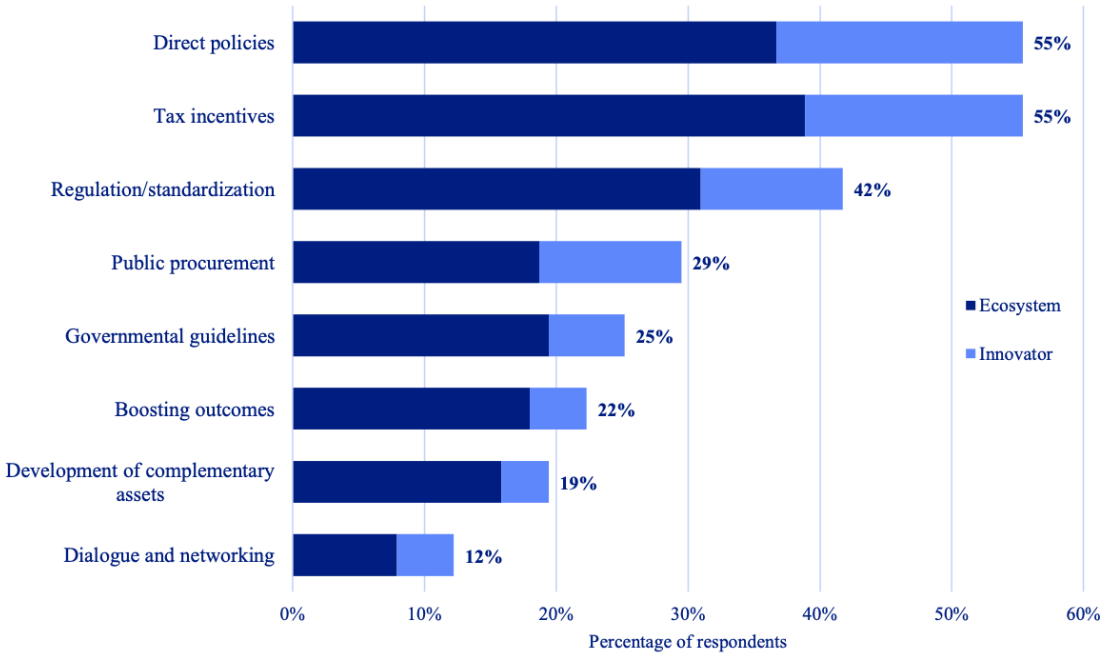
Supporting this innovation landscape, European policies have been implemented to nurture startup ecosystems. The UK's Seed Enterprise Investment Scheme (SEIS) and other tax relief policies, along with Startup Visa programs in the UK, Netherlands, France, Portugal, and Estonia, are designed to attract foreign entrepreneurs. These policies, combined with the European Union's longstanding green initiatives, such as the Eco-Management and Audit Scheme (EMAS) and the more recent Net-Zero Industry Act, provide a robust framework for supporting cleantech startups and enhancing European manufacturing capacity for net-zero technologies (EU, 2023). Cleantech startups are small companies that offer technologies, including products, materials, processes, or business models, designed to reduce environmental impacts and promote sustainability (Shakeel, 2021). The European Investment Fund (EIF) survey on Cleantech industry made it clear on why the cleantech sector has attracted so many entrepreneurs to Europe, which can be seen in Chart 1.

In Chart 1, each topic can be described as follows:

a) Direct Policies: Government frameworks aimed at stimulating cleantech development. Example: Eco-Management and Audit Scheme (EMAS).

b) Tax Incentives: Financial mechanisms to attract investment and innovation. Example: Tax deduction or credits such as UK's Seed Enterprise Investment Scheme (SEIS).
c) Regulation/Standardization: Establishment of standard procedures to ensure compliance of innovations in technical, safety and operational requirements. Example: European Union's AI Act.
d) Public Procurement: Government acquisition of cleantech products or services to stimulate market demand. Example: Brazil's Public Contract for Innovative Solutions (CPSI) under the Marco Legal das Startups.
e) Governmental Guidelines: Non-binding recommendations to promote sustainable practices. Example: Estonia's transparent regulatory infrastructure supporting the Startup Estonia initiative.
f) Boosting Outcomes: Programs to amplify the impact of cleantech innovations. Example: Scale Up Vaud in Switzerland, which prepares startups for scaling.
g) Development of Complementary Assets: Creation of supporting infrastructure for cleantech solutions. Example: Data centers in São Paulo hosting global companies like Microsoft and Amazon.
h) Dialogue and Networking: Initiatives to encourage collaboration and knowledge exchange among stakeholders. Example: Sweden's Global Impact Summit and Women in Tech Sweden.

Chart 1 - Answer to question “Which of these regulations/policies can mostly support technological development in the cleantech sector?”



Source: Cleantech Industry Survey 2023 Financing, regulatory, innovation and human capital issues – EIF (2023)

Another prime example is the European Union's AI Act, introduced in 2021, which creates governance mechanisms for effectively implementing AI regulations. By being the first to regulate AI, the EU aims to set a global benchmark, influencing how other countries develop and regulate AI technologies—a phenomenon known as the “Brussels effect.” The EU's standards and legislation often have an extraterritorial impact, potentially establishing the AI Act as a global standard for AI regulation (Outeda, 2024).

Beyond policies frameworks, the European innovation ecosystem also presents great numbers. According to The Global Startup Ecosystem Report 2023 (TGSER, 2023), Amsterdam is home to approximately 4000 startups, while looking out to Venture Capital funding, the main sector receiving funding are Fintech, Health and transportation, mainly due for being a multilingual place, with 7 universities producing talents and a well-developed ecosystem that produces events and connections between the startups and the VCs.

Also, adding to the diverse ecosystem of startups, Estonia is the place where most startups in Europe begin their business. The government initiative, Startup

Estonia, has been pivotal in developing three key drivers for innovation: availability of human resources and capital, an open and connected community and services, and a transparent regulatory infrastructure. Additionally, Estonia's policies on e-residency and the Startup Visa are among the most attractive in Europe due to their ease of access, global reach, and the streamlined processes they offer to entrepreneurs from around the world (TGSER, 2023).

Switzerland, known for deep tech innovation, has produced groundbreaking technologies like the Nespresso coffee machine and the solar-powered plane, Solar Impulse. In 2022, Vaud, which boasts the highest startup density in Switzerland broke a record of 13 tech firms acquired by private companies. The region's success is largely attributed to its excellent universities, such as EPFL and the University of Lausanne, and the robust support from innovation parks and programs like Scale Up Vaud, which prepares tech startups for scaling (TGSER, 2023).

With a strong culture of deep tech innovation, Stockholm contributes over 50% of Sweden’s total foreign direct investment. The city is home to more than 240 impact startups, with significant funding directed toward social good initiatives. The region also hosts influential events like the Global Impact Summit and Women In Tech Sweden, fostering a vibrant ecosystem for entrepreneurship and innovation (TGSER, 2023).

In Brazil, the innovation ecosystem presents a bigger contrast, marked by significant regional disparities, as shown in Table 1, it ranks as the 54th country in the Global Innovation Index Database (Global Innovation Index, 2022). From the 14.000 startups around all the territory, the sector from 42,2% are edtech, fintech, healthtech and retailtech. The State of São Paulo is the country's leading hub for innovation, home to a high concentration of research institutions, universities, and innovative companies. As seen in Table 2, the state is home to 38,4% of all the Brazilian startups (Abstartups, 2023). This concentration is supported by several factors that position São Paulo as a dominant force in the Brazilian and global startup ecosystems.

Table 2 - Startup regional density in per state from Brazil

State	Percentage of Startups in Brazil
São Paulo (SP)	38.4%
Minas Gerais (MG)	9.3%
Santa Catarina (SC)	9.0%
Paraná (PR)	7.0%
Rio de Janeiro (RJ)	6.3%
Rio Grande do Sul (RS)	6.2%
Bahia (BA)	3.1%
Ceará (CE)	2.6%
Espírito Santo (ES)	1.8%
Goiás (GO)	1.8%

Source: Abstartups (2023)

According to The Global Startup Ecosystem Report 2024, globally, São Paulo is currently ranked as the 26th leading city in startup ecosystems and the first in Latin America, it is also the largest economic and industrial center in the Southern Hemisphere, and a vibrant startup hub, it offers founders a large market and ample opportunity for networking. São Paulo is home to 2,770 startups, the highest number by far in Brazil, including 11 valued at $1 billion or more.

São Paulo contributes with more than 50% of data center investments in Latin America, being home to innovation and data centers for global giants such as Microsoft, Google, Airbnb, Netflix, and Amazon. The Brazilian market from the sector is expected to grow at a CAGR of 8.26% from 2022 to 2028, supported by 51 existing and 22 planned data center facilities across the country (TGSER, 2023).

Furthermore, the University of São Paulo was ranked the best university in Latin America in 2023 by Times Higher Education. With some of the best academic programs in STEM fields, the city's businesses benefit significantly from this talent pipeline (TGSER, 2023).

Meanwhile, the state of Santa Catarina has emerged as a notable tech hub, boasting 1.947 startups and substantial investments in innovation infrastructure (SEBRAE, 2023). The state's ecosystem has grown 49.65% in number of startups, with 55,41% of those based in Florianopolis, which is also known as "The Silicon

Island”. The ecosystem shows a different way of doing innovation, with a better-connected ecosystem. ACATE (Technology Association of Santa Catarina) is a major player in the work of bringing all the state together and developing each regional innovation hub. The state has 15 innovation hubs and 25 startup incubators. With all that, the most attractive aspect of the state, and particularly, Florianopolis, is the lower cost of living and doing business when comparing to Sao Paulo, better quality of life for the entrepreneurs, large number of events that help in networking and a strong sense of community inside its startup ecosystem, with mutual support among entrepreneurs, investors and industry experts.

Despite these advancements, Brazil faces challenges in scaling innovation due to bureaucratic hurdles, insufficient funding for R&D, and a lack of skilled workforce. In 2021, Brazil's total R&D expenditure was approximately 1.2% of its GDP, significantly lower than the global average of 1.7%. Moreover, only about 40% of Brazilian companies report engaging in open innovation practices, indicating room for growth and greater adoption of collaborative innovation models (Open Innovation Briefing Paper).

Unlike Europe, where policies supporting startups have been evolving for years, Brazil only began to implement dedicated startup-focused policies in 2021 with the introduction of the *Marco Legal das Startups*. This legislation represents a pivotal moment in Brazil's approach to fostering innovation and entrepreneurship, establishing a comprehensive framework to support the growth and development of startups across the country. The *Marco Legal das Startups* offers several key benefits, including reduced bureaucratic barriers, increased legal security for entrepreneurs and investors, and financial incentives such as tax breaks for angel investors. Additionally, the law introduces Regulatory Sandboxes, allowing startups to experiment with innovative business models in a controlled regulatory environment, and the Public Contract for Innovative Solutions (CPSI), which facilitates collaboration between startups and the public sector (Veneziani & Vaz, 2023).

When compared to European policies, which have long provided a stable and supportive environment for startups with extensive access to funding, streamlined regulations, and established ecosystems like those in the UK, Germany, and the Netherlands, Brazil's *Marco Legal das Startups* is a significant but relatively recent effort. While Europe has the advantage of mature ecosystems and a history of innovation-friendly policies, Brazil’s framework is a critical step toward leveling the

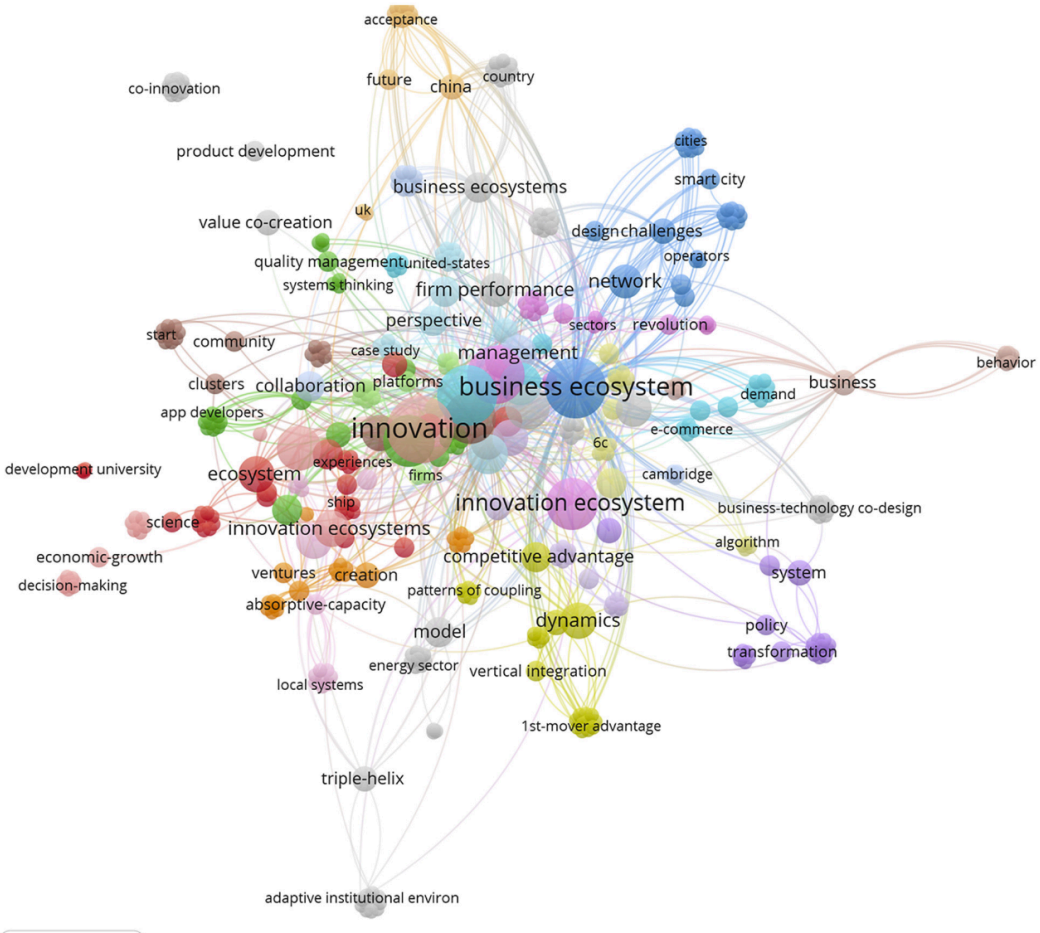
playing field by providing the necessary tools and incentives to nurture a vibrant startup ecosystem.

Geographical challenges play a significant role in shaping the effectiveness of open innovation (OI), particularly in regions with vast distances and diverse economic landscapes. The study conducted in Cyprus highlights that geographical proximity can facilitate easier knowledge exchange, reduce transaction costs, and support more efficient collaboration among firms. However, this proximity may also limit the scope of innovation to regional or domestic markets, potentially restricting access to cutting-edge technologies and advanced knowledge available internationally. This presents a considerable challenge for companies that aim to leverage global innovation networks, as they must navigate the complexities and costs associated with collaborating across larger distances (Kapetaniou; Lee, 2019).

In the context of Brazil, these geographical challenges are particularly pronounced due to the country's large size and significant regional disparities in economic development and innovation capacity. Startups and firms located in major hubs like São Paulo may benefit from a more concentrated and accessible innovation ecosystem, but they might still face barriers when attempting to engage with international partners or tap into global innovation flows. Conversely, companies in less developed regions may struggle with even greater isolation from both domestic and international innovation networks, further exacerbating the divide between Brazil's innovation leaders and laggards (TGSER, 2023).

Some aspects to lookout that contribute to a successful work in Open Innovation is the structure of the innovation ecosystem. As seen before, many initiatives are already explored in Europe and in Brazil to support both growth of startups and connections with the market. Figure 1 shows the most used terms in articles that researched on innovation ecosystem through VOSviewer software. The dense clustering of terms such as “business ecosystem”, “innovation ecosystem”, “collaboration” and “competitive advantage” in the image underscores the critical role of these factors in successful Open Innovation practices. It reflects how innovation is not a standalone activity but rather the result of complex interactions within a well-structured ecosystem (Sant´ana et al., 2020). Terms like “management”, “policy”, and “system” suggest that the governance and strategic alignment within the ecosystem are essential for sustaining innovation.

Figure 1 - Cloud Network with 449 keywords from research articles on innovation ecosystem



Source: The structure of an innovation ecosystem: foundations for future research (2019)

In Europe, the UK, and Brazil, the adoption of open innovation practices varies, with larger firms generally more advanced in their implementation. In 2022, 75% of European companies reported engaging in open innovation activities, compared to 65% in the UK and 40% in Brazil. Barriers to adoption include increased managerial costs, regulatory constraints, and cultural resistance within organizations (The Economist Group, 2022). Meanwhile, 55% of companies globally reported integrating open innovation into their strategies in 2021, highlighting the growing recognition of its importance in driving sustainable growth and competitiveness (Global Innovation Index, 2022).

Among Brazilian companies seeking startup partnerships, 31% still do not utilize open innovation practices (Open Startups, 2023). For those that have adopted open innovation, 51% report that the primary obstacle is the integration of open

innovation with internal company culture. Additionally, 48% face challenges in managing expectations and 39% in identifying suitable startup partners (ACE Cortex & Sling Hub, 2023). Open innovation is crucial for overcoming these barriers and enhancing the competitiveness of Brazilian companies. It facilitates the development of new products and access to emerging technologies, which are priorities for 36% and 19% of companies, respectively (ACE Cortex & Sling Hub, 2023). This scenario highlights the importance of open innovation as a vital tool for driving growth and maintaining the relevance of corporations in the global market.

Into European companies, open innovation is widely adopted, with 72% of corporations reporting collaboration with startups (Sopra-Steria, 2023). However, significant challenges remain, such as legal and regulatory constraints faced by 14% of companies, low risk tolerance reported by 13.7%, and cultural differences cited by 11.5% (Sopra-Steria, 2023). These barriers emphasize the need for dedicated business units or assistance by consulting companies to manage collaborations effectively, with 89% of corporates achieving their objectives when such units are in place. Similar to Brazil, where 31% of companies seeking startups do not utilize open innovation, European companies also struggle with integrating these practices despite their potential to drive growth and competitiveness. The key drivers for these collaborations in Europe include discovering new business opportunities (46%), creating new solutions (45%), and improving internal business practices (38%) (Sopra-Steria, 2023). This highlights the importance of open innovation as a critical strategy for companies across both regions to navigate market challenges and leverage external expertise for enhanced innovation outcomes.

Innovation consulting firms play a crucial role in facilitating open innovation for large corporations, helping them navigate the complexities of modern market demands and technological advancements. In Brazil, prominent firms such as ACE, Cubo, The Bakery, EloGroup, Visagio, BCG, Accenture, and McKinsey offer a range of services from startup incubation to strategic innovation management. For example, The Bakery specializes in creating tailored innovation programs for large corporates, fostering startup partnerships that drive significant business transformations. These firms primarily serve large corporations, providing them with the necessary tools and frameworks to implement effective open innovation strategies, thereby enhancing their competitive edge.

In Europe, leading innovation consulting firms such as Accenture, Board of Innovation, BCG Digital Ventures, Deloitte, and McKinsey play a similar role. These firms are instrumental in helping European companies leverage open innovation to overcome regulatory constraints, cultural barriers, and integration challenges. For instance, the Board of Innovation focuses on human-centered design and business model innovation, assisting companies in developing and sustaining robust innovation strategies. The Bakery, which also operates in the UK, exemplifies the cross-regional approach, bridging gaps between startups and large corporates to foster innovation ecosystems.

Both Brazilian and European consulting firms emphasize the importance of dedicated business units to manage innovation collaborations effectively. They address the main obstacles reported by their clients, such as the integration of open innovation with internal company culture and the alignment of expectations between startups and corporates.

Large corporations often struggle to balance protecting intellectual property with the agility needed for innovation, while startups may find it difficult to navigate corporate bureaucracy. Additionally, integrating sustainability into open innovation efforts introduces conflicting objectives, and the rapid pace of digital transformation requires constant adaptation (Bertello et al., 2023). These challenges will be explored further and validated during interviews conducted for this research, aiming to develop more effective and sustainable open innovation practices.

Inefficiency can generally be described as a gap between current performance and the best practice, often caused by an ineffective use of resources such as time, materials, or labor. This performance gap can be bridged through two main approaches. The first approach focuses on addressing design-related inefficiencies by modifying the structure and flow of a process to make it more efficient, thereby eliminating inefficiencies in its design. The second approach involves improving the quality of process execution to reduce variation, thereby bringing the execution quality in line with best practices. Essentially, inefficiency, as defined by the Cambridge Business English Dictionary, relates to failing to use resources effectively, whereas efficiency represents the ability to use resources optimally without wastage. By targeting both structural and executional aspects of processes, organizations can strive to minimize inefficiencies and move closer to best practice standards (Ardagna; Mecella; Yang, 2009; Cambridge Business English Dictionary).

The present study seeks to better understand these challenges faced by both stakeholders for the innovation ecosystem, corporations and innovation consulting companies. It aims to identify the main pain points of the innovation process and how new technologies can facilitate the development of new business and finding diverse and disruptive solutions by answering: *What are the primary inefficiencies in open innovation within large companies, and how can these be quantitatively measured and analyzed to enhance innovation effectiveness?*

1.1 OBJECTIVES

1.1.1 General Objectives

To investigate the key deficiencies in open innovation within large corporations and explore how these can be quantitatively measured and analyzed to enhance innovation effectiveness.

1.1.2 Specific Objectives

1) Identify and categorize the most significant inefficiencies that large corporations face when implementing open innovation practices.
2) Evaluate the overall impact of open innovation-driven outcomes, including metrics such as time-to-market, cost-effectiveness, and knowledge transfer efficiency.
3) Develop a framework to measure these inefficiencies using performance metrics and key indicators that can quantify their impact on innovation.
4) Recommend strategies and best practices to help large corporations optimize their open innovation processes, based on quantitative analysis, to improve overall innovation effectiveness.

1.2 JUSTIFICATION

The internal R&D model of closed innovation has long been the primary method for large corporations to develop new products, features, and even business models. This approach was particularly effective in stable markets like the petroleum, clothing, and beauty industries, where there were minimal changes in the operational environment until the 2000s. However, as global markets have evolved and become more dynamic, large corporations have increasingly struggled to innovate at the same pace as external markets. Examples of this challenge include the rise of Uber, the transformation of digital banking, and the development of user-centered products like modern vehicles. In response to these pressures, the previous decade has seen a significant shift in research from closed innovation to open innovation (OI) practices in all sectors. Open innovation facilitates a free flow of innovative ideas and knowledge both within and outside a firm, leading to greater flexibility and often more cost-effective innovation strategies (Bigliardi et al., 2020).

This evolution reflects the need for large corporations to adapt to a rapidly changing innovation landscape, where external collaborations and leveraging external knowledge have become essential to maintaining competitiveness and driving growth (Bessant et al., 2005).

For inbound innovation, companies must refine their ability to manage relationships with external technology providers and strategically integrate acquired knowledge with internal resources to avoid inefficiencies. Adopting OI practices comes with inherent risks, such as the potential for knowledge leakage, the exposure of strategic resources, and the loss of competitive advantage if internal knowledge is inadvertently shared. To mitigate these risks, companies must increase their absorptive capacity, enabling them to effectively acquire and integrate external knowledge. Additionally, they need to develop adaptive capacities to quickly respond to market opportunities and adjust their innovation strategies accordingly (Audrestsch & Belitski, 2022).

At the same time, the investment in R&D is also essential for developing the absorptive capacity necessary to successfully engage in external technology acquisition (ETA). Developing strong internal R&D capabilities allows a firm to better control and understand the tacit knowledge embedded in the ETA process, ensuring

that the acquired external technologies can be effectively integrated and utilized (Chesbrough et al. 2003).

However, failure is a possibility in the open innovation process, as not every corporation is adequately prepared to acquire and assimilate external technology. This underscores the importance of building a solid R&D foundation to develop the absorptive capacity needed to navigate the complexities of inbound open innovation and predict inefficiencies during the process of OI (Hung & Chou, 2013). Having strong absorptive capacities and adopting strategies facilitate the seamless integration of external innovations (Moradi et al., 2021).

Maturity, as described by Paulk et al., (1991), refers to the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective. It also implies potential for growth, highlighting not only the richness of an organization's processes but also the consistency with which they are applied across projects. Assessing the maturity of companies in relation to their processes is essential for understanding both their current capabilities and potential areas for improvement. A maturity model offers a systematic framework for evaluating and benchmarking an organization’s proficiency in various activities, providing insight into strengths and weaknesses. By assessing maturity, organizations can better identify process gaps, prioritize strategic initiatives, and implement targeted improvements. In this study, we will focus on analyzing the maturity of open innovation practices in large corporations to understand how these companies can more effectively adapt and integrate external knowledge and collaborations, ultimately enhancing their innovation outcomes (Oliveira, 2009).

After over two decades of existence, OI has matured significantly, offering deep insights into how firms can effectively integrate external knowledge and technologies into their internal processes. This extended period of study has enabled a comprehensive understanding of the mechanisms and benefits of OI, allowing companies to refine their approaches to innovation. As a result, OI has proven to be a powerful tool for accelerating innovation, improving firm performance, and navigating the complexities of modern business environments (Moradi et al., 2021).

Therefore, the current format of open innovation does not add as much value for large corporations as it did when it was created in 2003. Technologies and the market have advanced rapidly, enabling new forms of collaboration and competition.

Therefore, OI needs to update its model to include new digital tools, data strategies, and more integrated and fast collaboration approaches.

Corporates use OI to remain competitive and agile in a rapidly changing market. OI allows companies to leverage external ideas and technologies, reducing the time and cost associated with internal R&D while accelerating innovation processes. According to a study by Bigliardi et al., (2020), firms that engage in OI activities, such as inbound and outbound innovation, experience enhanced innovation performance and increased competitiveness. This approach helps companies access a broader spectrum of knowledge, leading to more innovative products and services, thereby maintaining their market relevance.

To effectively leverage OI, it is important to analyze the innovation ecosystem within big corporations. This analysis helps to understand how various entities, such as startups, research institutions, and large corporations, interact and collaborate. Gassmann, Enkel, and Chesbrough (2010) highlight that a well-integrated innovation ecosystem facilitates more efficient knowledge transfer, collaboration, and the effective use of external innovations, ultimately driving better innovation outcomes.

For corporates, effective OI practices are important for maintaining a competitive edge. By identifying and addressing inefficiencies in their OI processes, companies can enhance their innovation capabilities, reduce costs, and accelerate product development. Additionally, integrating new technologies, such as artificial intelligence and big data analytics, into OI practices can lead to more informed decision-making and improved innovation efficiency. This will not only help corporations remain competitive but also drive long-term growth and sustainability.

According to Greco et al., (2022)OI practices need to appropriate project and risk management to contain the probability of failures during the process. Based on lean thinking and problem solving, this research will focus on understanding and how to improve the process, so people can execute them and succeed.

For innovation consulting companies, understanding the challenges and dynamics of OI is essential for providing effective guidance to their clients. These firms offer essential services that help corporations navigate the complexities of OI. By developing tailored strategies and frameworks, consulting firms enable their clients to integrate external innovations more effectively and achieve better innovation outcomes. The insights from this study will help consulting firms enhance their service

offerings, ensuring they can support corporates in overcoming OI challenges and leveraging external expertise to drive growth and maintain market relevance.

1.3 RESEARCH DELIMITATION

For 6 months, from June 2024 to November 2024, this study has been made with a straight working timeline intending to result in findings with determined number of key people being interviewed. To be able to have a global approach of data, the author aimed to study the open innovation ecosystem in Florianopolis (Brazil), São Paulo (Brazil), and London (UK). The possibility of executing this study in other countries may influence the outcomes due to variations in criteria such as regulatory frameworks, cultural attitudes towards innovation, availability of technological infrastructure, government support and policies, industry collaborations, and market dynamics. Moreover, recommendations in this study were tailored to the specific findings from the interviews and might need adjustments if applied to different contexts.

One potential limitation of this study is the reliance on self-reported data from interviews and surveys, which may be subject to bias or inaccuracies due to participants' subjective perceptions and potential reluctance to disclose sensitive information fully. Another limitation is the geographic focus on specific regions, namely Florianopolis, São Paulo, and London, which may not fully capture the diversity and variability of open innovation practices globally.

1.4 RESEARCH STRUCTURE

The structure defined for this study is divided in six chapters. The introduction highlights the main and specific objectives of the study. The content of the chapter includes the justification for the study, its extent and boundaries and expose the overview of the project.

In the Literature Review, it will be brought to light, main concept of open innovation and startup ecosystem, including an analysis based on existing literature and ensuring a thorough understanding of the author's choices and the reasoning behind the study's final conclusions.

In the third chapter, Methodology, it is outlined about how the study was conducted as the research methodology used, ethical considerations on how the data

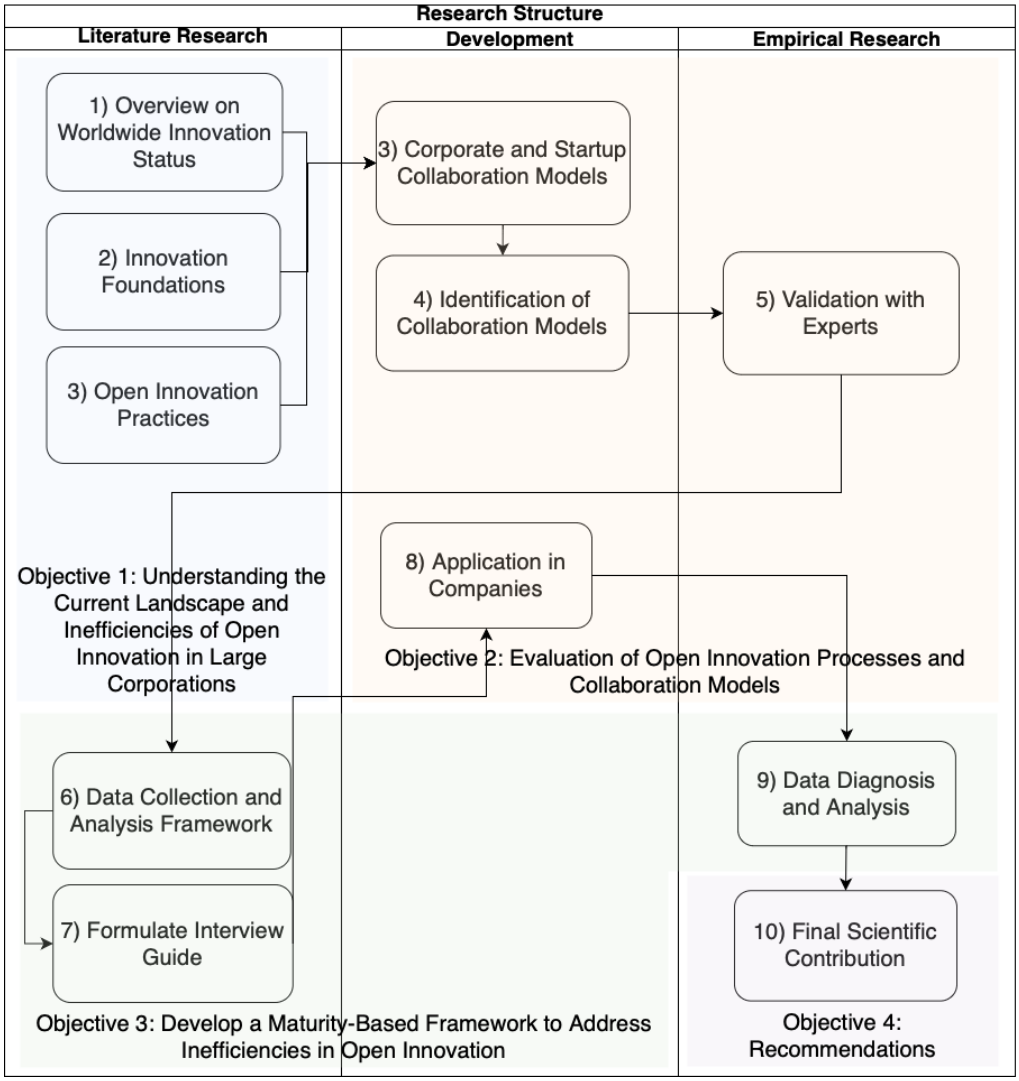
was threated to provide results based on ethics from the interviewed people and what are the limitations of the study.

The findings and analysis are presented in the fourth and fifth chapter. The research results are systematically presented and interpreted, following the established methodology. This section delves into the insights gained from the data, highlighting key patterns, trends, and relationships. It also assesses how effective were the applied strategies and provides recommendations for improving open innovation processes. Visual representations, such as charts and matrices, are used to make the analysis easier to understand.

In the final chapter, the author concludes the study by tying together the insights gained from the research. This section revisits the main objectives and evaluates whether they were achieved, reflecting on the implications of the results. Finally, it discusses potential future directions for research and practical recommendations for stakeholders.

Diagram 1 represent the structure of work.

Diagram 1 - Flowchart of the Research Structure



Source: Author (2024)

2 LITERATURE REVIEW

This literature review aims to provide a comprehensive understanding of the key concepts, theories, and current state of research on innovation, with a particular focus on open innovation, startups, and collaboration models. A wide range of scholarly sources and research papers are examined to build a solid foundation for this study.

It will be presented as a solid foundation to contextualize the research, provide a comprehensive overview of knowledge on open innovation. By the end of the literature review, the reader should have a good understanding of the most fundamental aspects of innovation, startups and collaboration models.

2.1 INNOVATION

Innovation, derived from the Latin term *innovare*, meaning renovation, change or to make something new, is a multifaceted concept. Generally, it involves a three-step process: idea generation, invention, and diffusion (Mohd Zawawi et al., 2016a). Damanpour (1991), Kimberly and Evanisko (1981), and Lin (2007) describe innovation as "any practices that are new to organizations, including equipment, products, services, processes, policies, and projects", highlighting its immense applicability across all facets of organizational operations. Following this concept, Kahn (2018) notes that innovation has become a very commonly used term—featured in the visions, missions, and objectives of organizations, and frequently discussed by politicians and business leaders.

Table 3 presents a summary of the key dimensions and constructs of innovation most frequently utilized across numerous studies in various fields. This summary illustrates the most common ways organizations implement innovation and demonstrates how expansive the definition of innovation can be. These factors represent trends in organizational approaches to innovation and will serve as a starting point for the interviews conducted in this research.

Table 3 - Dimensions and constructs of innovation as mostly mentioned in literatures

Innovation	Technological Innovation	1. New technologies
		2. New products
		3. New serivces
	Administrative/Managerial Innovaiton	1. New policies
		2. New procedures
		3. Organizational forms
		4. Encourage expansions
		5. Reward staff's creativity
		6. Exploring best method to achieve corporate goals

Source: Adapted from Zawawi et al. (2016)

However, innovation is often misunderstood. Many believe it must always be something entirely new and groundbreaking, a misconception that can lead to poor decisions and missed opportunities. This perspective undervalues ongoing small improvements, known as incremental innovations. Innovation exists on a spectrum—

from minor adjustments to major breakthroughs (Kahn, 2018). Effective innovation is not about excelling in just one area. Instead, it requires overseeing a system that balances multiple dimensions within an organization (Bessant et al., 2005).

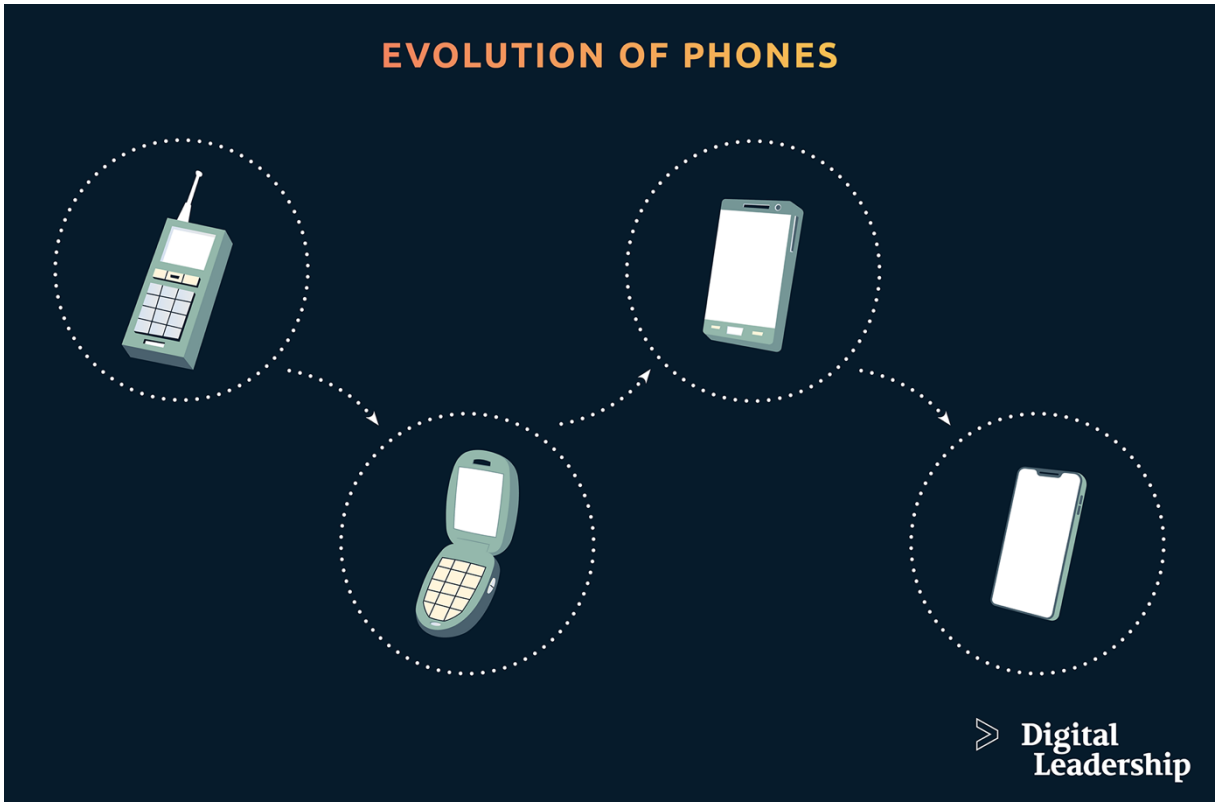
Kahn (2018) further explains the importance of cultivating an innovation mindset across the entire team, stating that “success and failure are part of a flourishing process, and a mindset accepting of this enables both outcomes and process.” A key challenge that can lead companies to fail when innovating is responding to discontinuities—major shifts in technology, markets, or society—that disrupt established conditions and open new opportunities (Utterback, 1996).

Established firms, while strong in steady-state innovation, often struggle with these disruptions due to rigid processes and an inability to handle uncertainty. Meanwhile, new entrants may be agile but lack the resources to fully seize these opportunities (Christensen, 1997). To thrive, organizations need both flexibility and resilience, balancing incremental improvements with the ability to adapt to disruptive changes—both of which are deeply connected to fostering an innovation mindset throughout the organization.

Chesbrough (2003) explains that innovation means an invention that was taken to the market and validated by changing social practices, that can be applied into products, services or processes. By that, it can be presented in some shapes:

a) Incremental Innovation: creating a new approach to aggregate value for the market and deliver better results from what it was earlier expected to(Ghosh et al., 2017). Examples: processing power in smartphones that upgrade from time to time to improve the ability to handle more complex tasks as it can be seen in Figure 2; also, Starbucks introducing a new feature to the user being able to see the real-time order status in the application used to make the orders.

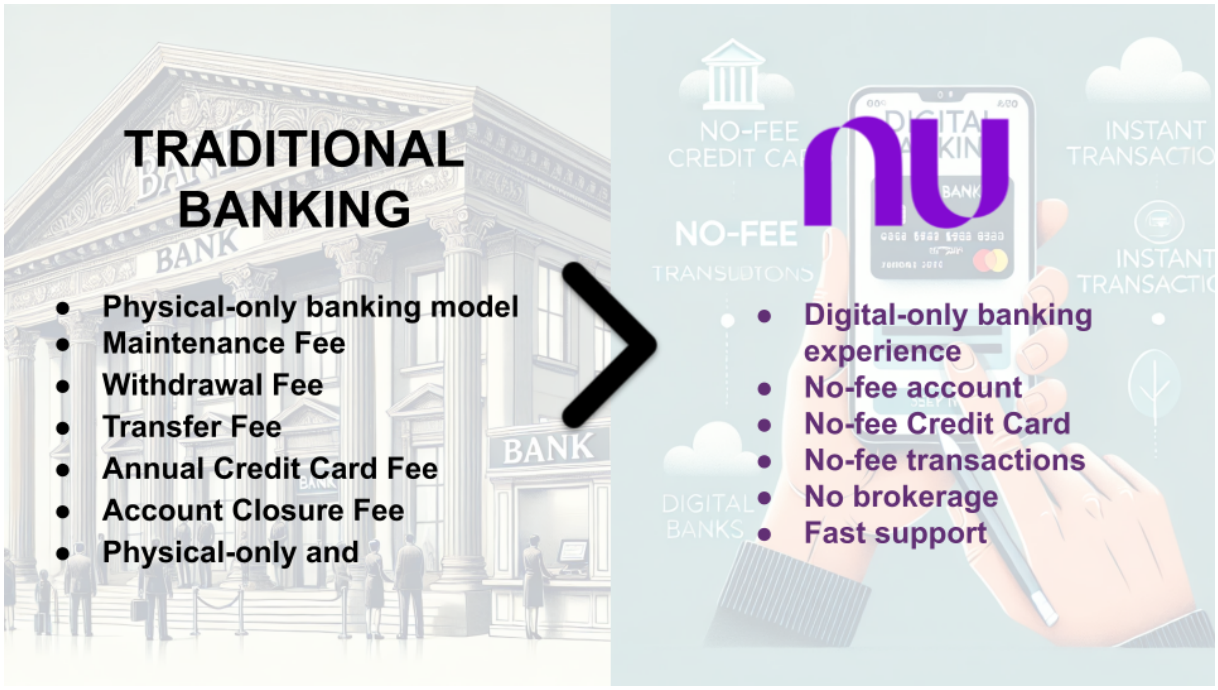
Figure 2 - Smartphones Incremental Innovation. Source: DIGITAL LEADERSHIP. *Incremental Innovation: Definition & Examples*



Source: Digital Leadership (2023)

b) Disruptive Innovation: Creates a new market approach for a completely new category of customers, delivering an alternative to existing solutions that initially targets a niche market or underserved segment and eventually disrupts and displaces established market leaders (Christensen, 1997). Example: Nubank offered digital-only banking experience with a no-fee credit card and no-fee transactions between Nubank account users, as it can be seen in comparison to a traditional banking operation in Figure 3.

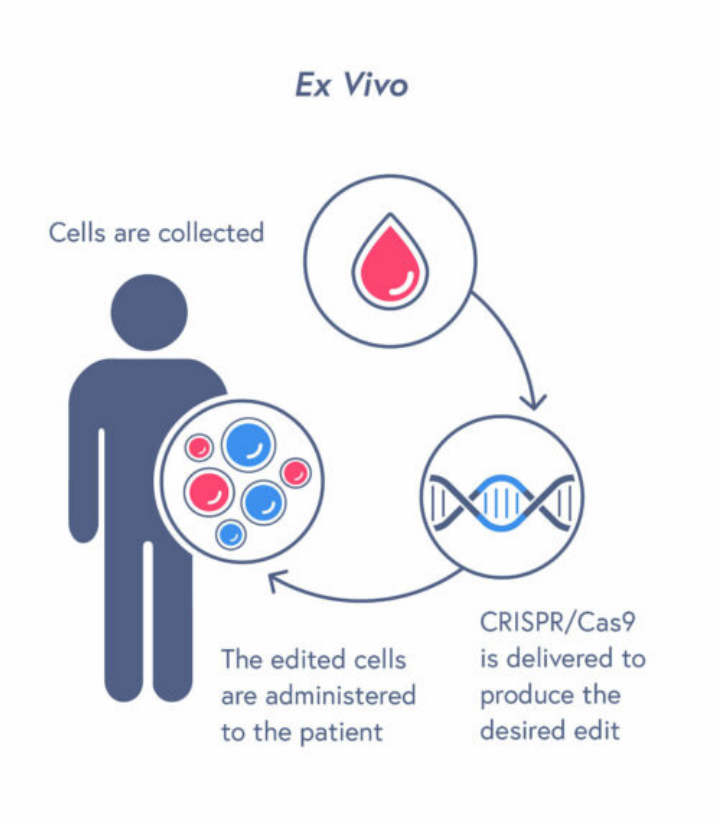
Figure 3 - Banks Disruptive Innovation



Source: Author (2024)

c) Radical Innovation: Radical innovation refers to breakthroughs that fundamentally change existing products or markets. These innovations often involve significant technological advancements and can create entirely new markets (Bouncken et al., 2015). Example: The development of CRISPR-Cas9 gene-editing technology.

Figure 4 - Ex Vivo CRISPR-Cas9 application example



Source: CRISPR Therapeutics (2024)

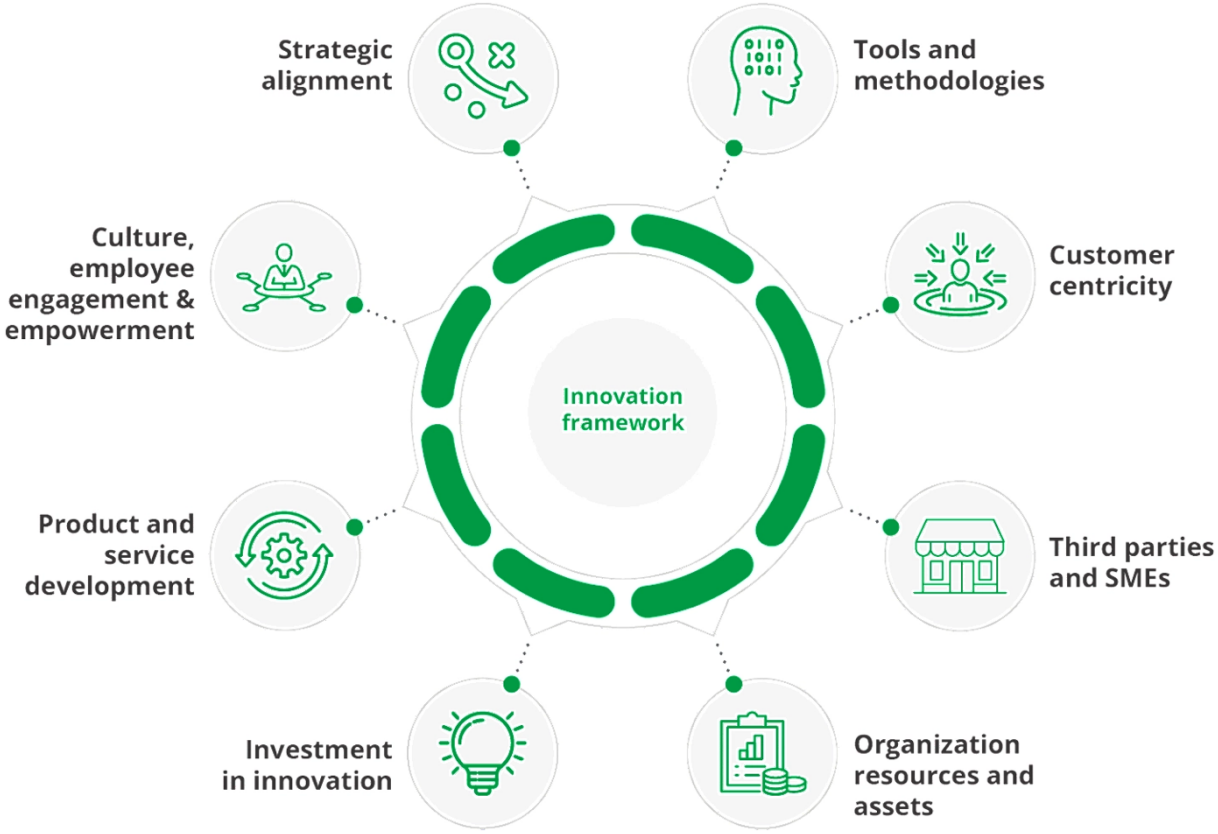
d) Architectural Innovation: Architectural innovation involves reconfiguring existing technologies and components in new ways to create new products or services. This type of innovation changes the overall architecture of a product rather than introducing new technologies(Henderson & Clark, 1990). Example: Vacuum robots are a product that reconfigure existing technologies like vacuum cleaning mechanisms, sensors and robotics in one product, the difference in technology can be seen in Figure 5.

Figure 5 - Example of Architectural Innovation in Vacuum Cleaners

Source: Author (2024)

Recent literature stresses the need for organizations to integrate new strategies and methodologies to enhance innovation outcomes. Pisano (2015) advocates for a systematic approach to innovation, incorporating structured processes and frameworks. Bessant, Lamming, and Noke (2014) highlight the importance of continuous learning and adaptation. This is reflected in the innovation framework developed by Deloitte (2024), which identifies key elements essential for evaluating and managing innovation effectively (Figure 6).

Figure 6 - Key elements in any practical evaluation of innovation



Source: Deloitte (2024)

Furthermore, the Deloitte (2024) framework (Figure 6) shows that innovation is not just about product development or technological advancement. It involves multiple dimensions, such as strategic alignment, customer-centric approaches, and employee engagement. Additionally, organizations must invest in innovation, collaborate with SMEs, and optimize their resources. These elements ensure that companies can innovate incrementally while staying agile enough to respond to major market shifts, positioning themselves for long-term success. These external partners are integral to the broader innovation ecosystem, which will be explored in detail in the following section, positioning companies for long-term success.

2.2 INNOVATION ECOSYSTEM

The roots of innovative ecosystems can be traced back to the work of economist Alfred Marshall in the late 19th and early 20th centuries. Marshall introduced the concept of industrial districts, where businesses in the same industry cluster

together in specific geographic areas, benefiting from shared resources, labor pools, and knowledge spillovers. This idea was further developed by scholars like Michael Porter, who introduced the concept of “clusters” in the 1990s. Porter's work highlighted the competitive advantage gained by businesses located in proximity, as they could more easily collaborate, share knowledge, and innovate (Porter, 1990).

The transition from industrial clusters to innovation ecosystems marked a shift in focus from geographic proximity to a broader, more interconnected view of innovation. Adner's work in the mid-2000s emphasized the importance of relationships and interdependencies among diverse actors, including firms, universities, government agencies, and other organizations. This perspective recognized that innovation is not confined to individual organizations but is the result of interactions within a complex network of stakeholders (Adner, 2006).

Freeman (1987) and Lundvall (1992) introduced the concept of national innovation systems, which examined how government policies, institutions, and interactions among actor’s influence innovation at a national level. Their work underscored the importance of systemic approaches to understanding innovation and laid the groundwork for later ecosystem-based models.

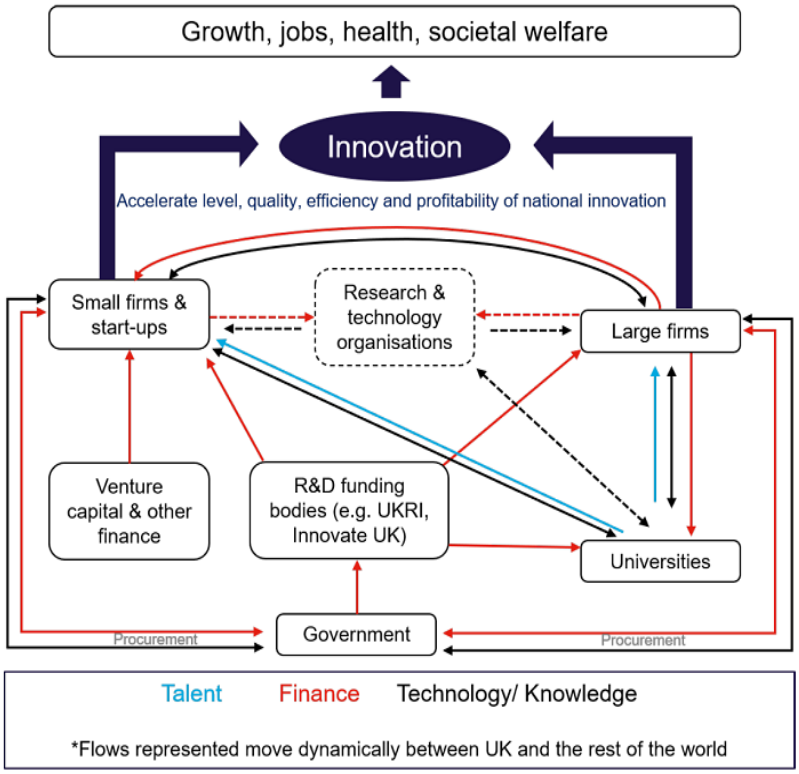
In the late 2000s and early 2010s, the innovation ecosystem concept gained further traction as globalization and digitalization reshaped the innovation landscape. The rise of the internet, digital platforms, and collaborative technologies enabled more distributed and networked forms of innovation. Researchers like Chesbrough (2003) and West and Bogers (2014) explored how open innovation practices, which involve leveraging external knowledge and partnerships, fit within the broader context of innovation ecosystems.

Schäper (2023) describe an innovation ecosystem as an interconnected network of entities, including businesses, research institutions, government agencies, and other organizations, that collectively support the development and diffusion of innovations. This ecosystem fosters collaboration, knowledge sharing, and resource pooling to drive technological advancements and economic growth (Adner, 2006). Recent literature emphasizes the dynamic and complex nature of these ecosystems, highlighting the importance of integrating new strategies and methodologies to enhance innovation outcomes (Sant'ana et al., 2020).

Figure 7, adapted from Luke Georgiou's *Improving the Framework Conditions for R&D* (2015) and presented in the UK Innovation Strategy: *Leading the Future by*

Creating It (gov.uk), illustrates the dynamic exchanges of talent, finance, and technology across the innovation ecosystem. These interactions ensure that innovation is collaborative rather than siloed, fostering incremental and radical advancements. The diagram highlights that Small Firms & Startups and Large Firms are the primary drivers of innovation, while other entities, such as government, universities, and funding bodies, act as enablers by providing resources and research capabilities. This collaborative ecosystem facilitates a continuous flow of funding, knowledge, and talent, empowering firms to drive impactful innovation initiatives.

Figure 7 - Innovation Ecosystem.

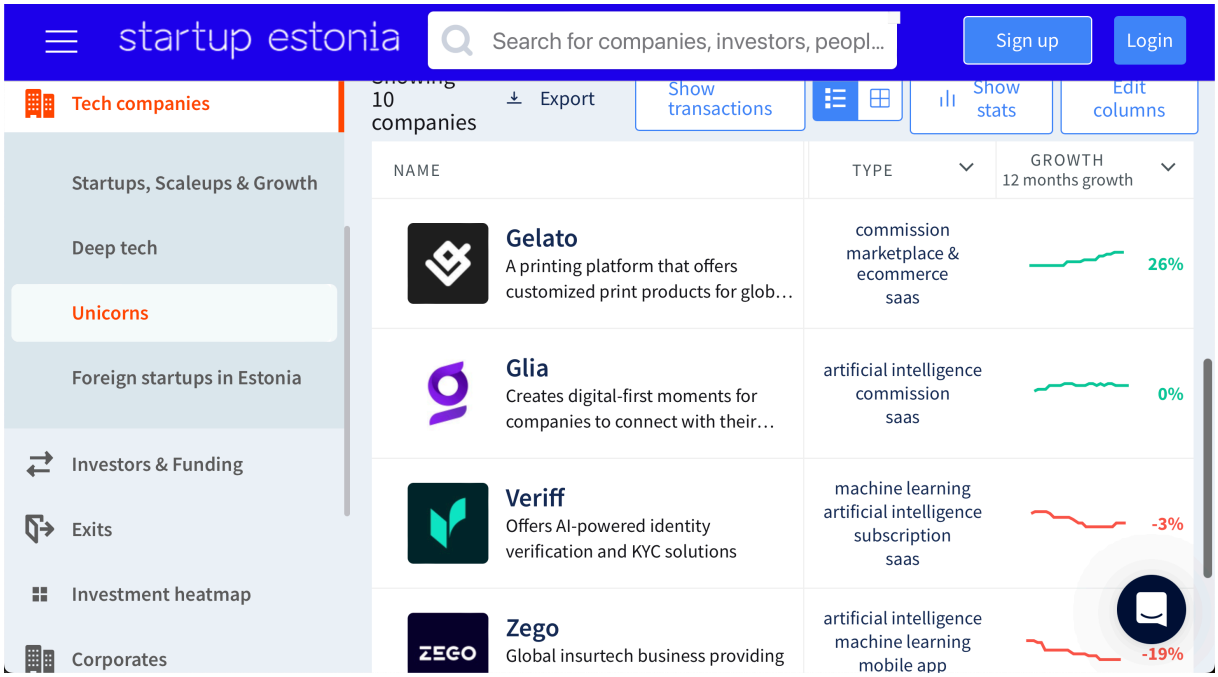


Source: UK Innovation Strategy: Leading the future by creating it. Adapted from Luke Georgiou, *Improving the Framework Conditions for R&D* (2015)

Recent research has also identified the need for a better understanding of the internal collaboration and architectural models within innovation ecosystems as this is key for developing effective strategies to manage and support these ecosystems. The integration of digital tools, data strategies, and more agile collaboration approaches is also essential to address the challenges faced by innovation ecosystems in today's rapidly changing technological and market landscapes (Sant'ana et al., 2020).

Estonia's innovation ecosystem is highly integrated with advanced digital platforms that facilitate collaboration and interaction among key players cited before in this text. Platforms like Startup Estonia serve as a centralized digital hub where information about companies, funding opportunities, and market trends is easily accessible (Saluveer & Truu, 2020).

Figure 8 - Print screen from Startup Estonia website Platform demonstrating how open and well connected the ecosystem is



Source: Startup Estonia Ecosystem (2024)

Figure 8 illustrates how the Startup Estonia initiative supports the growth of the innovation ecosystem, these tools provide real-time data and insights, helping to identify growth trends and market demands. As a result, Estonia has created an environment where stakeholders can leverage technology to collaborate seamlessly, driving innovation forward and establishing the country as a leading hub for digital advancements in Europe. All these efforts contribute to making Estonia a prime destination for startups, as showcased on the Startup Estonia initiative website.

The discussion on innovation ecosystems highlights the interconnected nature of innovation, where diverse entities collaborate to drive technological advancements and economic growth. Building on this understanding, the next topic explores how open innovation takes this concept further by actively involving external partners and a broader range of ideas and expertise to enhance the innovation process.

2.3 OPEN INNOVATION

Open innovation is a paradigm that assumes firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology (Chesbrough, 2003). Open innovation strategies include licensing agreements, partnerships, crowd-sourcing platforms, mergers and acquisitions and other ways of business making. Chesbrough (2006) argues that open innovation enables firms to leverage external knowledge and share risks associated with innovation.

It can be implemented in various ways, from an inside developing for open innovation processes or from outside methodology provided from consulting companies services. Both approaches define the sector and archetypes of the solutions that will be scouted and usually bring the solutions with best fit for the pain points of the corporate interested into a matchmaking session, from which a selected number of those will continue to business making into the strategies mentioned before (Holzmann, 2014).

Recent research on open innovation emphasizes its evolving nature and the increasing importance of integrating digital tools and collaborative platforms. According to Randhawa, Wilden, and Hohberger (2016), open innovation has become more dynamic, with firms continuously adapting their strategies to the rapidly changing technological landscape. Alongside, the rise of digital platforms has facilitated more efficient knowledge sharing and collaboration, making it easier for companies to engage with external partners.

West and Bogers (2017), highlight the need for firms to balance open and closed innovation practices. Closed innovation, where firms rely solely on internal R&D and resources, offers greater control over the innovation process but may limit the diversity of ideas and speed of development. In contrast, open innovation allows firms to access a broader range of knowledge and expertise, which can accelerate innovation and enhance competitiveness. However, it also requires effective management of intellectual property and collaboration risks.

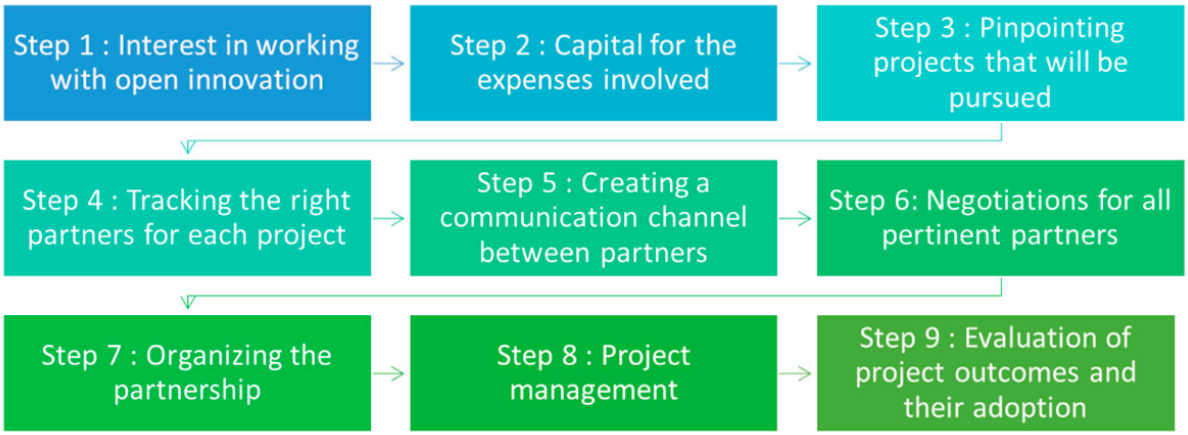
Open innovation can be implemented through various mechanisms. One approach is internal development, where companies establish dedicated units or teams to manage open innovation activities that are responsible for identifying external

partners, managing collaborations, and integrating external innovations into the company's operations. For example, large corporations like Procter & Gamble and General Electric have established open innovation programs to tap into external expertise and accelerate product development (Chesbrough & Brunswicker, 2014).

Another approach involves engaging external consulting firms that specialize in open innovation. These firms offer services such as strategy development, innovation scouting, and matchmaking, therefore help companies identify suitable external partners and facilitate collaborations (Holzmann, 2014). In general, these services aim to connect startups with large corporations to solve specific business challenges and drive innovation.

Arvaniti et al., (2022) outline a structured pathway commonly followed when implementing open innovation processes, as seen in Figure 9. This approach is presented as a nine-step pathway, which includes key stages such as preparing the organization for open innovation, defining the specific areas and technologies to be scouted, selecting the appropriate collaboration model, and evaluating the outcomes of the entire process. This structured pathway provides a clear framework for organizations to systematically manage their open innovation activities and ensure alignment with strategic goals while maximizing the potential for successful collaborations and knowledge transfer.

Figure 9 - Steps taken during the adoption of open innovation



Source: Aravaniti (2022)

The distinction between closed and open innovation is critical for understanding the benefits and challenges of each approach. Closed innovation relies on internal resources and capabilities, offering greater control and protection of intellectual property, however, it may lead to slower innovation cycles and limited access to external knowledge. Open innovation, on the other hand, leverages both internal and external resources, enabling faster innovation and access to diverse ideas. The trade-off is the need to manage collaboration risks and intellectual property issues effectively (Hung & Chou, 2013).

Choosing open innovation for this study is justified by its ability to enhance innovation performance and competitiveness (Chesbrough, 2003). It enables firms to overcome resource constraints, accelerate innovation processes, and mitigate R&D risks by leveraging external knowledge and expertise (Enkel et al., 2012). The collaborative nature of open innovation aligns with the growing shift towards networked and ecosystem-based models, essential for tackling complex market challenges (Adner, 2006). Successful open innovation relies on effective collaboration, involving various forms of alliances and partnerships to strengthen a firm's innovation capabilities (Todeva & Knoke, 2005).

Maturity in open innovation reflects an organization's capability to systematically manage and sustain collaborative innovation processes by integrating internal competencies with external resources. According to Enkel et al., (2011), maturity involves evaluating how structured, consistent, and aligned these processes are across key dimensions, such as partnership capacity, innovation climate, and internal systems. As organizations progress in their maturity, they shift from reactive, fragmented innovation efforts to fully institutionalized practices, where innovation becomes a core strategic function.

The five levels of open innovation maturity, as defined by Enkel et al., (2011), will serve as a filter for data analysis:

a) Level 1 — Creative individual attempts are dismissed. The organization focuses on day-to-day operations. Innovation output is inconsistent and unpredictable.

b) Level 2 — The need to innovate is identified; innovation is clearly defined. There is a basic understanding of the influential factors. Innovation output is inconsistent but traceable.

c) Level 3 — Appropriate practices, procedures and tools are in place, innovation is encouraged among employees. Outputs are consistent and ensure sustained market share and positioning.

d) Level 4 — Practices, procedures and tools for integrating innovation activities are used. A deep understanding has been established of the internal innovation model and how it relates to business requirements. Innovative outputs are consistent, diverse and a source of differentiation.

e) Level 5 — Practices, procedures and tools are institutional. Individuals are empowered to innovate. Synergy is achieved through the alignment of business and innovation strategy and synchronization of activities. Outputs provide sustained competitive advantage in existing and new markets.

These levels illustrate the progression of open innovation maturity from ad hoc efforts to fully integrated systems, highlighting the strategic value of aligning business and innovation initiatives. The next section delves into collaboration models, which outline the structures and strategies that organizations can employ to effectively work with external partners, ranging from startups to established firms, to drive innovation outcomes.

2.4 COLLABORATION MODELS

A collaboration model refers to a structured approach in which multiple stakeholders collectively work towards a common goal, sharing power and responsibilities to achieve desired outcomes. This model emphasizes an integrated decision-making process for effective problem-solving, where each participant recognizes that their individual success is intertwined with the collective success of the group. In organizational contexts, collaboration is characterized by joint action, mutual accountability, and an understanding that the failure of one member can significantly impact the entire group (Nisula et al., 2022; Martins, 2020).

According to Todeva & Knoke (2005), collaboration models encompass various forms of partnerships and alliances that facilitate joint innovation activities. These models include:

a) Strategic alliances: A partnership where two or more organizations collaborate while maintaining their legal independence. This model allows companies to share resources, knowledge, and capabilities without merging their operations. Strategic

alliances are often used to enter new markets, access external expertise, or achieve economies of scale. The primary motivation is to leverage complementary strengths and gain competitive advantage while minimizing risk.

b) Joint ventures: Involves creating a new, jointly owned entity where all participating firms contribute resources to achieve a common goal. This model is commonly used for large-scale projects like research and development or market entry in unfamiliar regions. Joint ventures enable shared risk and resource pooling, but they require clear governance and strategic alignment to avoid conflicts.

c) Equity investments: This model entails one firm acquiring a stake in another through direct stock purchases. Often seen in corporate venture capital, equity investments provide strategic insights and potential financial returns. This model allows for strategic influence over the partner firm's activities without full ownership, making it a less risky way to explore new business opportunities.

d) Cooperatives: Cooperatives are collaborative models where smaller firms or organizations join forces to enhance their market position and resource capabilities. This model is characterized by shared ownership and collective decision-making, which can enhance market access and provide greater bargaining power. However, managing diverse member interests can be complex.

e) Consortiums: Formal agreements between multiple organizations that collaborate on specific projects, usually in research and development. This model is particularly useful in high-tech or knowledge-intensive industries where pooling resources and sharing expertise is important. Consortiums reduce costs and risks for individual firms, but coordinating among diverse participants can be challenging.

f) Licensing: Licensing allows one company to grant another the right to use its intellectual property, such as patents or trademarks, in exchange for royalties. This model enables firms to monetize intellectual assets and enter new markets with minimal investment. Licensing agreements require robust oversight to ensure compliance and protect the licensor's interests.

According to Tidd and Bessant (2013), effective collaboration models help firms to combine complementary resources and capabilities, thereby enhancing their innovation potential. For example, strategic alliances allow companies to share knowledge and access new markets, while joint ventures involve co-investment in new ventures to develop innovative products or services. Additionally, consortiums and

innovation networks bring together multiple stakeholders to address common challenges and drive collective innovation efforts.

Schuh et al., (2022) emphasize that established manufacturing corporates face significant challenges from technology-based startups that disrupt existing markets. As a result, collaborations between corporates and startups are increasingly sought to gain access to resources, markets, or technologies that each partner might not be able to develop independently, additionally, collaboration models must be carefully chosen to match the strategic goals of both partners, considering their respective strengths and weaknesses. Figure 10 provides a comprehensive framework to identify suitable collaboration types, offering a structured typification that aligns to the requirements of both corporates and startups in achieving effective partnerships (Schuh, 2022).

Figure 10 - Initially identified design characteristics of collaboration

Design characteristics	Potential characteristic values			
Resources	Tangible	Intangible	Financial	Human
Resource linkage & competence transfer	Complementary collaboration		Additive collaboration	
Goal	Objective goal (effectiveness)		Formal goal (efficiency, economy, speed)	
Capital investment	No investment	Minority investment (<50%)	Investment at par (both 50%)	Majority investment (>50%)
Legal form	Non-contractual agreement	Contractual agreement without capital involvement	Contractual agreement incuding capital involvement	
Direction of collaboration	Horizontal	Vertical	Diagonal	
Initial objective	Outside-in		Inside-out	

Source: Characteristics for Collaboration Types between Corporates and Startups. Schuh et al. (2022)

In open innovation, collaboration models are a fundamental part of the process, enabling interactions between corporations, SMEs, and startups. These partnerships bridge differences in organizational cultures, where startups excel in dynamic markets while corporations often face challenges due to rigid internal

processes. Success in such collaborations relies on both partners' absorptive capacity to process and integrate new knowledge, particularly tacit knowledge, which is deeply rooted in personal experience and specific contexts. Therefore, well-designed collaboration models are necessary to facilitate knowledge sharing and learning, ensuring effective outcomes within the open innovation framework (Todeva & Knoke, 2005).

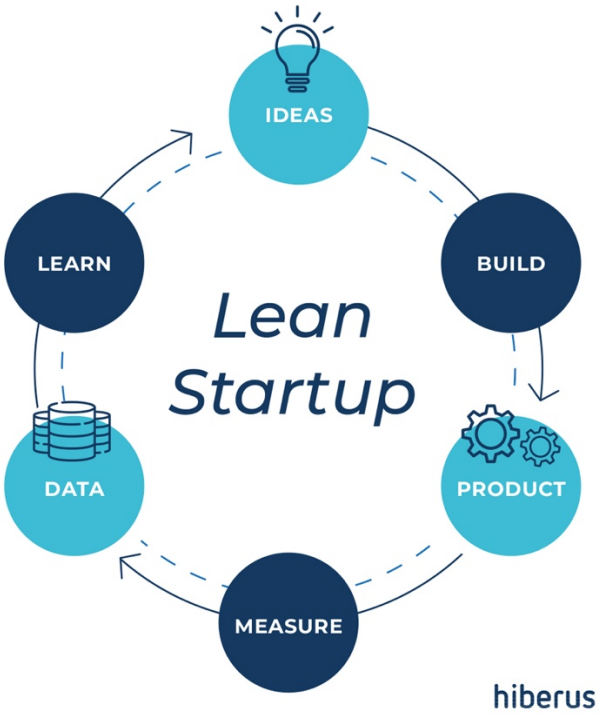
Startups, in particular, benefit from these collaboration models, as they provide the agility and innovative mindset needed to thrive in competitive markets. By forming strategic partnerships, startups can leverage the strengths of established corporations, enhancing their potential for growth and innovation.

2.5 STARTUP

A startup is typically defined as a company established for less than ten years that brings innovative technologies and/or new business models to the market (Kollman et al., 2016). Ries (2011), defines a startup as “a human institution designed to create new products and services under conditions of extreme uncertainty”. Startups are characterized by their focus on high growth and scalability, often leveraging technology to disrupt existing markets or create entirely new ones (Kollmann et al., 2016). Founded by entrepreneurs with a vision to address specific market needs, startups typically operate in environments of high uncertainty, necessitating a flexible and adaptive approach to business development (Ries, 2011).

A startup is a young and innovative company that is typically in the early stages of its development. Unlike traditional businesses, startups are characterized by their focus on high growth and scalability, often leveraging technology to disrupt existing markets or create entirely new ones. They are usually founded by entrepreneurs who aim to develop a unique product or service, and their business models are often based on new ideas or innovative solutions to existing problems, usually in highly uncertain environments, which necessitates a flexible and adaptive approach to business development, frequently involving iterative testing and refinement of their products or services based on customer feedback. This iterative process, known as the lean startup methodology, emphasizes rapid prototyping, validated learning, and pivoting based on market feedback to find a viable business model (Euchner; Blank, 2021), this process can be seen in Figure 11.

Figure 11 - Lean Startup Methodology Cycle



Source: Hiberus (2023)

Given their propensity for innovation and rapid growth, startups play a critical role in driving economic development and technological advancement by stimulating competition and drive productivity improvements across industries (Ries, 2011). Moreover, modern startups increasingly rely on digital tools and platforms to enhance their operational efficiency and market reach. Ghezzi (2019) highlights the role of digital startups in adopting lean startup approaches, such as effectuation and bricolage, to rapidly adapt to market changes and customer needs, as this digital transformation is crucial for startups to remain competitive and innovative in the fast-paced global market.

The funding of startups typically comes from various sources such as personal savings, family and friends, angel investors, venture capital firms, and crowdfunding platforms. These funding sources provide the necessary capital to fuel their growth and development in the early stages. Startups are known for their agile and dynamic culture, often operating with a small, cross-functional team that works collaboratively to achieve the company's goals. The ultimate objective for many startups is to achieve significant growth and market penetration, which can lead to substantial returns for their investors and founders (Moss et al., 2018). This often culminates in a successful

exit strategy, such as being acquired by a larger company or going public through an initial public offering (IPO).

Investing in startups is crucial for large corporations to maintain a competitive edge and drive long-term growth. According to the International Entrepreneurship and Management Journal (2022), startups operate in highly uncertain environments, and their ability to innovate and adapt quickly makes them valuable partners for established companies. By investing in startups, corporations can explore new market opportunities, improve operational efficiency, and respond to changing customer demands more effectively.

2.6 CORPORATES

A corporate entity is generally defined as a large company that has significant influence in the economy (Cambridge Dictionary, 2023). They are often characterized by their size and structure, encompassing multinational corporations, publicly traded companies, and private firms and due to their scale, they play a central role in modern economies by controlling vast resources and shaping market trends (Khan, 2011). Larger corporates tend to have more complex operational and governance structures, which further differentiates them from smaller, less formalized organizations (Garvey & Swan, 1994).

Corporates possess several key characteristics that distinguish them from smaller businesses or startups. Their internal processes are typically highly structured, governed by corporate governance frameworks, and regulated by legal and compliance standards. This includes the establishment of boards of directors, audit committees, and policies aimed at ensuring accountability (OECD, 1999). Corporates typically pursue objectives such as profit maximization, long-term sustainability, and increasing shareholder value. Unlike startups, which are often agile and flexible, corporates are more methodical in their strategic planning due to their size and market influence (Berle & Means, 1932).

Corporates are crucial drivers of economic growth, creating jobs, stimulating innovation, and contributing to global trade. They not only influence the economic landscape but also play a vital role in shaping industry standards and practices (Shleifer & Vishny, 1997). Research has shown that good corporate governance

practices enhance a firm’s performance and shareholder value, making corporates a central force in modern economies (Khan, 2011).

Corporates, with their established structures and resources, increasingly recognize the value of collaborating with startups to drive innovation and adapt to rapidly evolving markets. These collaborations offer corporates access to new technologies and agile business models that are often difficult to develop internally. The relationship between corporates and startups, however, presents challenges due to the inherent differences in organizational culture and objectives. To ensure successful outcomes, well-structured collaboration models are essential to bridge these gaps and align both parties' strategic goals (Dizdarevic, Van de Vrande, & Jansen, 2024). In the next chapter, the methodology used to analyze the dynamics of corporate-startup collaboration will be discussed, outlining the approaches and frameworks applied to assess this relationship in detail.

3 METHODOLOGY

A well-defined methodology enhances the reliability of the results by detailing the research design, data collection methods, sampling techniques, and analytical tools employed. This clarity is essential for validating the research outcomes and establishing the study's contribution to existing knowledge.

3.1 CLASSIFICATION OF THE STUDY

This study focuses on examining the open innovation ecosystem within large corporations, exploring how these entities collaborate with startups and other external partners to drive innovation. The research aims to identify the various collaboration models employed, evaluate their effectiveness, and understand the underlying factors that influence successful open innovation practices.

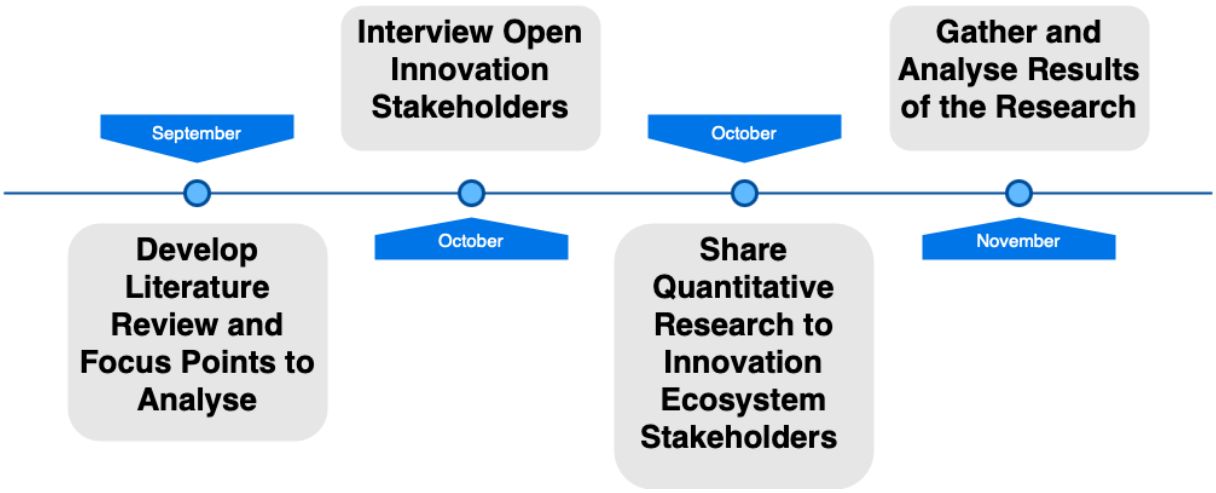
The primary sources of data include interviews, which data will be analyzed from a qualitative and comparative way. By combining these methods, the study aims to provide actionable insights into how large corporations can effectively implement open innovation strategies to enhance their innovation capabilities and overall competitiveness.

The data collected from these interviews will be analyzed qualitatively, focusing on identifying patterns, themes, and key factors that contribute to the success or failure of open innovation initiatives. This approach allows for a comprehensive understanding of the diverse ways in which large corporations implement open innovation, and the comparative analysis will highlight differences and commonalities across different organizations.

3.2 DATA COLLECTION

The data collection for this study is scheduled to be completed by the end of October. This timeline showed in Diagram 2 ensures that all necessary data is gathered and organized. All data collected will be systematically organized in Google Drive.

Diagram 2 - Flowchart of the Timeline of Data Collection and Analysis



Source: Author (2024)

The interview script was developed based on key insights from the literature review to ensure alignment between theoretical concepts and practical data collection from 71 references, which are cited in the end of this work. The following table describes it further in category.

Table 4 - Distribution of Studies by Category

Category	Number of Studies
Innovation	41
Open Innovation	22
Research Methods	5
Other Theses	2

Source: Author (2024)

The key references that guided the development of the qualitative interview script and the quantitative questionnaire are outlined in table 5, along with a brief description of each study:

Table 5 - Key References for the Development of Research Instruments

Author, Year	Title	Description of the Work and Connection to the Research
Chesbrough, 2003	Open Innovation: The New Imperative for Creating and Profiting from Technology	Introduces the concept of open innovation, advocating for the use of both internal and external ideas to drive innovation.
Moradi et al., 2021	Impact of organizational inertia on business model innovation, open innovation, and corporate performance	Explores challenges in adopting open innovation, including cultural resistance and the alignment of internal and external innovation.
Randhawa et al., 2016	A bibliometric review of open innovation: Setting a research agenda	Reviews open innovation literature, focusing on the role of digital tools, such as AI and Big Data, in innovation practices.
Sant'Ana et al., 2020	The structure of an innovation ecosystem: Foundations for future research	Examines innovation ecosystems and how data is leveraged for decision-making within open innovation practices.
Todeva & Knoke, 2005	Strategic Alliances and Models of Collaboration	Investigates the effectiveness of collaboration models, including strategic alliances and joint ventures.
Schuh et al., 2022	Characteristics for Collaboration Types between Corporates and Startups	Explores collaboration models and the role of organizational culture in supporting open innovation.
Bigliardi et al., 2020	The influence of open innovation on firm performance	Assesses the role of consulting firms in supporting open innovation and examines factors for success.
Kapetanious & Lee, 2019	The Geographical Challenges of Open Innovation: A Study of SMEs in Cyprus	Discusses the impact of regional factors and regulatory differences on open innovation.
Bertello et al., 2023	Open Innovation: Status Quo and Quo Vadis—An Analysis of a Research Domain	Analyzes the integration of sustainability goals into open innovation strategies.
Hung & Chou, 2013	Organizing for knowledge creation in a strategic interorganizational innovation project	Investigates knowledge management practices, focusing on intellectual property protection in open innovation collaborations.

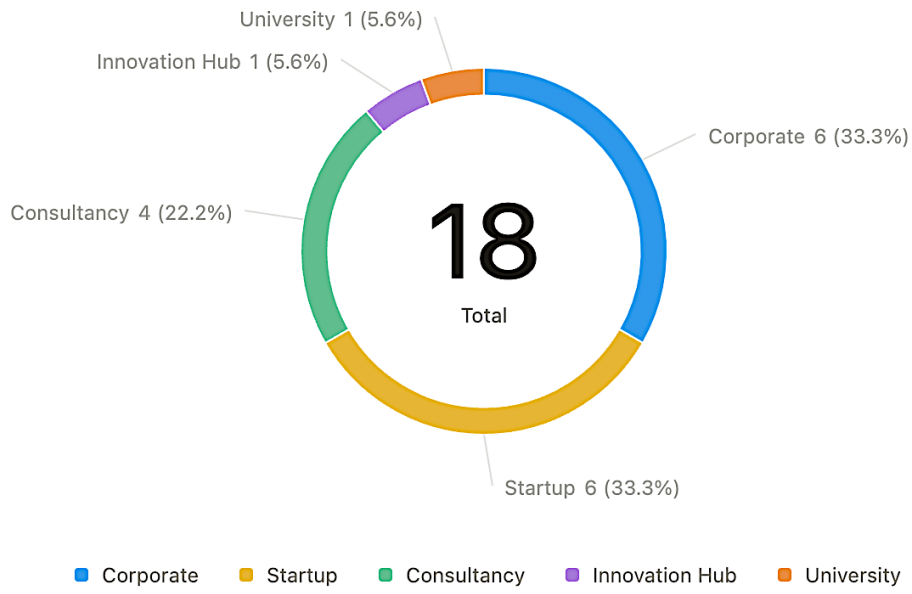
Source: Author (2024)

The base text for the interviews was created by developing a structured guide with open-ended questions, ensuring consistency while allowing for detailed exploration of each topic.

The types of data analyzed in this study include qualitative data from semi-structured interviews with key stakeholders such as corporate innovation managers, startup founders, and consultants; quantitative data collected from questionnaires distributed to a broader sample of corporates and startups; detailed examination of documented case studies of successful and unsuccessful open innovation initiatives; and scholarly articles, industry reports, and books on open innovation and collaboration models.

Interviews were conducted with 18 stakeholders, all worldwide connected to OI, to gather valuable insights into real-world open innovation practices inefficiencies. Each interview lasted 30 minutes, and the distribution of participants across startups, consultancies, and corporates is presented in Chart 2.

Chart 2 - Distribution of Interview Participants by Organization Type



Source: Author (2024)

The interview script for the qualitative interviews contains 15 structured questions across 12 key sections. Each question is designed to ensure that the insights collected are detailed and relevant to startups, corporates, and consultancies. This comprehensive approach allows for the exploration of inefficiencies in open innovation from various organizational perspectives. The questions and their references are presented in Table 6.

Table 6 - Interview Question for the Research

Interview Question	Context and Reference to the Question
1. General Challenges in Open Innovation	
1.1 How do you define Open Innovation within your organization?	Understanding how companies perceive and implement OI practices in their operations. This will set the baseline for how organizations view OI's role and scope (Chesbrough, 2003).
1.2 What challenges have you faced when integrating Open Innovation practices into your corporation?	Focuses on understanding organizational difficulties when shifting to OI, such as cultural resistance, coordination complexity, and the alignment of internal and external innovation efforts (Moradi et al., 2021).
2. Role of Digital Tools in OI	
2.1 How have digital technologies like AI and Big Data transformed your Open Innovation practices?	Assessing how digital tools, such as AI and Big Data, influence the speed, efficiency, and scope of innovation activities (Randhawa et al., 2016).
2.2 What role does data play in the decision-making process during your Open Innovation activities?	Explores how organizations are using data to guide innovation decisions, evaluate potential partners, and monitor ongoing collaborations (Sant'Ana et al., 2020).
3. Collaboration Models	
3.1 What collaboration models (e.g., strategic alliances, joint ventures) have you implemented?	To identify which collaboration models organizations are using, based on Todeva & Knoke's (2005) classification of collaboration models, and the reasons behind these choices.
3.2 Which collaboration model has been the most effective, and why?	Examining the effectiveness of collaboration models in achieving OI goals, considering factors like strategic fit, mutual benefits, and knowledge transfer efficiency (Schuh et al., 2022).
4. Consulting Firms' Influence	
How do innovation consulting firms support your open innovation initiatives, and what improvements would you suggest?	Investigating the role of consulting firms in supporting OI by providing frameworks, guidance, and identifying gaps (Bigliardi et al., 2020).
5. Regional Differences in OI Practices	
What regional factors (e.g., regulatory frameworks, cultural attitudes) impact your open innovation strategies in different locations like Florianopolis, São Paulo, and London?	Examines how geographical and regulatory differences influence the success or barriers of OI initiatives (Kapetanious & Lee, 2019).
6. Impact of Policies and Regulations	
How do local and international policies, such as the EU's AI Act or Brazil's Marco Legal das Startups, affect your open innovation activities?	To investigate the role of regulatory environments in shaping OI practices and identifying related inefficiencies.
7. Integration with Startups	
What are the key factors that determine the success of your collaborations with startups in your open innovation initiatives?	Identifies factors that contribute to successful startup collaborations and strategic fit, providing a perspective on practical success factors (Todeva & Knoke, 2005).

8. Measuring OI Inefficiency	
How do you measure the effectiveness and efficiency of your open innovation processes, and what metrics do you find most useful?	Understanding the performance measurement tools used for OI to assess its efficiency and outcomes (Moradi et al., 2021).
9. Organizational Culture and OI	
In what ways does your organization's culture support or hinder open innovation practices?	Exploring cultural factors within organizations that support or pose barriers to implementing OI practices (Schuh et al., 2022).
10. Future of Open Innovation (OI) 4.0	
What features or strategies do you believe are essential for Open Innovation 4.0 to effectively transform large corporations?	Gathering expert opinions on evolving OI models and strategies necessary to achieve transformative innovation (Chesbrough, 2003).
11. Sustainability and OI	
How does your open innovation strategy incorporate sustainability and what challenges have you encountered in this integration?	Exploring how companies integrate sustainability goals into their OI strategies, especially in terms of product development and partner selection (Bertello et al., 2023).
12. Knowledge Management in OI	
What practices do you employ to manage and protect intellectual property while engaging in open innovation collaborations?	Investigating how firms balance knowledge sharing with protecting intellectual property during OI activities (Hung & Chou, 2013).

Source: Author (2024)

The interview data was analyzed using NVivo to ensure a structured and insightful examination of open innovation inefficiencies. The software assists in organizing interview data and supports the coding process. Additionally, it facilitates the labeling of interview data, the establishment of relationships between different codes, and the classification of codes and concepts into categories (Alemu, 2015).

Key methods include thematic analysis to identify patterns and recurring themes across stakeholder responses and word cloud generation to visualize the most frequently mentioned terms. Matrix coding queries will enable comparisons between startups, corporates, and consultancies, revealing differences in their approaches to innovation. These methods ensure the data is systematically organized and insights are presented clearly for further analysis.

This questionnaire consists of 20 questions distributed across 9 sections, focusing on key aspects of open innovation inefficiencies. The sections explore areas such as organization type, maturity levels, consulting companies, involvement, digital tools usage, collaboration models, sustainability goals, intellectual property protection, future of open innovation. Each section is structured with Likert-style questions (1–5 scale), aiming to gather comprehensive insights from startups, corporates,

consultancies, and innovation hubs, providing both quantitative metrics and qualitative perceptions to support a detailed analysis.

The questions for the quantitative research shared through Typeform platform are shown in Table 7.

Table 7 - Questions at the Quantitative Research

Question	Options	Reference
Q1: What is your organization type?	Startup, Corporate, Consultancy & Hub, Other	Chesbrough (2003); Enkel et al., (2011) – open innovation across different organizational types
Q2: How would you rate your organization's current level of maturity in Open Innovation (OI)?	Levels 1-5 (based on Enkel's model)	Enkel et al., (2011) – Innovation Capability Maturity Model
Q3: How would you describe your organization's general attitude towards the integration of external knowledge and ideas into internal innovation processes?	1 (Strongly Resistant) – 5 (Strongly Welcoming)	Chesbrough (2003) – Open Innovation model
Q4: How effective do you consider your OI activities?	1 (Not Effective) – 5 (Very Effective)	Chesbrough & Brunswicker (2014) – Adoption of OI in large firms
Q5: How challenging is it to implement OI activities in your organization?	1 (Not Challenging) – 5 (Very Challenging)	Moradi et al., (2021) – Challenges of implementing OI
Q6: How frequently do you engage consulting firms or hubs to support your OI activities?	1 (Never) – 5 (Very Frequently)	Bigliardi et al., (2020) – The role of consulting firms in innovation
Q7: How would you rate the support of consulting firms and innovation hubs in your OI practices?	1 (No Support) – 5 (Extensive Support)	Bigliardi et al., (2020) – Impact of consulting on OI outcomes
Q8: How would you rate the impact of local policies on your OI activities?	1 (No Impact) – 5 (Major Impact)	Bertello et al., (2023) – Influence of local regulations on OI
Q9: How would you rate the impact of international regulations (e.g., EU's AI Act) on your OI activities?	1 (No Impact) – 5 (Major Impact)	Outeda (2024) – Global policy frameworks impacting OI
Q10: How frequently do you use AI in your OI activities?	1 (Never) – 5 (Always)	Randhawa et al., (2016) – Digital tools and AI in OI
Q11: How important is AI to your OI activities?	1 (Not Important) – 5 (Very Important)	Chesbrough (2006) – Role of technology in OI models
Q12: How frequently do you use Big Data in your OI activities?	1 (Never) – 5 (Always)	Randhawa et al., (2016) – Use of Big Data in driving innovation

Q13: How important is Big Data in your OI activities?	1 (Not Important) – 5 (Very Important)	Sant'Ana et al., (2020) – Importance of data in OI frameworks
Q14: Which KPIs are most important in your OI activities?	Number of ideas generated, Number of involvements in OI, ROI, Time-to-market, Delivery quality, Pain point solved, Team diversity, Team background, Development stage, Investment received, Media appearance	ACE Cortex & Sling Hub (2023) – Key performance indicators in OI
Q15: What type of collaboration model do you implement most often?	Strategic alliances, Joint ventures, Equity investments, Cooperatives, Consortiums, Licensing	Todeva & Knoke (2005) – Models of collaboration
Q16: How would you rate the efficiency of the chosen collaboration model?	1 (Not Efficient) – 5 (Very Efficient)	Schuh et al., (2022) – Characteristics for collaboration efficiency
Q17: How often does your OI activity include sustainability goals?	1 (Never) – 5 (Always)	Bertello et al., (2023) – Sustainability integration in OI
Q18: How structured is your intellectual property protection in OI collaborations?	1 (Not Structured) – 5 (Very Structured)	Hung & Chou (2013) – IP management in collaborative innovation
Q19: How often do you collaborate with universities during OI activities?	1 (Never) – 5 (Always)	Chesbrough (2003) – Open innovation and academic partnerships
Q20: How much do you believe that OI will endure as a long-term strategy?	1 (Will Not Endure) – 5 (Will Endure Significantly)	Gassmann et al., (2010) – Future directions in OI

Source: Author (2024)

Thematic analysis was applied to the interview transcripts to identify common themes, patterns, and insights. Statistical analysis was conducted on survey responses, utilizing descriptive statistics and correlation analysis. Comparative analysis of case studies was performed to draw insights and lessons from documented examples. Nvivo was used to analyze qualitative interviews and Python based coding for quantitative data from the questionnaire.

3.3 ETHICAL CONSIDERATIONS

The General Data Protection Law (LGPD) from Brazil, enacted as Law No. 13.709/2018, will serve as a foundational basis for the ethical considerations in this study. The LGPD establishes comprehensive guidelines for the collection, processing, storage, and sharing of personal data. It mandates that data must be handled with respect for privacy, protection of personal rights, and adherence to the principles of necessity, transparency, security, and accountability.

In this study, compliance with the LGPD will ensure that all personal data collected from interviews, surveys, and other sources are processed in a manner that respects the privacy and rights of the participants. This includes obtaining informed consent from all participants, clearly explaining the purpose of data collection, and ensuring that data is used only for the intended research purposes. Additionally, measures will be taken to protect the data from unauthorized access or breaches, aligning with the security principles outlined in the LGPD.

The ethical considerations will also include ensuring data anonymization where possible to protect the identity of the participants, especially when sensitive information is involved. Regular audits and compliance checks will be conducted to ensure ongoing adherence to the LGPD guidelines throughout the study.

4 RESULTS

This chapter presents the findings from the qualitative and quantitative research on open innovation. The results are divided into sections that highlight key themes, insights, and patterns from interviews and the survey.

The qualitative analysis explores key themes from interviews, focusing on word cloud analysis, common topics, challenges, and strengths and weaknesses in open innovation. The quantitative analysis provides structured insights, including organization profiles, innovation maturity, and factors influencing open innovation effectiveness, such as AI and Big Data usage, sustainability goals, and intellectual property protection.

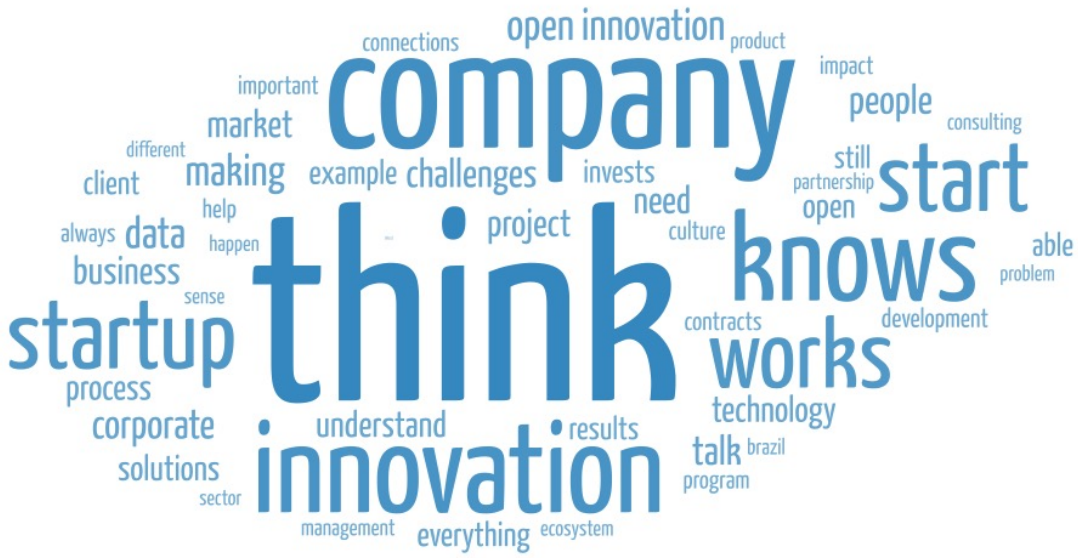
4.1 ANALYSIS OF QUALITATIVE RESEARCH

This section presents insights from interviews, focusing on key themes, challenges, and strengths in open innovation. It includes word cloud analysis and a discussion of the main topics highlighted by participants.

4.1.1 Word cloud analysis

The word cloud generated from the qualitative research interviews highlights key terms that reflect the participants' views and focus areas within open innovation. Here's an analysis of the most common words, present in Figure 12.

Figure 12 - Word Cloud of the Qualitative Research



Source: Author (2024)

a) Think: Represents a sense of uncertainty and personal assumptions, reflecting the exploratory and evolving nature of open innovation. The frequent usage of "think" suggests that participants rely heavily on personal insights and speculative thinking to navigate the inherent challenges and opportunities in open innovation. This aligns with the notion of open innovation as a speculative process, where organizations continually assess and adapt external ideas to fit internal needs (Randhawa et al., 2016).

b) Company: This term emphasizes the corporate structure that typically provides the resources and financial stability necessary to support open innovation initiatives. Established companies often serve as primary drivers of open innovation, offering the structural foundation and financial support required for sustained collaboration (Chesbrough & Tucci, 2020).

c) Knows: The term "knows" suggests a level of certainty and deeper understanding within companies regarding open innovation processes. It represents

the knowledge and wisdom that established companies bring to managing and adapting open innovation efforts strategically. Lin (2007) supports this by asserting that companies with strong knowledge bases are better equipped to align open innovation with strategic goals.

d) Startup: Defined as an entity that contributes to solving open innovation challenges, the presence of "startup" within the word cloud highlights the crucial role these firms play in bringing agility, fresh ideas, and innovation potential to corporate structures. Startups introduce disruptive solutions and new technologies that larger firms may struggle to develop internally (Greco et al., 2022).

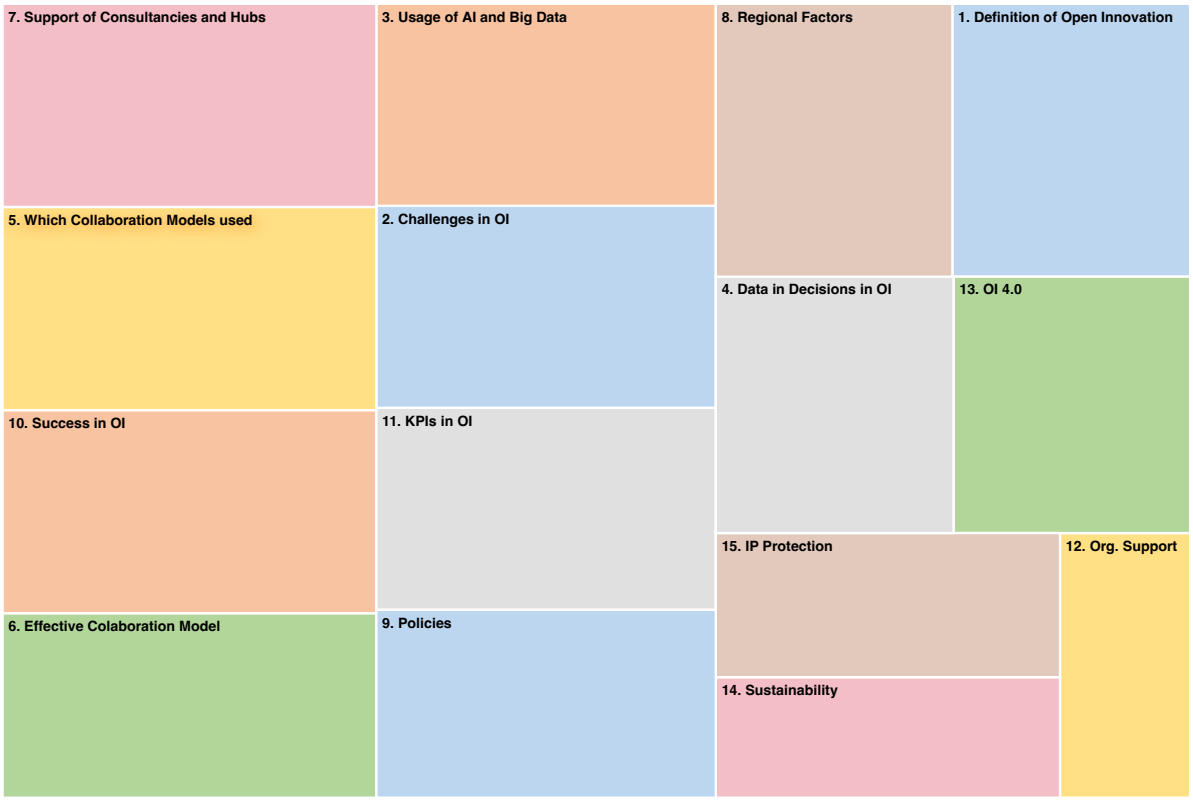
e) Start: This term captures the initiation of new processes driven by shifts in open innovation strategies. It reflects the beginning of innovative approaches and projects, showcasing companies' adaptability and their openness to continuous evolution in innovation practices. Arvaniti et al., (2022) note that successful open innovation strategies often involve iterative cycles, where organizations continuously refine and initiate new processes to maintain competitiveness and relevance.

4.1.2 Most discussed topics

An analysis of response frequencies for each interview question was conducted to identify the primary areas of focus within open innovation across various organizations. This approach highlights the themes most frequently discussed by interviewees, providing insights into the topics that are potentially more widely implemented or better understood. Conversely, themes with fewer mentions may represent emerging areas, complex subjects, or topics with limited established processes within the companies.

High-frequency topics suggest key areas of interest and critical focus points for organizations as they seek to enhance their open innovation strategies (Chesbrough & Tucci, 2020). Larger squares in Figure 13 indicate topics with higher response rates, from those, four can be analyzed in detail when analyzing the interviewees answers such as Definition of Open Innovation, Challenges in Open Innovation, Usage of AI and Big Data, and Success in Open Innovation.

Figure 13 - Frequence of Discussed Topics of the Qualitative Research



Source: Author (2024)

a) Most Discussed Topics:

a. Definition of Open Innovation: As one of the most frequently referenced topics, this highlights the necessity for a clear, shared understanding of open innovation within varied organizational contexts. Establishing a cohesive definition aid in aligning teams and setting effective strategies (Chesbrough, 2003). Clear definitions are particularly important, as they provide a foundation for collaborative efforts and ensure that all stakeholders are aligned in their understanding of the innovation objectives (Radziwon et al., 2023).

b. Challenges in Open Innovation: Interviewees extensively discussed the obstacles encountered in implementing open innovation, including cultural resistance, bureaucratic inefficiencies, and alignment issues among stakeholders. The prominence of this theme highlights the need for strategies that specifically address these barriers, which are commonly cited as challenges in adapting external innovation to internal structures (Wang et al., 2022). These challenges underscore the complexity of integrating diverse perspectives and the need for adaptability within corporate structures (Veneziani & Vaz, 2023).

c. Usage of AI and Big Data: Frequent references to AI and Big Data suggest that many companies view these technologies as essential for enhancing innovation processes. AI and Big Data are seen as enabling tools that optimize decision-making, streamline processes, and provide insights crucial for driving innovation (Greco et al., 2022). As Holzmann (2014) argues, digital transformation plays a critical role in fostering open innovation by improving efficiency and accelerating knowledge flows.

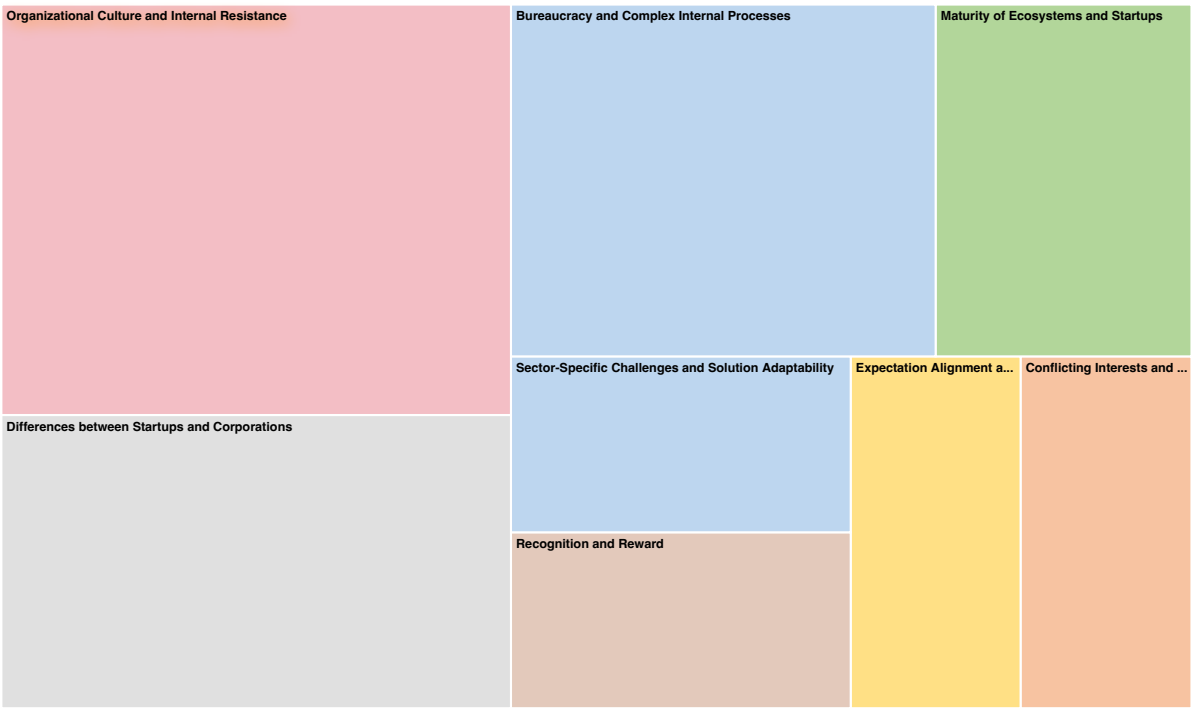
d. Success in Open Innovation: Success metrics and evaluation methods were frequently discussed, reflecting a strong interest in understanding how to measure the effectiveness of open innovation initiatives. This focus on tangible outcomes underscores the importance of impact assessment, as organizations aim to justify and optimize their investments in innovation. The Sopra Steria Open Innovation Report (2023) highlights that companies seek measurable outcomes to demonstrate the value and effectiveness of innovation partnerships.

This frequency analysis provides a nuanced view of current open innovation priorities, identifying widely discussed topics and those that may require further development to support innovation across diverse organizational contexts.

4.1.3 Challenges categorization

The challenges faced in open innovation initiatives have been categorized and detailed based on their broader influence and impact levels—high, medium, and low. Each level reflects the degree to which these challenges influence innovation processes, with high-impact challenges requiring more immediate attention to support successful implementation. The categories can be seen in Figure 14 and a detailed description of the impact levels below it:

Figure 14 - Categorization of Challenges Analyzed in the Qualitative Research



Source: Author (2024)

a) High Impact Challenges: These challenges represent significant barriers to achieving open innovation goals. Examples include:

a. Stakeholder Management: Difficulty in identifying and engaging appropriate stakeholders within large organizations often leads to communication gaps, which slow down innovation cycles. This complexity is frequently noted as a core challenge, given the varied interests and priorities of different departments (Chesbrough & Tucci, 2020).

b. Internal Resistance: Cultural resistance to open innovation within traditional departments hinders the adoption and integration of innovative solutions, creating friction between established practices and new ideas. Resistance to change is a well-documented challenge in open innovation, as traditional corporate cultures may be risk-averse and hesitant to collaborate with external entities (Randhawa et al., 2016).

c. Bureaucratic Processes: Excessive bureaucratic hurdles and lengthy approval processes for initiatives, especially for Proofs of Concept (POCs), create bottlenecks, making it challenging for companies to engage effectively with agile startups. Research indicates that rigid corporate structures often conflict with the fast-paced nature of startups, complicating collaboration efforts (Veneziani & Vaz, 2023).

d. Sector-Specific Adaptability: Some industries, such as pulp and paper, require highly tailored solutions, limiting the immediate applicability of standardized

innovations. Such specialization is critical in sectors with unique operational needs, where generalized solutions may not align with specific industry requirements (Holzmann, 2014).

e. Startup Density in Certain Sectors: In industries like energy, the limited presence of startups restricts the pool of potential innovation partners, posing additional obstacles to open innovation. This scarcity can inhibit collaborative efforts by narrowing the diversity of ideas and solutions available to organizations (Bertello et al., 2023).

b) Medim Impact Challenges: Although less severe than high-impact challenges, these issues contribute to inefficiencies within the innovation pipeline. They include:

a. Process Agility: Standardized, time-consuming processes can delay the implementation of innovative projects, particularly for fast-moving startup collaborations. Flexible and adaptive processes are recommended to address these delays, allowing for quicker responses to emerging opportunities (Arvaniti et al., 2022).

b. Expectation Alignment: Misalignment of goals between corporations and startups creates friction, reducing the effectiveness of collaborative efforts. Successful open innovation requires alignment in objectives and expectations to maximize the benefits of partnership (Chesbrough, 2003).

c. Technology Adoption: Slow integration of new technologies within the organization limits the potential benefits of open innovation. Studies emphasize that companies must actively engage with emerging technologies, like AI and Big Data, to support agile and innovative environments (Greco et al., 2022).

d. Cultural Gaps: Differences in work culture between innovation teams and traditional departments restrict the acceptance of novel practices and ideas. Such cultural discrepancies are common barriers in corporate-startup collaborations, where differing operational norms can hinder smooth integration (Radziwon et al., 2023).

c) Low Impact Challenges: These represent areas where incremental improvements could strengthen the foundation for open innovation without requiring immediate intervention:

a. Early-Stage Process Development: Initial challenges in establishing structured open innovation processes suggest that refinement is ongoing in many organizations.

Early process development is essential for long-term sustainability in innovation (Lin, 2007).

b. Digital Transformation: Limited use of tools like AI and Big Data indicates an opportunity to enhance decision-making efficiency. Adoption of these technologies can streamline operations and improve strategic decision-making, thereby supporting open innovation goals (Sopra Steria, 2023).

c. Dependency on Consultancy: Heavy reliance on external consultancies highlights the need to develop stronger internal innovation capabilities to foster long-term sustainability. Building in-house expertise reduces dependency and strengthens the company's capacity for innovation-driven initiatives (Thompson et al., 2020).

In summary, the challenges in open innovation reflect both common and sector-specific obstacles that organizations face in implementing collaborative strategies. High-impact challenges, such as stakeholder alignment, cultural resistance, and bureaucratic hurdles, highlight the need for targeted interventions to create a more innovation-friendly environment (Chesbrough, 2003; Bertello et al., 2023).

Medium-impact challenges—related to agility, goal alignment, and technology integration—suggest that adopting technologies like AI and Big Data can streamline processes and improve innovation efficiency (Greco et al., 2022; Sopra Steria, 2023). Low-impact challenges represent foundational areas where incremental improvements could strengthen open innovation capabilities, supporting long-term sustainability through reduced dependency on consultancies (Lin, 2007). Together, these challenges illustrate a complex landscape that requires balancing traditional structures with the adaptive needs of open innovation, combining cultural adaptation, efficient processes, and sector-specific strategies (Randhawa et al., 2016; Chesbrough & Tucci, 2020).

4.1.4 Strengths and weaknesses identified

In evaluating insights from interviewees across various companies and sectors, a diverse range of strengths and weaknesses in open innovation practices emerged. These strengths underscore proactive approaches and strategic partnerships, reflecting an understanding of the benefits of external collaboration in driving innovation (Chesbrough, 2003). Conversely, structural and cultural barriers commonly impede open innovation efforts, with differences in objectives and internal

resistance posing significant challenges (Randhawa et al., 2016; Veneziani & Vaz, 2023).

a) Strengths

a. Proactive Engagement in Open Innovation: Many companies show a strong commitment to open innovation, particularly through partnerships with startups, universities, and other external entities, recognizing the value of external collaboration in driving innovation (Chesbrough, 2003; Greco et al., 2022).

b. Cross-Industry Partnerships: Organizations are increasingly forming partnerships across sectors to access a broader range of innovative ideas. Such cross-disciplinary exchanges allow companies to address complex challenges more effectively by leveraging knowledge from different fields (Holzmann, 2014; Veneziani & Vaz, 2023).

c. Industry-Specific Expertise: Interviewees noted that many companies possess deep sectoral knowledge, which enables tailored innovation solutions that meet specific industry needs, especially in highly specialized areas (Radziwon et al., 2023).

b) Weaknesses

a. Cultural Resistance to Innovation: Internal resistance within traditional departments is a frequently cited challenge, as it hinders the adoption and integration of new ideas, a common barrier in open innovation (Randhawa et al., 2016; Chesbrough & Tucci, 2020).

b. Bureaucratic Hurdles: Lengthy approval processes and bureaucratic structures slow down agile collaborations, particularly with startups, creating bottlenecks that delay project execution and decision-making (Bertello et al., 2023).

c. Limited Startup Ecosystem in Certain Sectors: In industries like energy, the scarcity of relevant startups restricts partnership opportunities, limiting innovation potential within these fields (Sopra Steria, 2023).

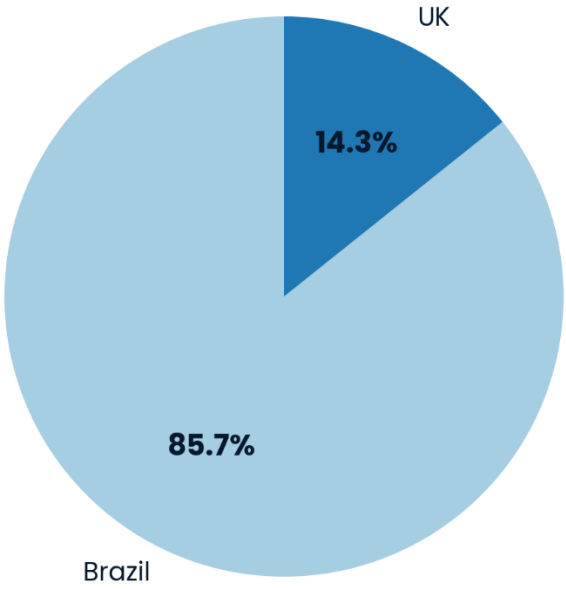
This analysis of strengths and weaknesses offers a comprehensive understanding of factors influencing open innovation across varied organizational contexts. Addressing these challenges—such as stakeholder alignment and agility limitations—while leveraging strengths like cross-sector partnerships and deep industry knowledge can enhance the effectiveness of open innovation initiatives across sectors, aligning with goals for sustainable innovation development (Greco et al., 2022; Bertello et al., 2023).

4.2 ANALYSIS OF QUANTITATIVE RESEARCH

The quantitative research was designed to capture structured insights into open innovation practices across 3 types of organizations. A total of 33 responses were collected using a questionnaire consisting of 16 Likert-scale questions, allowing respondents to indicate their level of agreement or the intensity of challenges and opportunities they face. Additionally, 4 closed-ended questions were included to gather specific data on the context and profile of the participating organizations.

The target audience for this survey included corporates, startups, and consultancy firms or innovation hubs from different sectors, located primarily in Brazil and the United Kingdom. Geographically, the respondent distribution was predominantly Brazilian, with 85.7% of responses coming from Brazil, while the United Kingdom accounted for 14.3% as it can be seen in Chart 3. This regional focus provides a nuanced view of open innovation practices in two distinct business contexts, offering insights into the cultural and structural particularities that influence the implementation of open innovation.

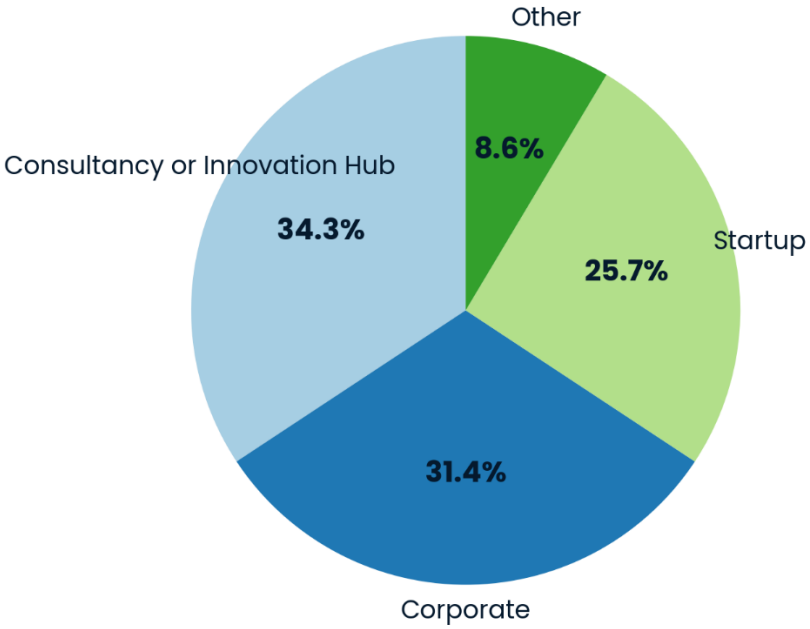
Chart 3 - Distribution of Questionnaire Participants by Country



Source: Author (2024)

Regarding the organizational profile, the survey revealed a balanced distribution among different types of companies: 34.3% of responses came from consultancies or innovation hubs, 31.4% from large corporations, and 25.7% from startups. This balanced representation allows for a robust comparative analysis, enabling the identification of differences and similarities in open innovation practices according to organization type. Additionally, a small segment (8.6%) of respondents fell into the “Other” category, which includes academic innovation specialists and independent professionals, thereby enriching the diversity of insights gathered.

Chart 4 - Distribution of Questionnaire Participants Organization Type



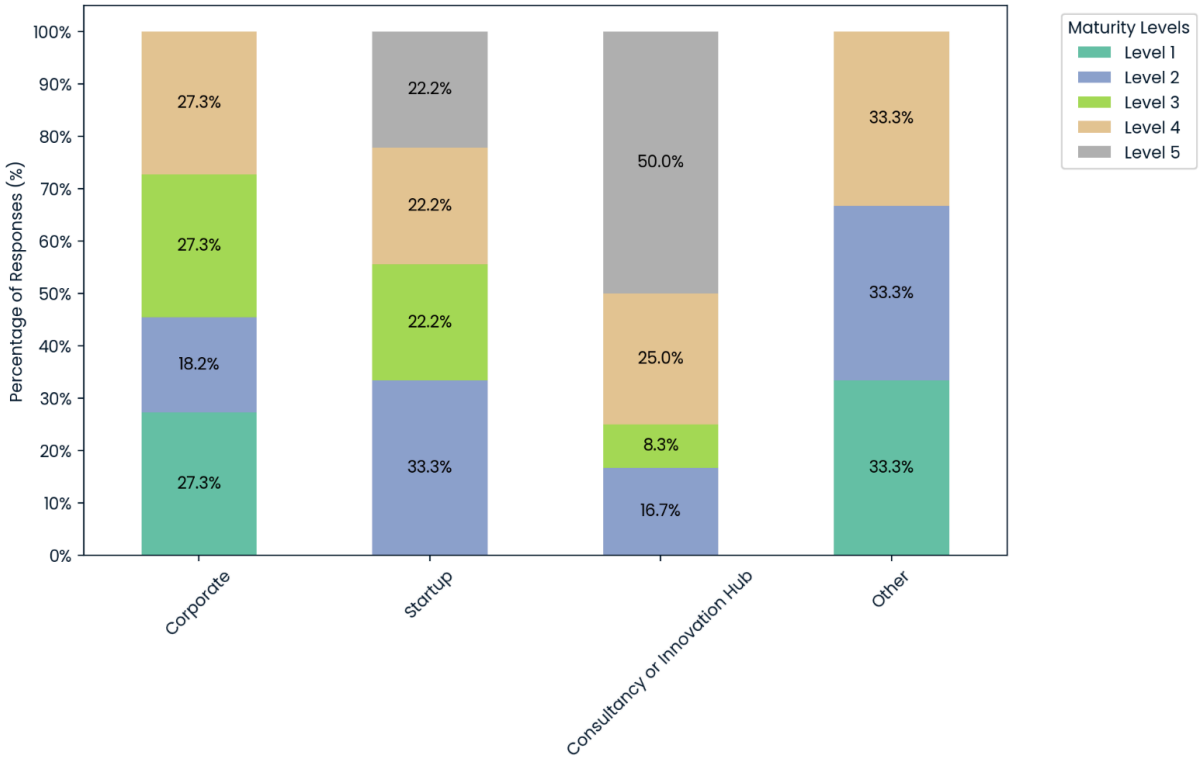
Source: Author (2024)

This presents an analysis of the survey data, exploring organizational engagement in open innovation practices. Key aspects such as organizational maturity, effectiveness, challenges, and the influence of emerging technologies and regulatory environments are examined to reveal patterns and insights into the current landscape of open innovation.

Higher maturity levels often correlate with more established OI frameworks and strategic alignment, supporting sustained innovation efforts (Chesbrough, 2003; Randhawa et al., 2016). This section explores these maturity levels to understand how they influence the effectiveness and challenges of OI practices across different organizations.

The analysis of maturity levels in open innovation (OI) across different organization types reveals a significant maturity gap between corporations and startups. According to the data, corporations do not reach the highest level of maturity (Level 5), indicating challenges in fully integrating OI into their strategic processes (Chart 5). Startups, however, display a broader distribution across all maturity levels, suggesting a higher adaptability and advancement in OI practices, possibly due to their flexible structures and innovation-oriented cultures. This pattern aligns with the maturity model established by Enkel et al., (2011), which was employed in the questionnaire to assess OI maturity levels.

Chart 5 - Maturity Levels in Open Innovation by Organization Type

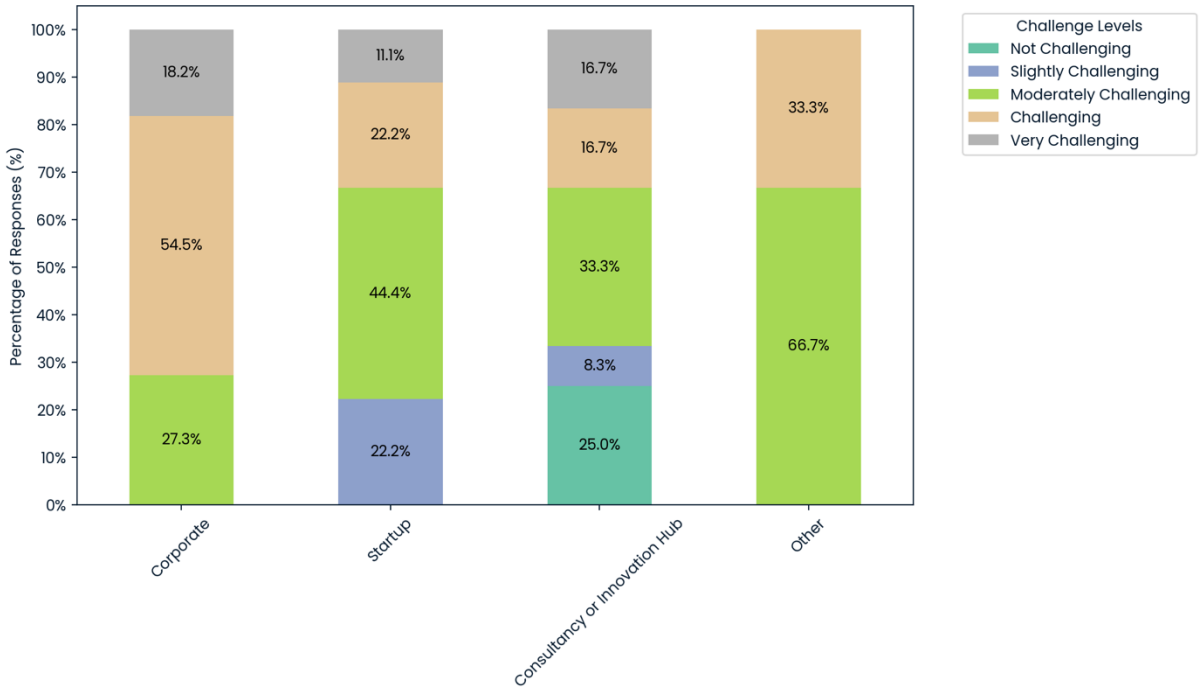


Source: Author (2024)

72.7% of corporations report OI as “challenging” or “very challenging” (Chart 6). This finding aligns with existing literature, which identifies structural and cultural barriers within large organizations as common impediments to OI adoption, often due to rigid hierarchies and a cautious approach to external collaboration (Souza, 2024). In contrast, consulting firms and innovation hubs perceive OI as less challenging. This may be attributed to their specialized knowledge and experience in managing OI processes, as well as their role in providing strategic support to larger corporations.

Their proficiency in OI processes allows them to navigate these challenges more effectively, thus reinforcing their value as support entities for companies aiming to enhance their OI maturity.

Chart 6 - Perceived Challenges in Open Innovation by Organization Type



Source: Author (2024)

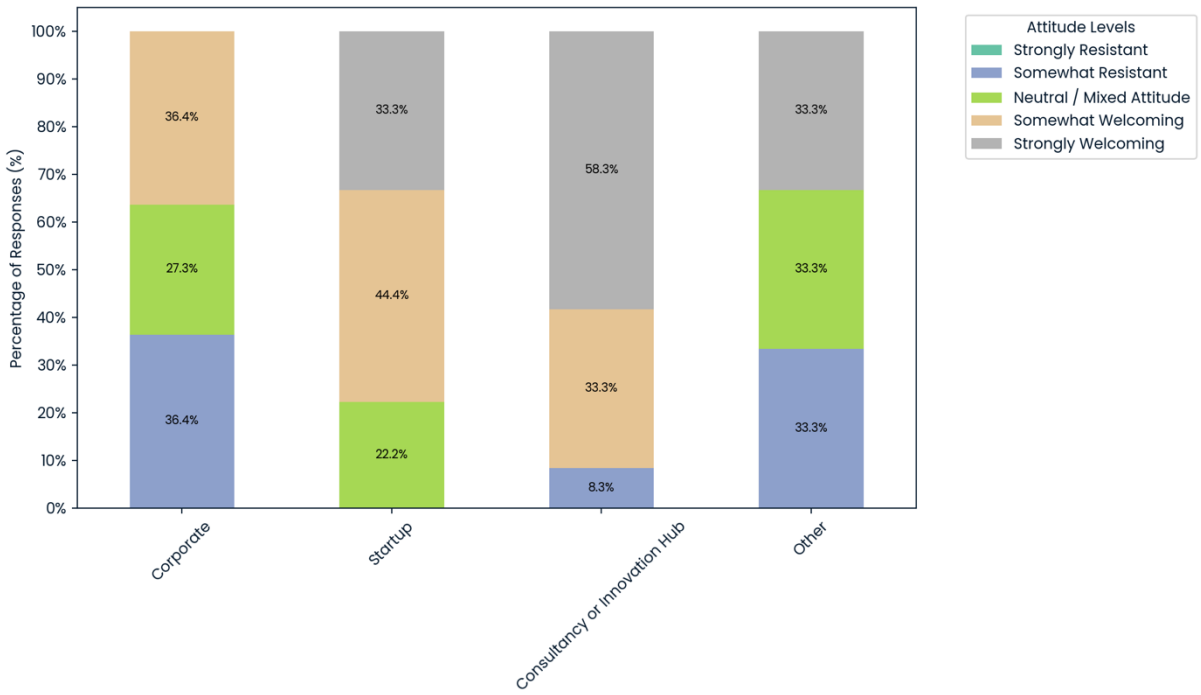
Startups, while not finding OI entirely without challenges, report lower difficulty levels, with 66.6% perceiving it as only slightly or moderately challenging. This suggests that startups are more accustomed to the iterative, risk-embracing nature of OI, as their operational frameworks generally accommodate flexibility and rapid adaptation (Almeida, 2023). This adaptability enables startups to engage in OI activities with fewer barriers, benefiting from a cultural alignment with innovative practices.

The data presented in Chart 7 highlights the differences in attitudes regarding the integration of external knowledge between corporations and startups. Specifically, 63.7% of corporations show a neutral or somewhat resistant attitude towards the adoption of external technologies and knowledge. This indicates a conservative approach, which is possibly driven by concerns regarding intellectual property, risk aversion, and the complexity of managing external partnerships in the corporate environment (Chesbrough, 2003). These results align with the findings from Enkel et

al., (2011), who explain that the maturity level of open innovation is influenced by the organization's culture and risk management practices, aspects explored in the present research.

Conversely, 67.7% of startups are somewhat or strongly welcoming towards external knowledge integration. The agility of startups and their innovation-centric culture facilitate these collaborative dynamics, making them more open to such integration (Blank, 2013). Additionally, innovation consulting firms and hubs display a naturally high level of openness, with 91.6% indicating a welcoming attitude, reflecting their accumulated expertise in managing open innovation processes, as analyzed in this study (Enkel et al., 2011).

Chart 7 - Company's Attitude Towards External Knowledge by Organization Type



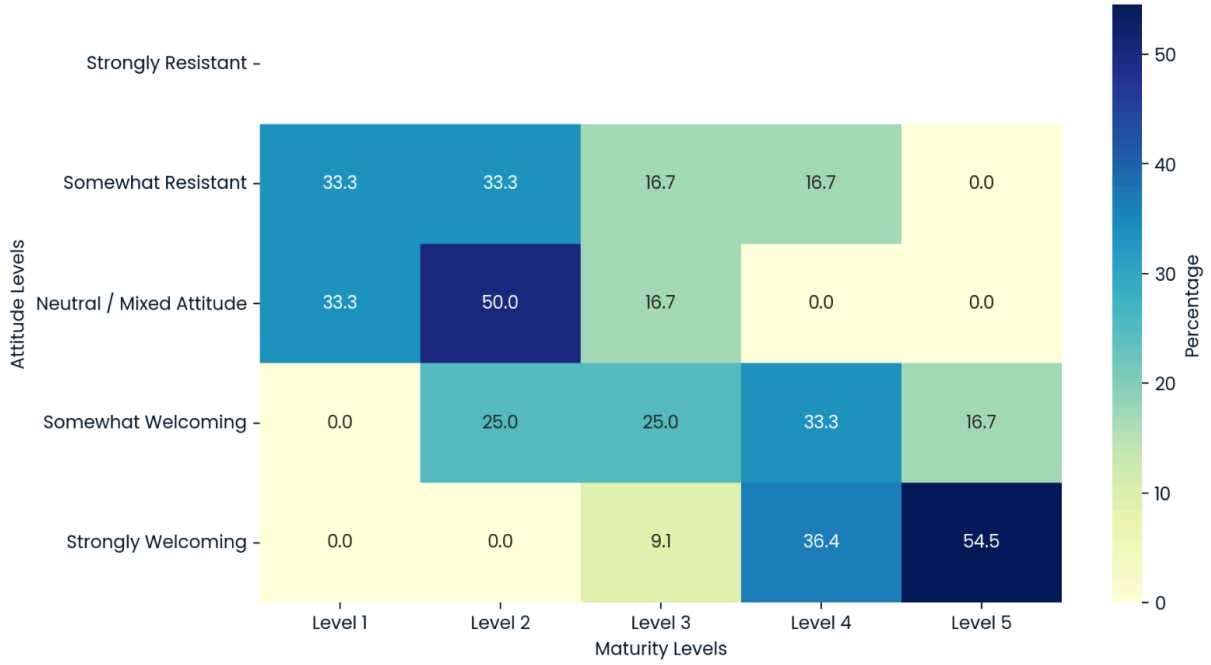
Source: Author (2024)

Chart 8 explores the relationship between maturity levels in open innovation and organizational attitudes toward the practice. Level 3 maturity is present in all attitudinal categories, suggesting that organizations at this stage are in a transitional phase regarding their openness to external innovation. It is notable that 90% of respondents who are highly receptive to open innovation belong to organizations with maturity levels 4 and 5. This indicates that organizations with well-structured and strategically aligned innovation processes are more capable of fostering a receptive

attitude. This observation aligns with the maturity model described by Enkel et al., (2011), further supported by the findings in this study, which indicate that higher maturity levels in open innovation are closely associated with a more favorable organizational culture towards innovation.

The perception of employees regarding open innovation also reflects the maturity levels of their organizations. There are no significant indications of strong resistance to open innovation among teams, suggesting a general openness, although this openness is more pronounced in organizations with higher maturity levels in open innovation, as detailed in this research (Chesbrough, 2006).

Chart 8 – Company's Attitude Towards External Knowledge by Maturity Level

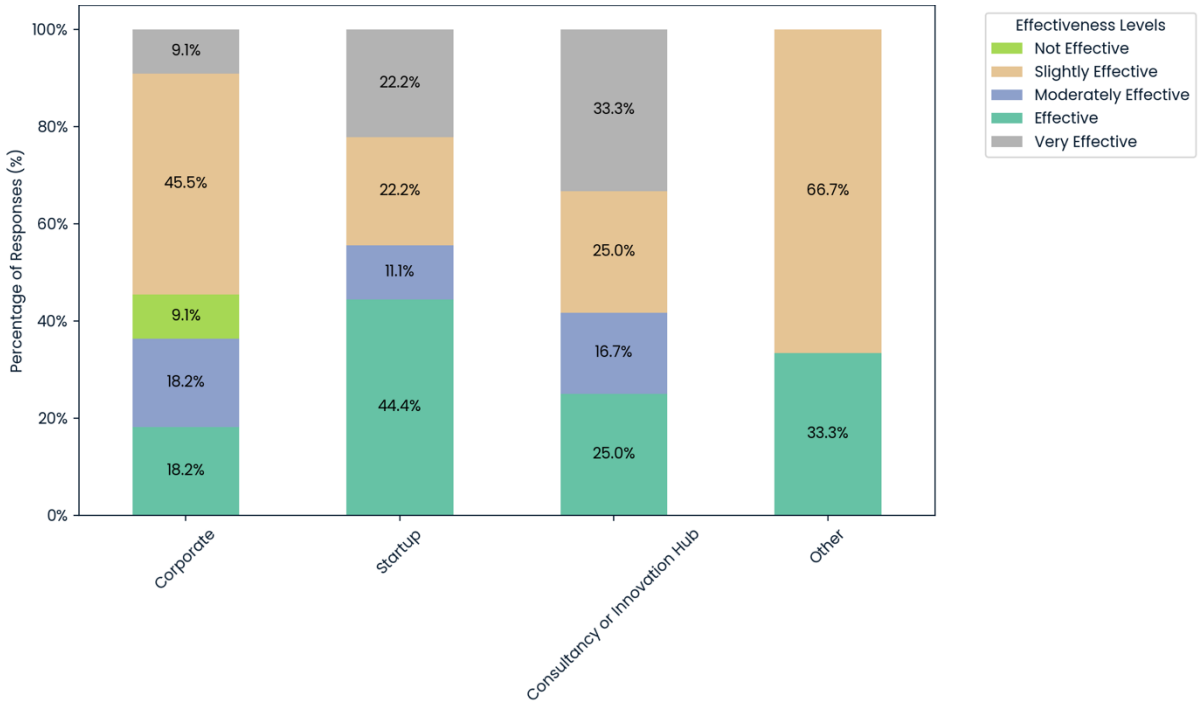


Source: Author (2024)

The effectiveness of open innovation practices varies based on the organization type and maturity level. In Chart 9, 54.6% of corporations rate open innovation as either ineffective or only slightly effective, with 45.7% of these organizations being at maturity levels 1 or 2. This finding is consistent with the literature, which suggests that higher levels of maturity in open innovation tend to yield better results due to more structured processes and strategic integration (Chesbrough, 2003; Enkel et al., 2011). Chart 10 further reinforces this point, showing that organizations with maturity levels 4 and 5 report higher effectiveness in their open

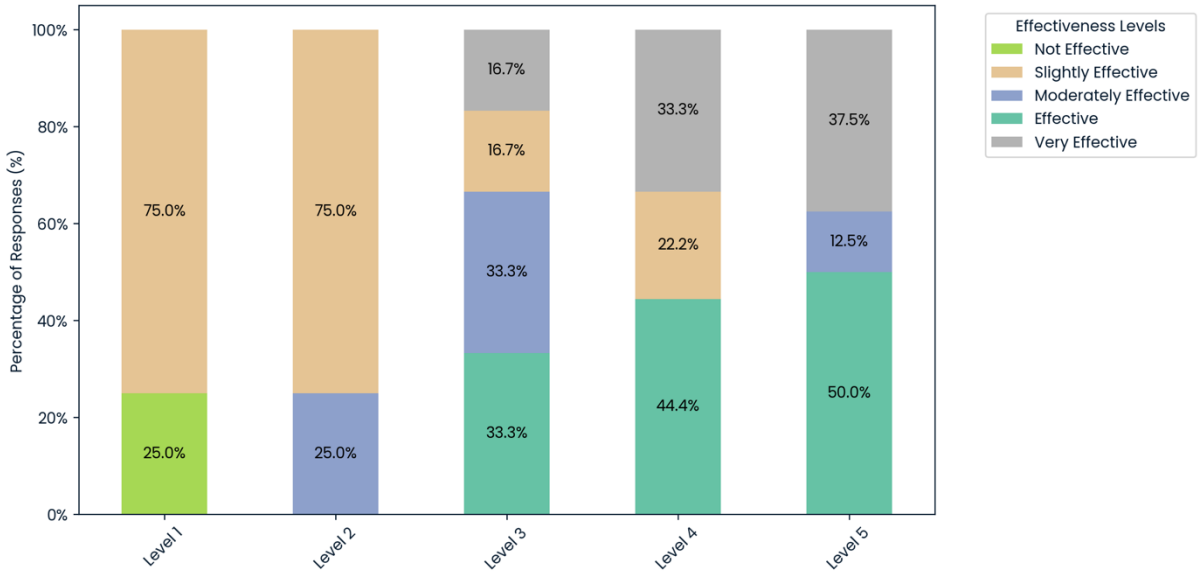
innovation practices. This observation is also supported by the findings in this study, emphasizing that well-structured innovation practices are fundamental for success in open innovation (Adner, 2006).

Chart 9 - Effectiveness in OI activities by Organization Type



Source: Author (2024)

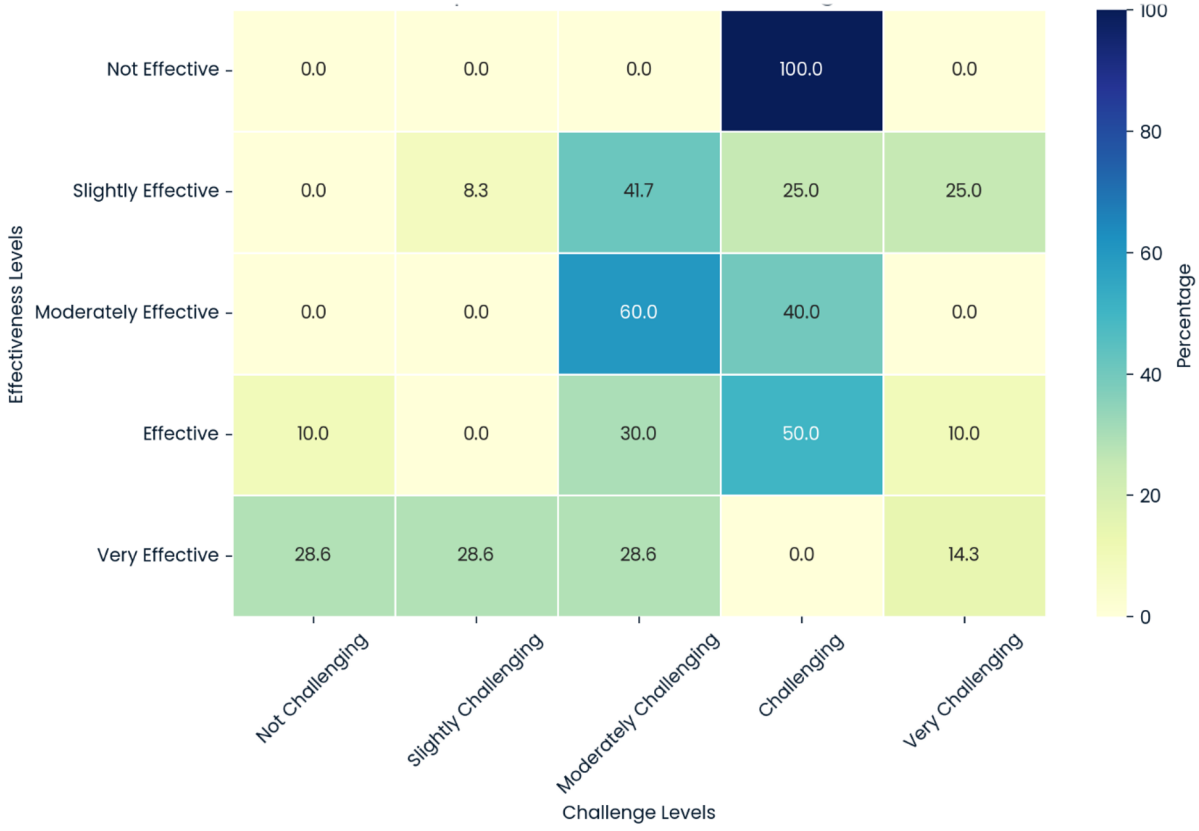
Chart 10 - Effectiveness in OI activities by Maturity Level



Source: Author (2024)

The analysis of Chart 11 reveals an interesting observation: there is no direct correlation between the perceived difficulty of implementing open innovation and its effectiveness. Some respondents face significant challenges but still achieve high effectiveness in open innovation activities, whereas others find open innovation less challenging but do not report strong results. This suggests that challenges do not necessarily limit success. As discussed in this study, companies with higher maturity levels in open innovation may face complex challenges due to ambitious goals but are better positioned to achieve effective results due to their structured approaches (Gawer & Cusumano, 2014; Schilling, 2020).

Chart 11 – Effectiveness in OI activities by Level of Challenge in OI

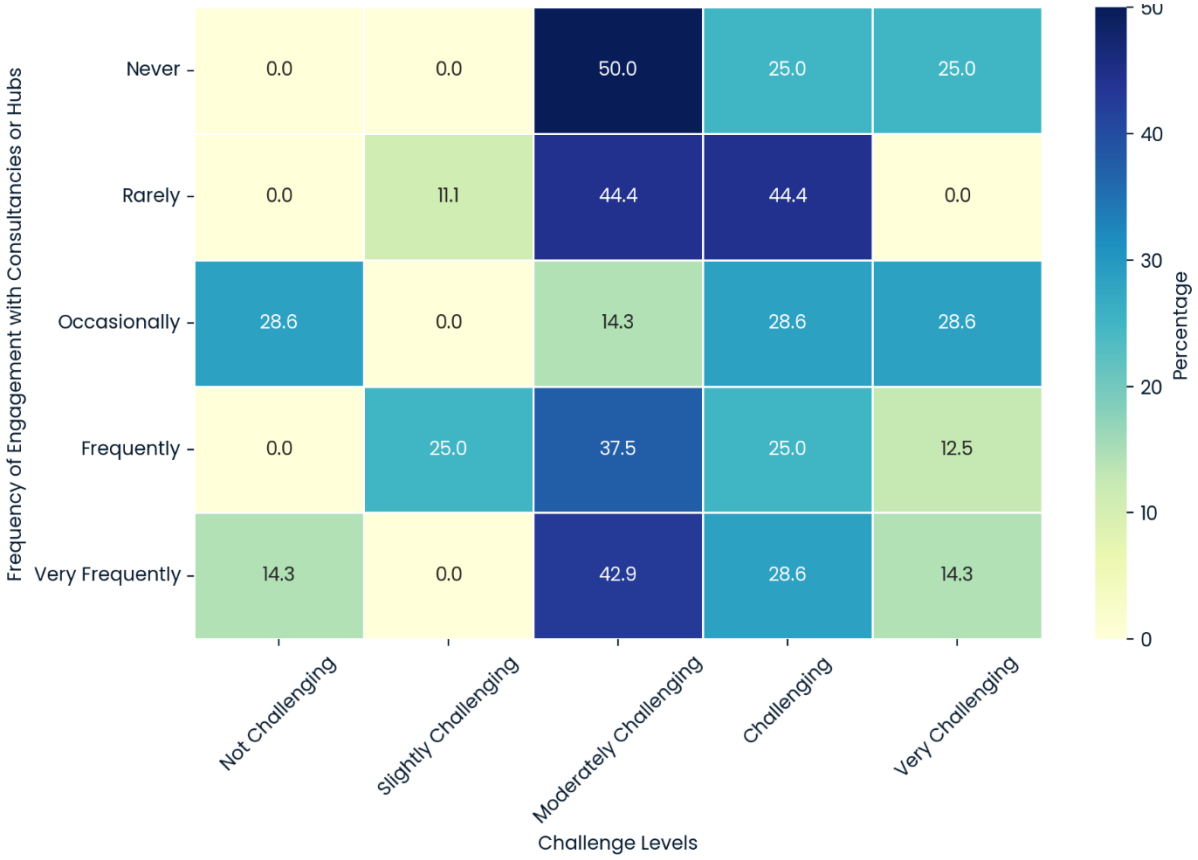


Source: Author (2024)

When analyzing respondent engagement levels in open innovation activities, Chart 12 shows that organizations with limited interaction with consulting firms or innovation hubs tend to report higher challenges in OI activities. However, only 18.2% of corporations and 44.4% of startups reported engagement with consultancies or hubs during the innovation process (Chart 13). This lack of engagement could explain some

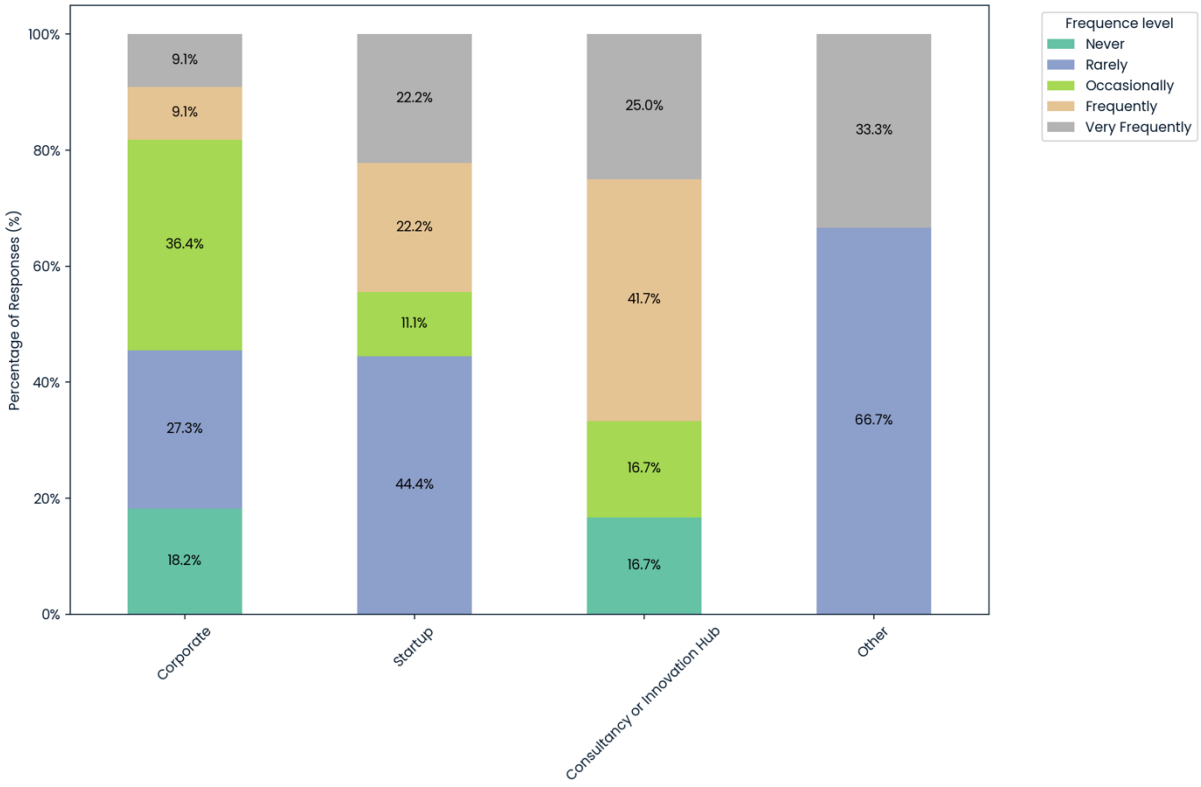
of the challenges reported, as consultancies often provide valuable support to enhance OI processes, as described in this study (Chesbrough & Brunswicker, 2014; Gassmann et al., 2010).

Chart 12 - Engagement with Innovation Stakeholders by Challenge Level



Source: Author (2024)

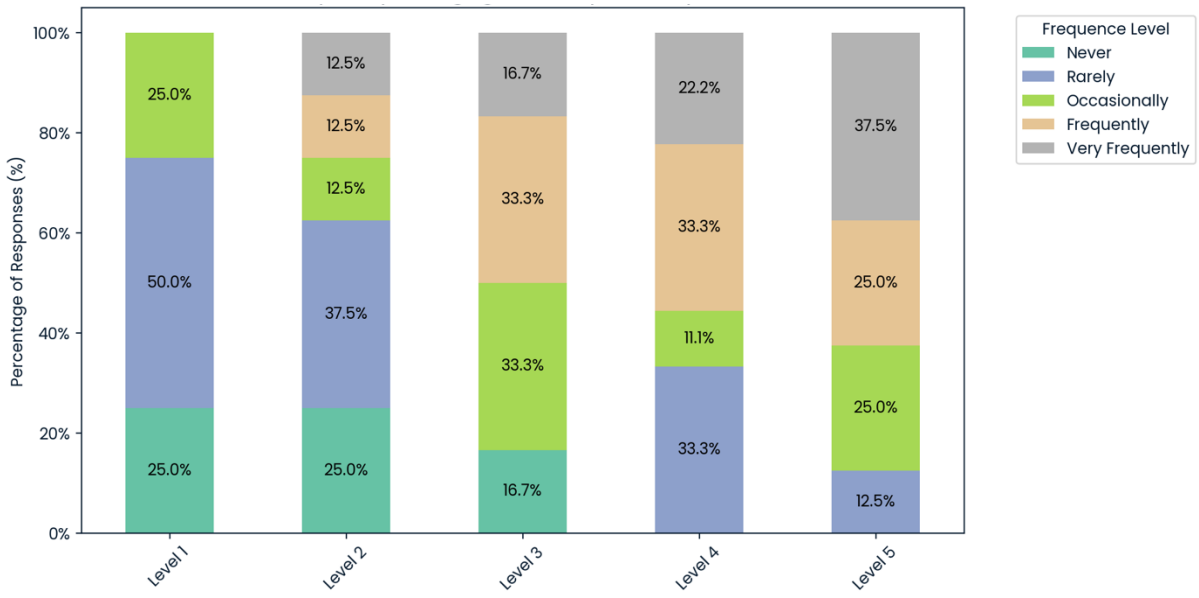
Chart 13 - Engagement with Innovation Stakeholders by Organization Type



Source: Author (2024)

Organizations with higher maturity levels in open innovation show a greater frequency of engagement with consulting firms and innovation hubs, as illustrated in Chart 14. At maturity level 5, 62.5% of respondents report frequent or very frequent engagement with these stakeholders. The high frequency of interaction at advanced maturity levels indicates that consulting firms play a fundamental role in providing strategic support for organizations seeking to consolidate and refine their open innovation processes, as discussed in this research (Chesbrough, 2020).

Chart 14 - Engagement with Consulting Firms by Maturity Level

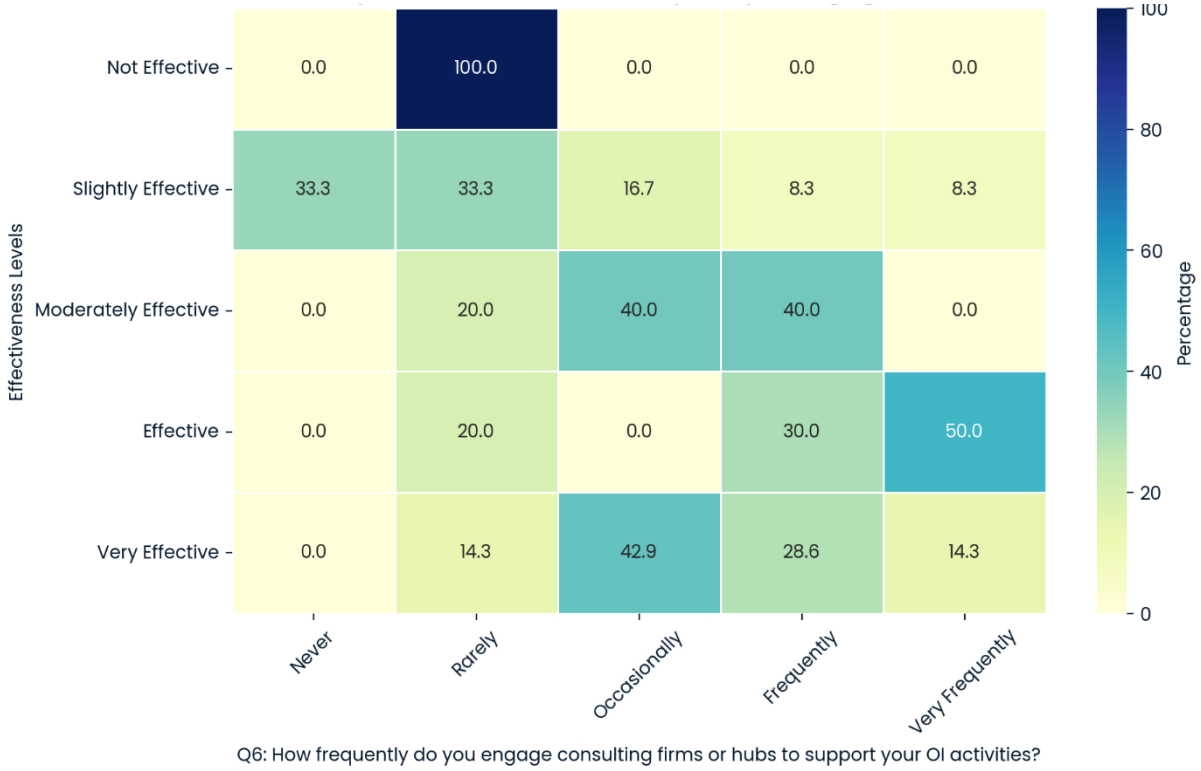


Source: Author (2024)

Chart 15 confirms the positive impact of frequent engagement with consulting firms on open innovation effectiveness. Only 16.6% of respondents reporting low effectiveness had frequent or very frequent engagement with consultancies. In contrast, 80% of respondents who considered OI effective, and 93.7% of those who considered it highly effective, maintained occasional or more frequent engagement with consultancies. These data reinforce the hypothesis that consultancies and innovation hubs play an essential role in successful open innovation practices, particularly in organizations with maturity levels 4 and 5, as discussed in this research (Bigliardi et al., 2020; Chesbrough, 2006).

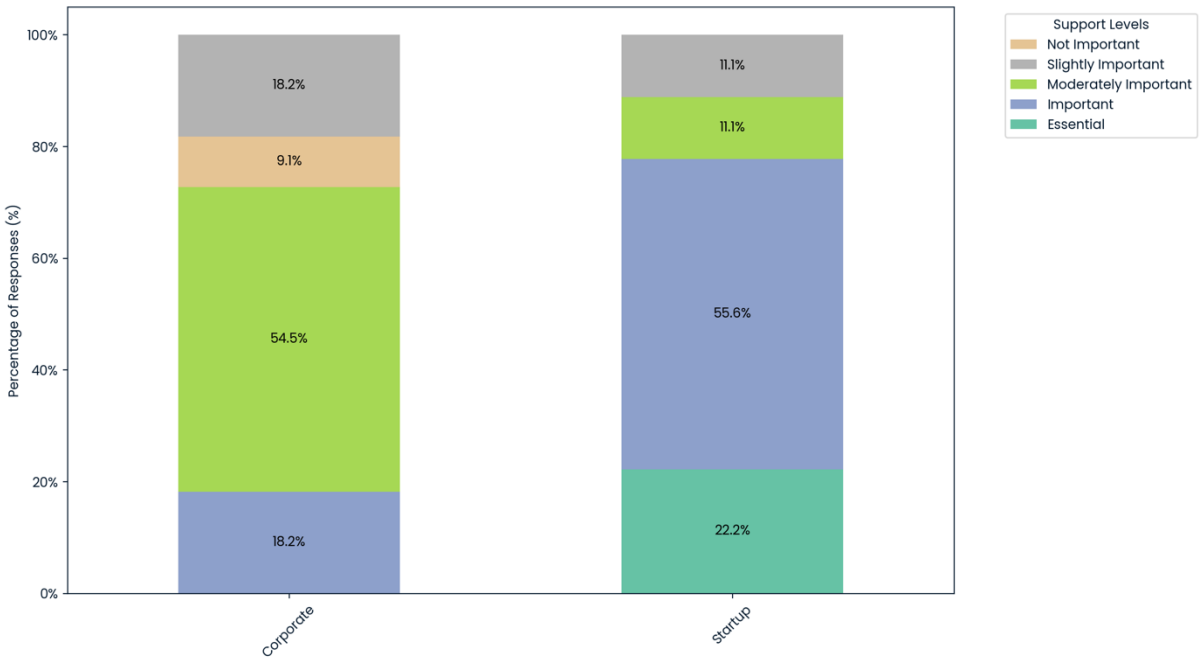
Additionally, startups perceive the support from consultancies as more valuable, with a higher percentage rating it as important for the success of their open innovation initiatives. This result can be explained by the limited internal resources of startups, making external knowledge crucial for overcoming strategic and operational challenges in OI (Ries, 2011; Enkel et al., 2011).

Chart 15 - Effectiveness and Frequency of Engagement with Consultancies



Source: Author (2024)

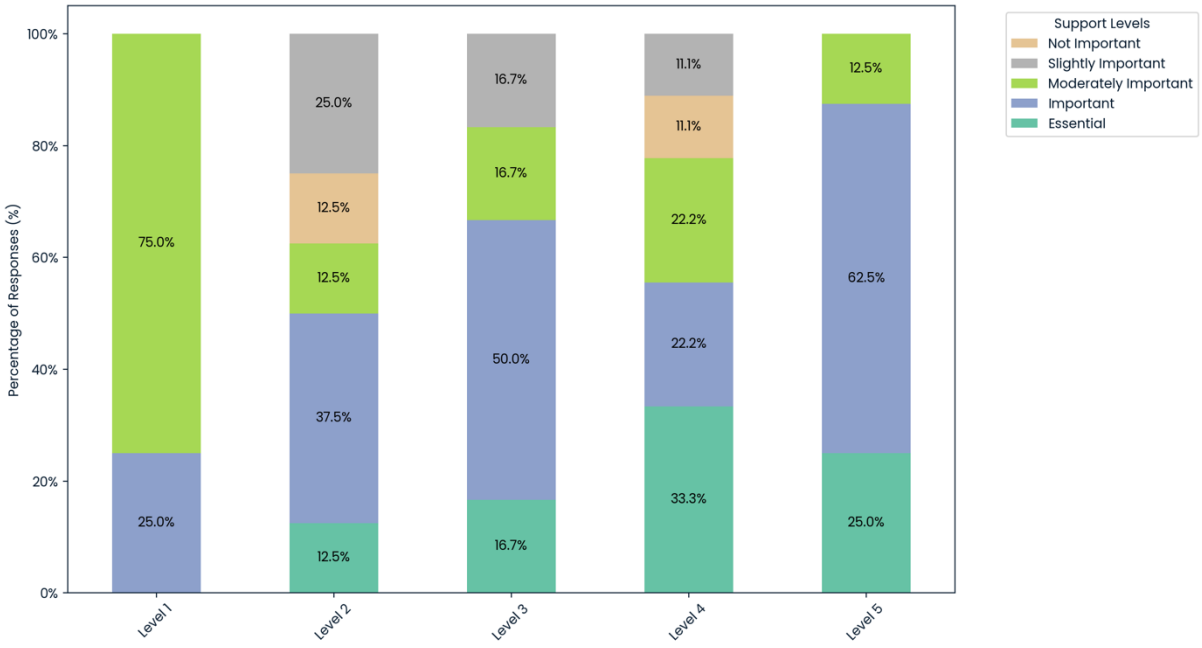
Chart 16 - Importance of Consulting Support by Organization Type



Source: Author (2024)

Overall, organizations at maturity levels 4 and 5 value the support of innovation consulting firms the most, as shown in Chart 17. This reflects the role of consultancies in providing specialized insights and guidance that become increasingly valuable as organizations advance in maturity and face more complex innovation challenges. The analysis in this study corroborates these findings, highlighting the importance of consulting engagement for success in open innovation at advanced maturity levels (Tidd & Bessant, 2013; Chesbrough, 2020).

Chart 17 - Importance of Consulting Support by Maturity Level

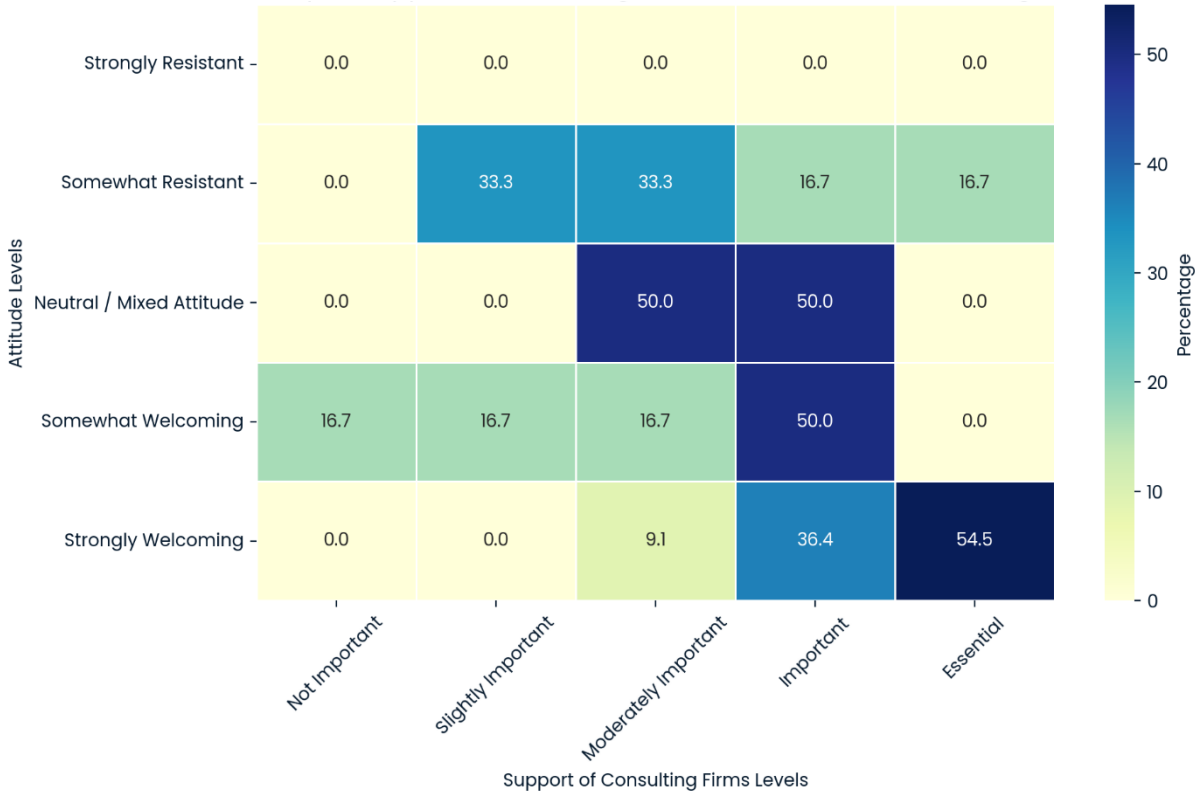


Source: Author (2024)

Among respondents who are strongly welcoming towards open innovation, 90.9% consider consulting firm support to be important or essential in the OI process. Notably, of these, 54.5% view such support as essential. This strong endorsement underscores the critical role that consulting firms play in guiding organizations toward more mature OI practices. Organizations that are highly receptive to OI likely benefit from consulting firms' structured methodologies and insights, which facilitate a faster adoption of open innovation and help foster a culture that is increasingly conducive to external collaboration. As demonstrated in Chart 18, these findings align with existing literature emphasizing that consulting support is instrumental in building the foundational culture and operational frameworks necessary for effective and

sustainable open innovation (Chesbrough, 2006; Gassmann et al., 2010; Tidd & Bessant, 2013).

Chart 18 - Consulting Firms Support by Attitude Towards External Knowledge

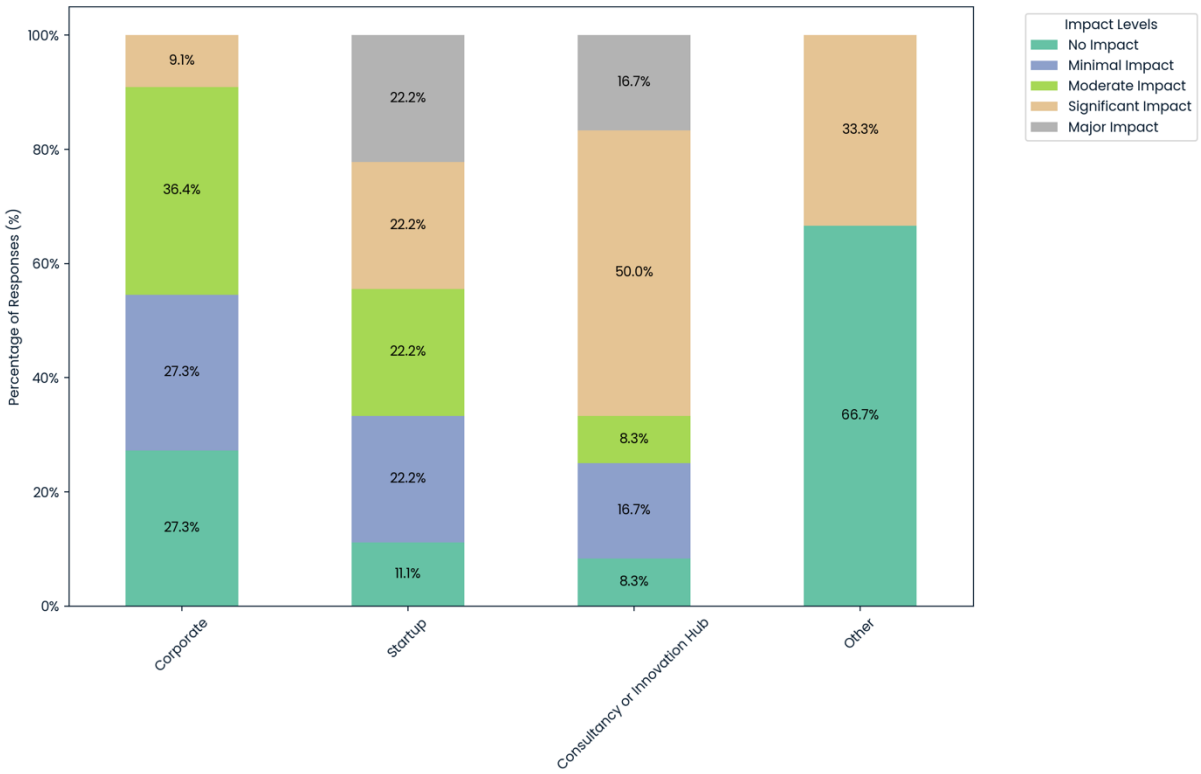


Source: Author (2024)

Most respondents involved in open innovation, including both corporations and startups, do not perceive significant impacts from global policies on their activities. In contrast, consulting firms and innovation hubs view these policies as highly impactful. Specifically, 54.6% of corporations report that global policies have minimal or no impact, a perspective shared by 33.3% of startups. This trend is even more pronounced with international regulations: 63.6% of corporations report minimal or no impact from international policies, indicating that large organizations may perceive their operations as less sensitive to global regulatory shifts or are more established in complying with existing frameworks. Among startups, 33.3% also perceive minimal or no impact; however, an equal proportion (33.3%) views these international policies as having significant impacts, suggesting that startups may be more directly affected by shifts in the international regulatory environment due to their agility and tendency toward cross-border innovation activities.

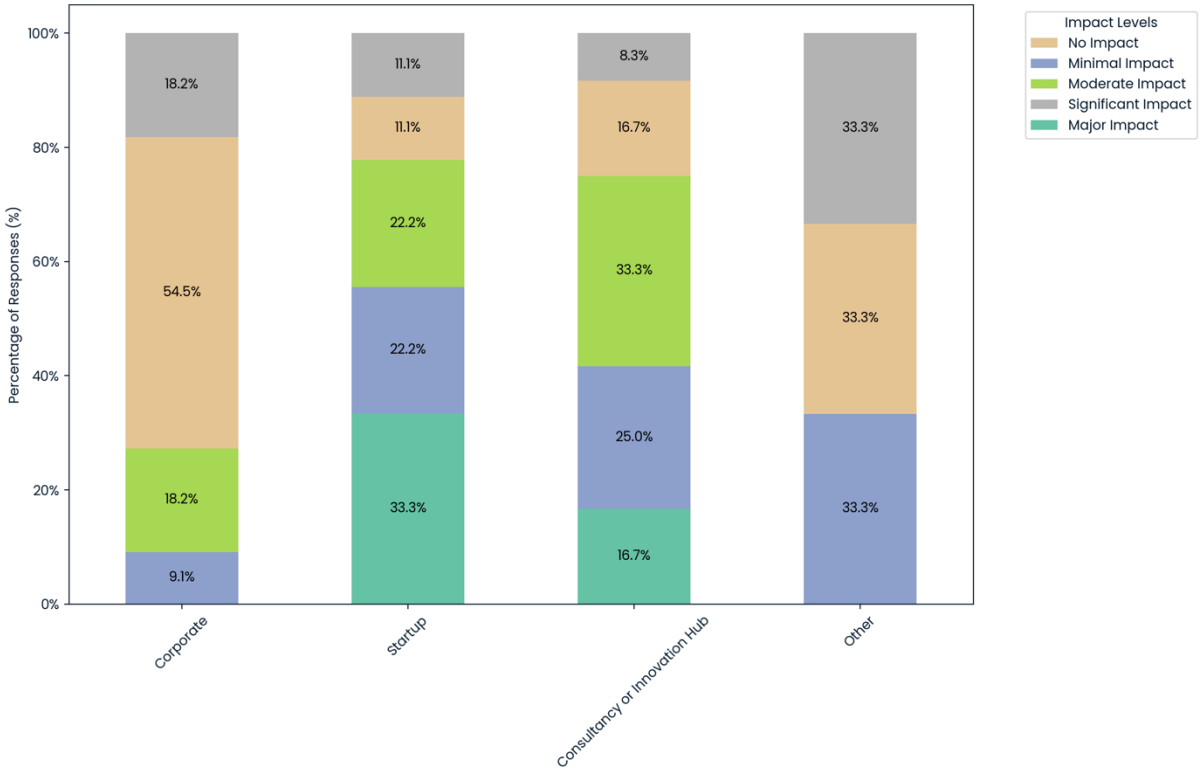
Consulting firms and innovation hubs, however, show a different perspective, with 66.7% rating local policies as having a significant or major impact on their operations. For international regulations, only 25% consider the impact to be significant or major, indicating that these entities may be more specialized and focused within the regulatory framework of their primary country of operation. These varied perspectives highlight the influence of national frameworks, such as Brazil's *Marco Legal das Startups*, which aims to foster a more favorable environment for innovation by reducing bureaucratic barriers and encouraging partnerships between startups and large corporations (Veneziani; Vaz, 2023). These findings, depicted in Chart 19 and Chart 20, align with existing literature that suggests smaller, more adaptable firms often feel the effects of international regulations more acutely than larger corporations (Chesbrough & Brunswicker, 2014; OECD, 2015; Sant'ana et al., 2020).

Chart 19 - Impact of Local Policies on Open Innovation by Organization Type



Source: Author (2024)

Chart 20 - Impact of International Regulations by Organization Type



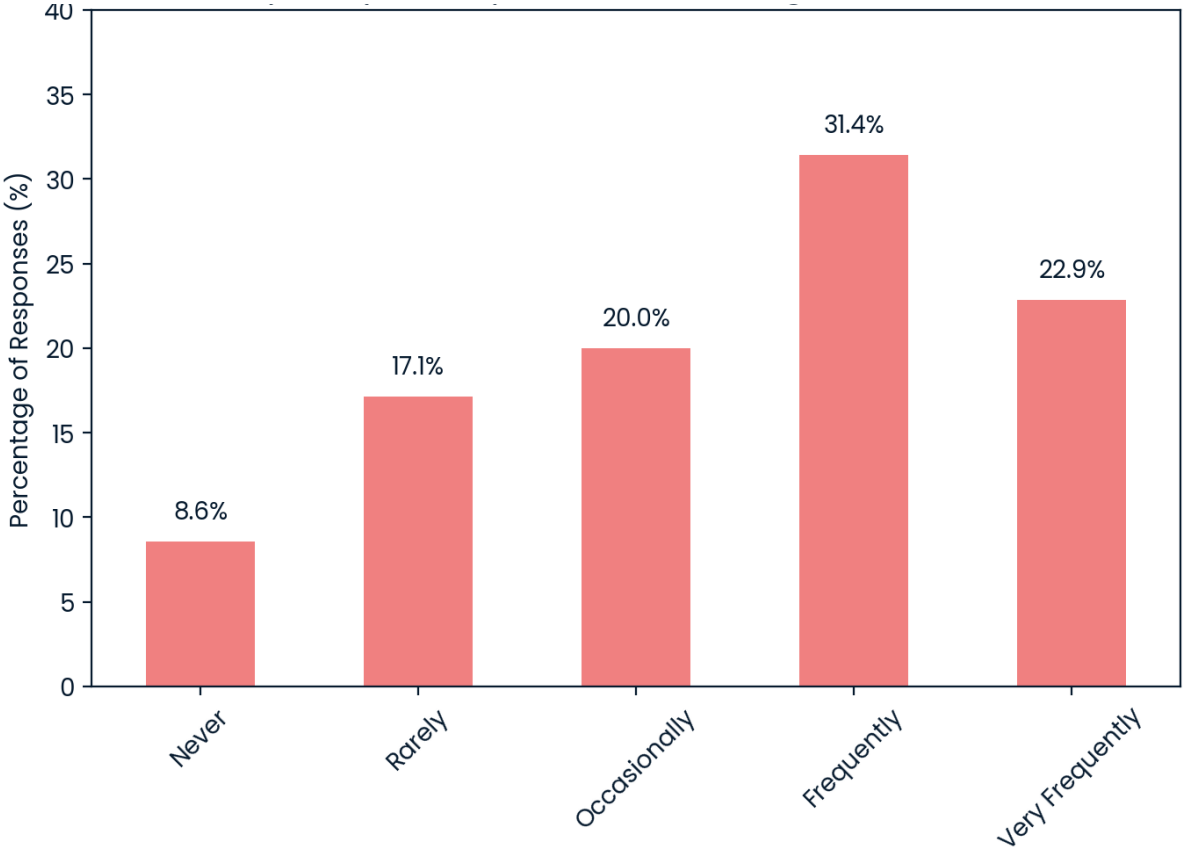
Source: Author (2024)

The data analysis reveals that 54.1% of respondents frequently or very frequently utilize AI in their open innovation (OI) activities, with interview insights indicating AI's role in startup scouting and challenge refinement, thus supporting more targeted innovation processes (Chart 21). This finding aligns with the literature, which suggests that advanced technological tools can streamline OI practices and enhance the identification of viable partnerships and solutions (Chesbrough, 2003; Tidd & Bessant, 2013).

When comparing AI usage by organization type, startups and consultancies or innovation hubs are the most frequent users (Chart 22). This trend indicates that organizations with flexible structures or specialized knowledge in OI are more likely to adopt AI, aligning with findings from Chesbrough & Brunswicker (2014) that highlight the relationship between organizational openness and the adoption of advanced tools. Notably, 33.3% of startups and 58.3% of consultancies report frequent AI usage, which reflects their proactive engagement with cutting-edge technologies to support innovation efforts.

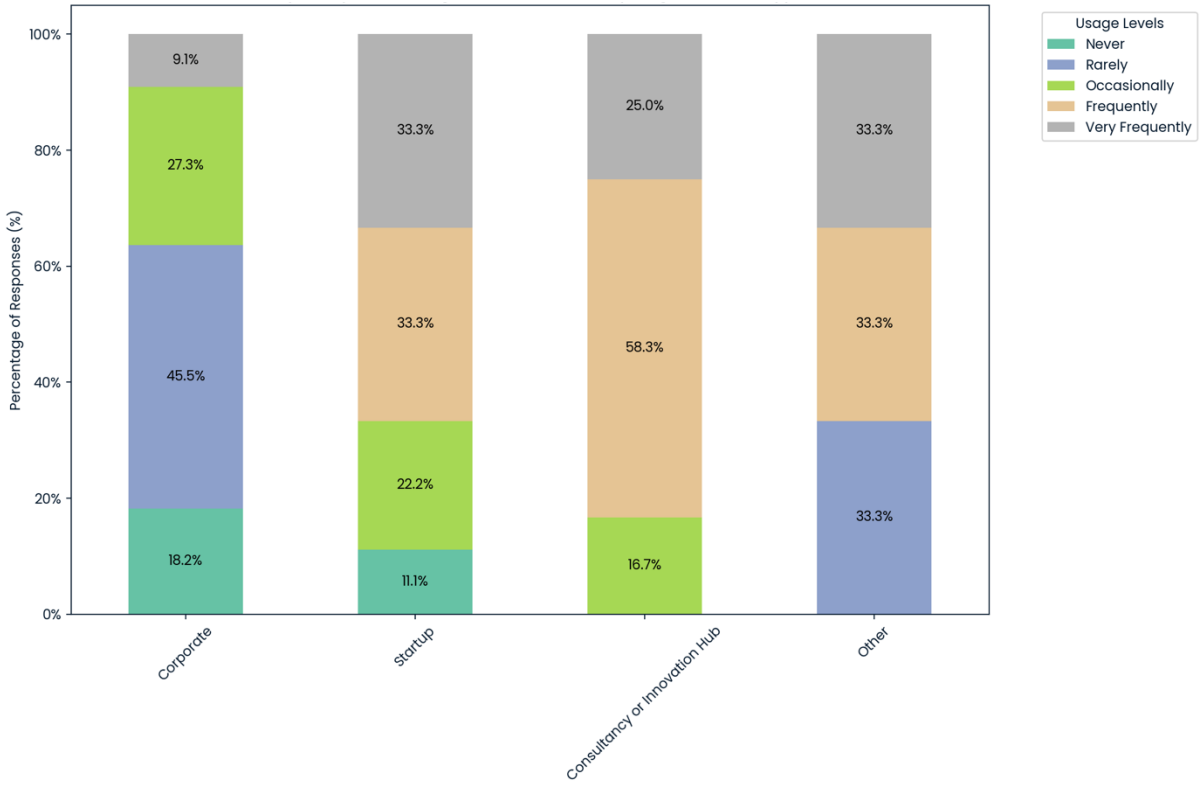
The analysis by maturity level reveals a significant correlation between high maturity in OI and frequent AI usage. Specifically, 66.6% of respondents at maturity level 4 and 87.5% at maturity level 5 report frequent or very frequent AI usage in OI activities, illustrating that more mature organizations are better equipped to integrate AI into their innovation processes (Chart 23). This supports the maturity model described by Enkel et al., (2011), which posits that higher maturity in OI is associated with better-structured processes and a greater capacity for advanced tool adoption.

Chart 21 - Frequency of AI Usage in OI Activities



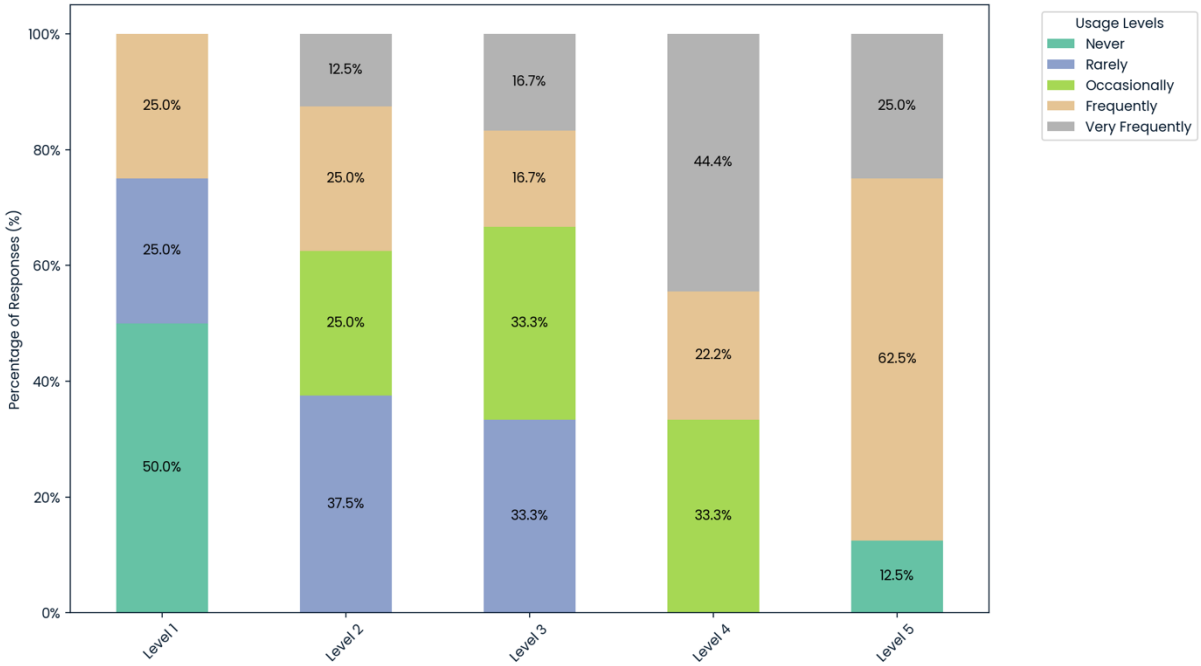
Source: Author (2024)

Chart 22 - Frequency of AI Usage in OI Activities by Organization Type



Source: Author (2024)

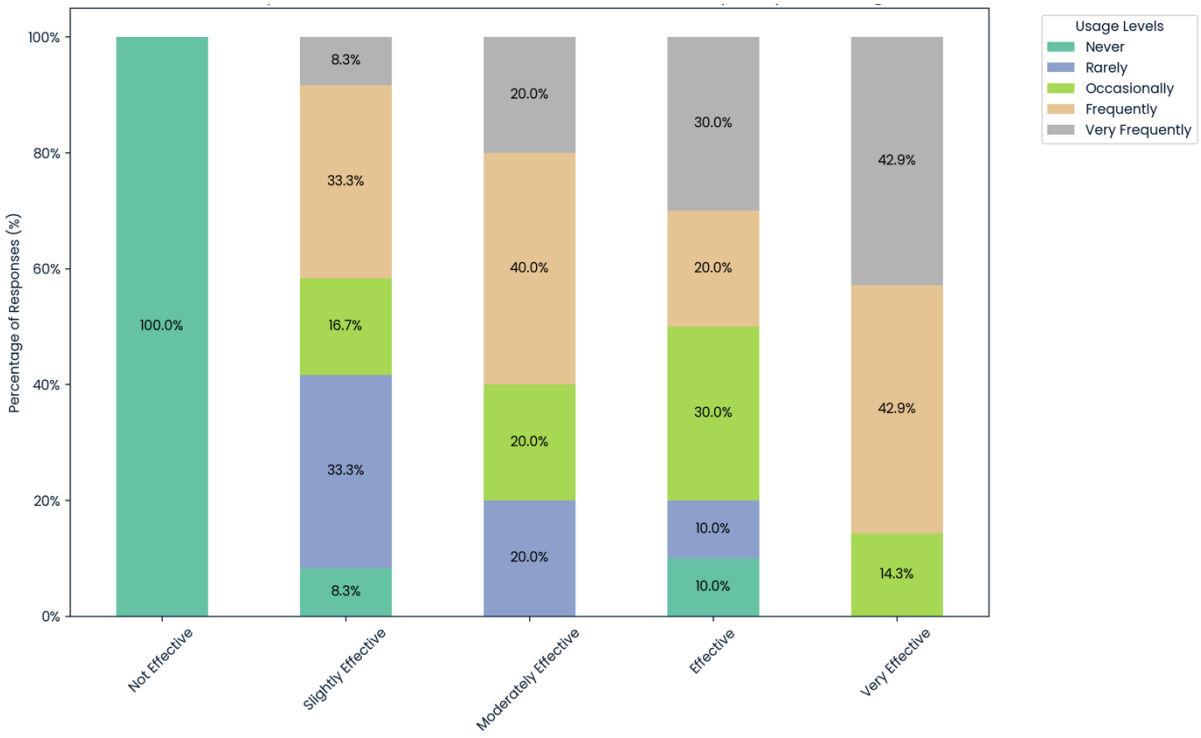
Chart 23 - Frequency of AI Usage in OI Activities by Maturity Level



Source: Author (2024)

When examining the relationship between the effectiveness of OI activities and the frequency of AI usage, the data shows that 85.8% of respondents with highly effective OI activities use AI frequently or very frequently (Chart 24). This correlation suggests that organizations achieving greater OI effectiveness often leverage AI as part of their innovation strategies, an observation consistent with literature that emphasizes the role of technology in enhancing innovation outcomes (Schilling, 2020; Chesbrough, 2020). This pattern aligns with previous findings, where higher maturity levels and structured OI practices are linked to both effective results and increased technology utilization (Gassmann et al., 2010).

Chart 24 - Effectiveness of OI Activities and Frequency of AI Usage

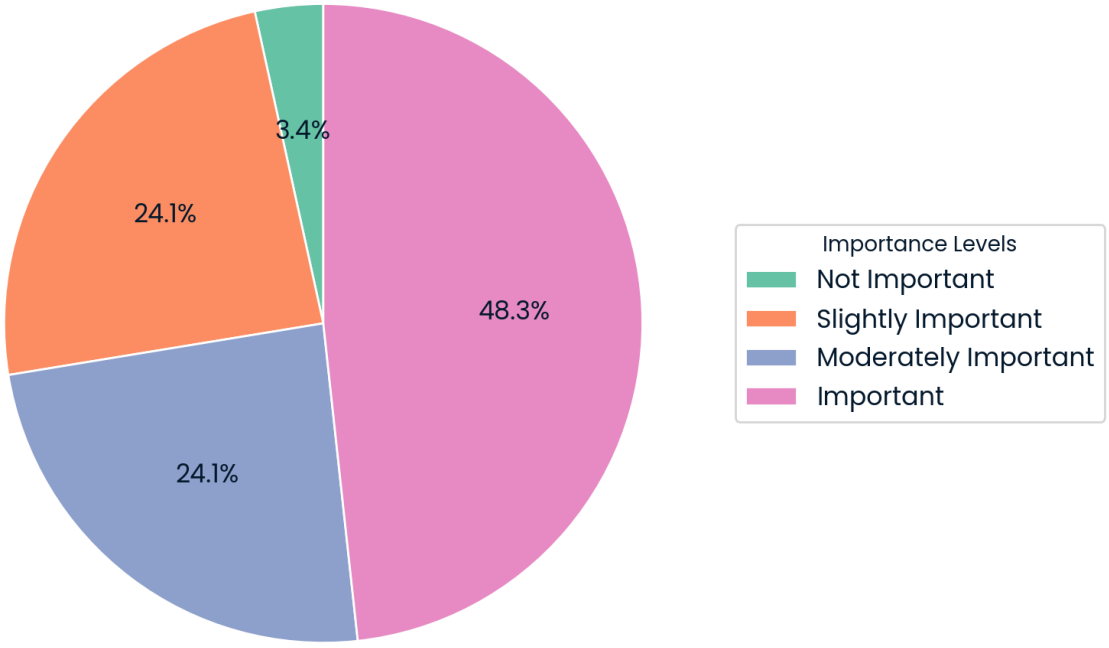


Source: Author (2024)

The data in Chart 25 shows that while 48.3% of respondents consider AI to be “important” in open innovation activities, none of them view it as “essential”. This suggests that, while AI is valued, it may still be perceived primarily as a supportive tool rather than a critical component in OI strategies. The qualitative analysis reinforces this, indicating that AI is mainly utilized to accelerate processes and assist with operational tasks rather than drive strategic decision-making. This observation aligns with existing literature, which often highlights AI’s role in enhancing efficiency rather

than fundamentally transforming innovation strategy (Chesbrough, 2003; Tidd & Bessant, 2013).

Chart 25 - Perceived Importance of AI in Open Innovation Activities



Source: Author (2024)

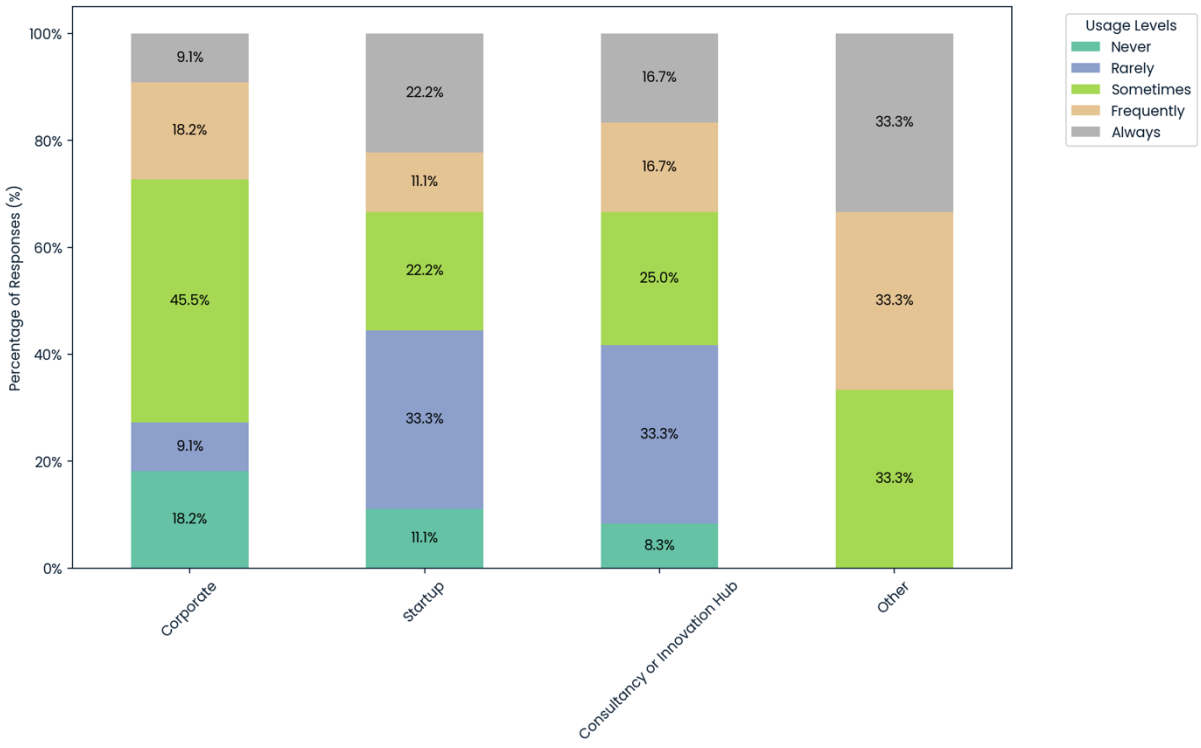
Regarding Big Data usage in open innovation (OI) activities, the data reveals that the most frequent users are startups and consultancies or innovation hubs, which is indicative of their reliance on comprehensive market data to ensure OI success (Chart 26). This aligns with findings from Chesbrough (2003) and Enkel et al., (2011), who emphasize that more adaptable and market-responsive organizations tend to leverage data-driven insights to enhance their OI strategies.

Chart 27 illustrates a strong correlation between higher maturity levels and increased Big Data usage. Specifically, 50% of organizations at maturity level 5 and 44% at level 4 use Big Data frequently or always in their OI activities. This trend supports the perspective that organizations with advanced maturity levels in OI are better positioned to integrate complex data into their innovation processes, as suggested by Gassmann et al., (2010) and Chesbrough & Brunswicker (2014).

When analyzing Big Data usage by effectiveness, Chart 28 shows no exact correlation between Big Data utilization and OI effectiveness. This suggests that while

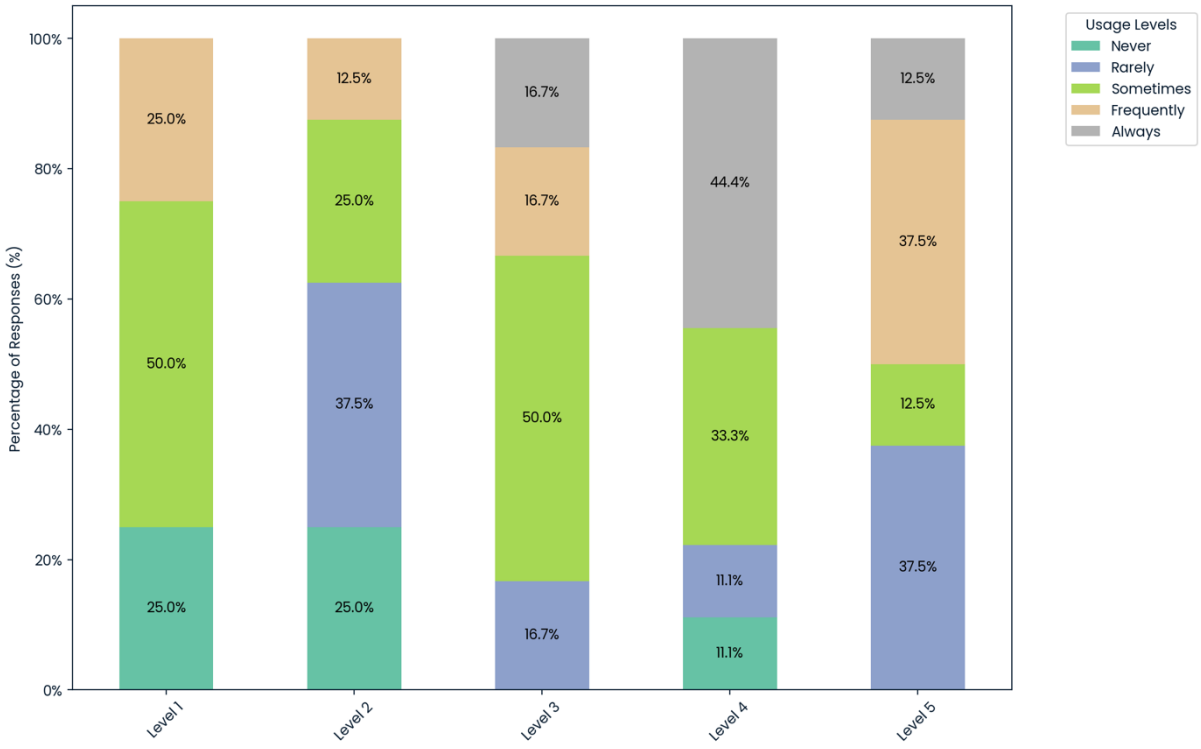
Big Data can accelerate and facilitate operational tasks in OI, it may not directly impact effectiveness without a structured framework for its application. This observation aligns with findings by Bigliardi et al., (2020) and Tidd & Bessant (2013), who propose that the strategic application of tools like Big Data within a well-defined OI process is essential for yielding substantial results.

Chart 26 - Frequency of Big Data Usage in OI Activities by Organization Type



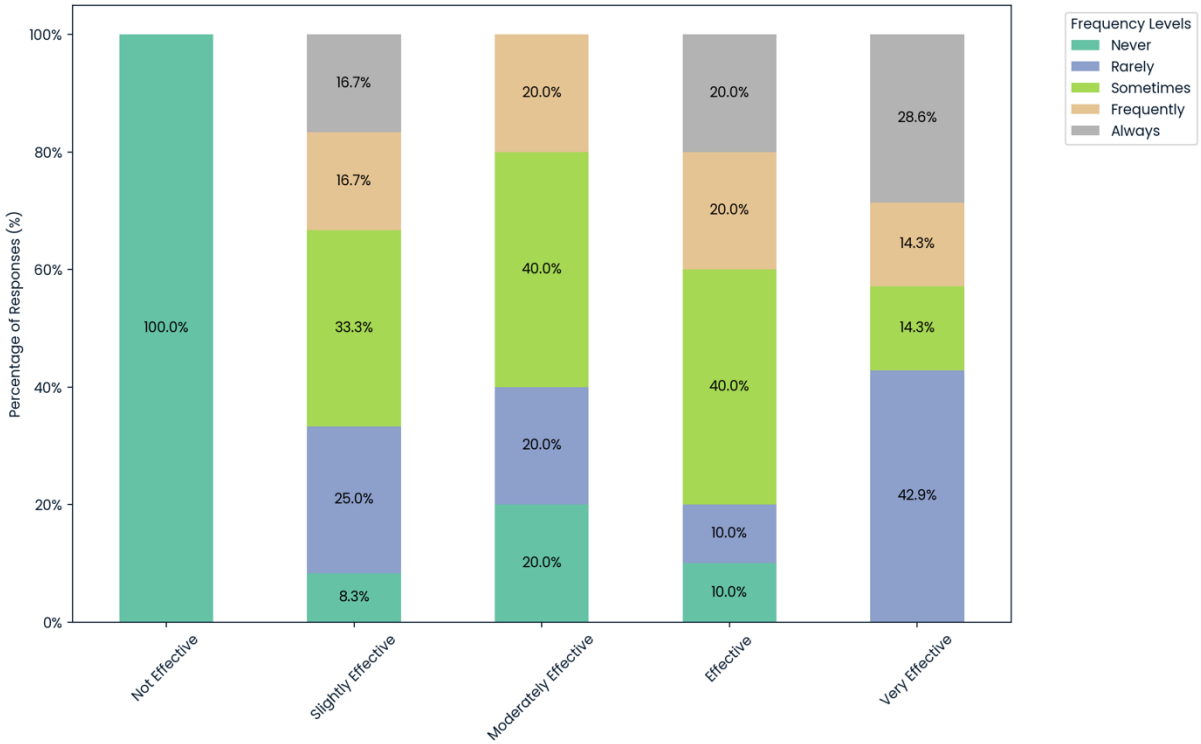
Source: Author (2024)

Chart 27 - Frequency of Big Data Usage in OI Activities by Maturity Level



Source: Author (2024)

Chart 28 - Frequency of Big Data Usage in OI Activities by Effectiveness



Source: Author (2024)

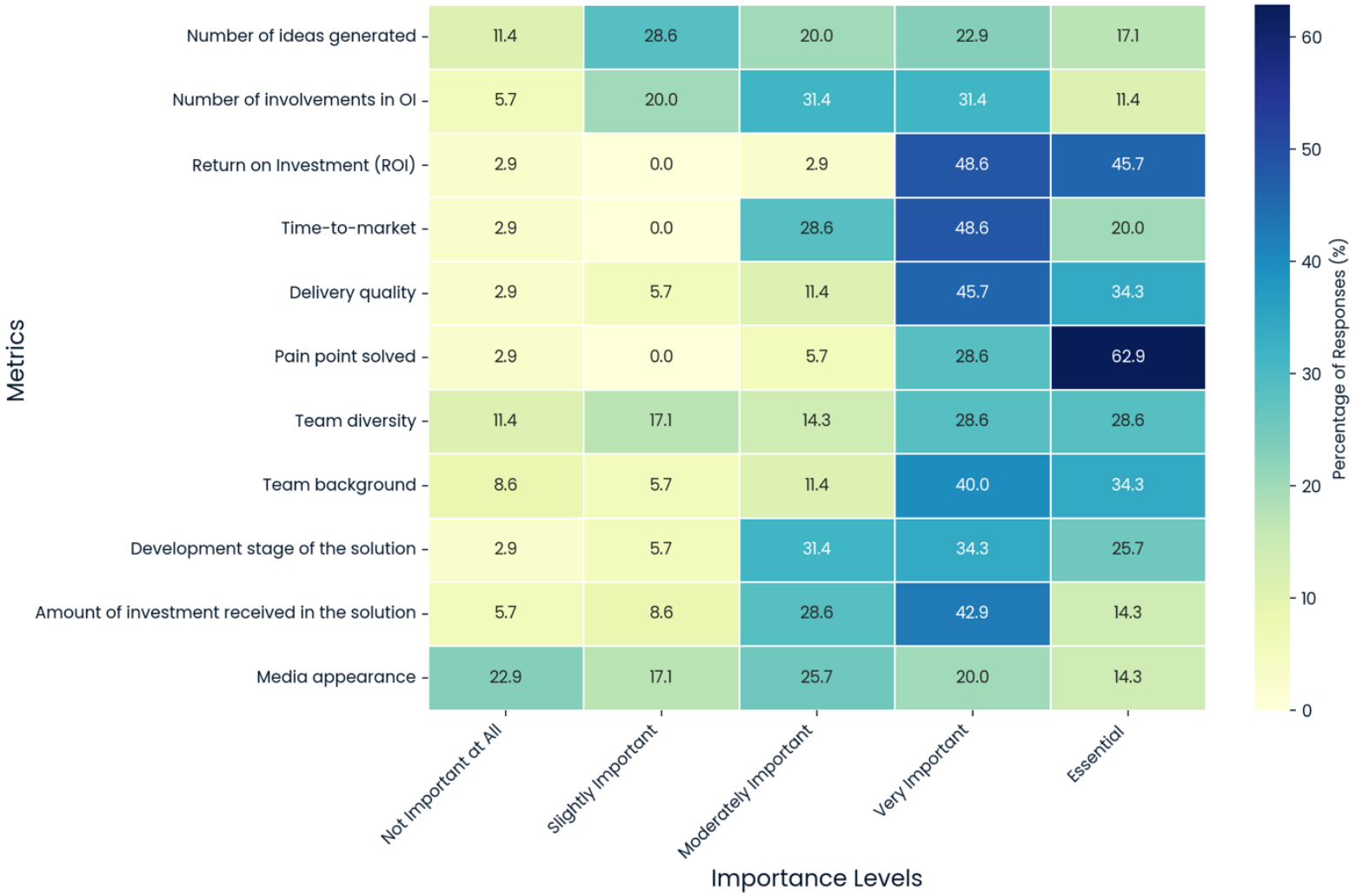
Key metrics such as “Return on Investment” (ROI), “Pain Point Solved”, "Time-to-Market” “Delivery Quality”, “Team Background” and “Amount of Investment

Received in the Solution" emerge as particularly significant (Chart 29). These metrics act as foundational indicators that link structured OI processes with high-impact outcomes, reflecting the importance of well-defined metrics in achieving desired results (Chesbrough, 2003).

Specifically, "Pain Point Solved" stands out as the most critical metric, with 62.9% of respondents rating it as essential, highlighting the value of OI activities that directly address practical challenges. ROI, similarly valued, was marked as essential by 45.7% of participants in its rating, a finding that aligns closely with qualitative feedback from interviews (Chart 29) (Adner, 2006).

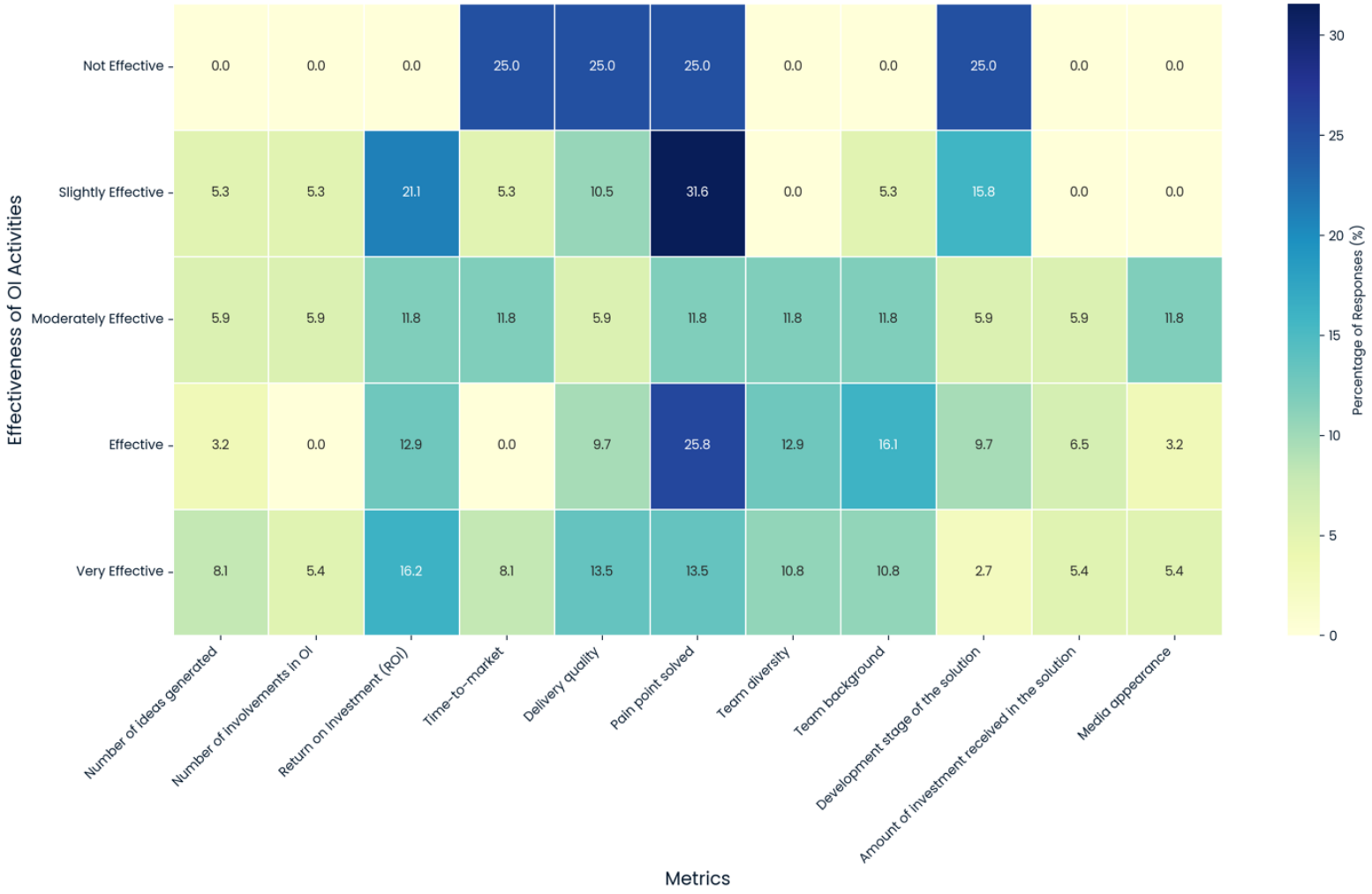
Moreover, examining the perceived effectiveness of OI activities through these metrics reveals that "Pain Point Solved" and "Return on Investment" are the most impactful indicators for respondents who assess their OI initiatives as effective or highly effective. This highlights the importance of focusing on metrics that are closely tied to concrete outcomes and strategic objectives, particularly in mature organizations where robust OI processes enable strong alignment with business goals (Chart 30) (Gawer & Cusumano, 2014).

Chart 29 – Importance of Various Metrics in Open Innovation Activities



Source: Author (2024)

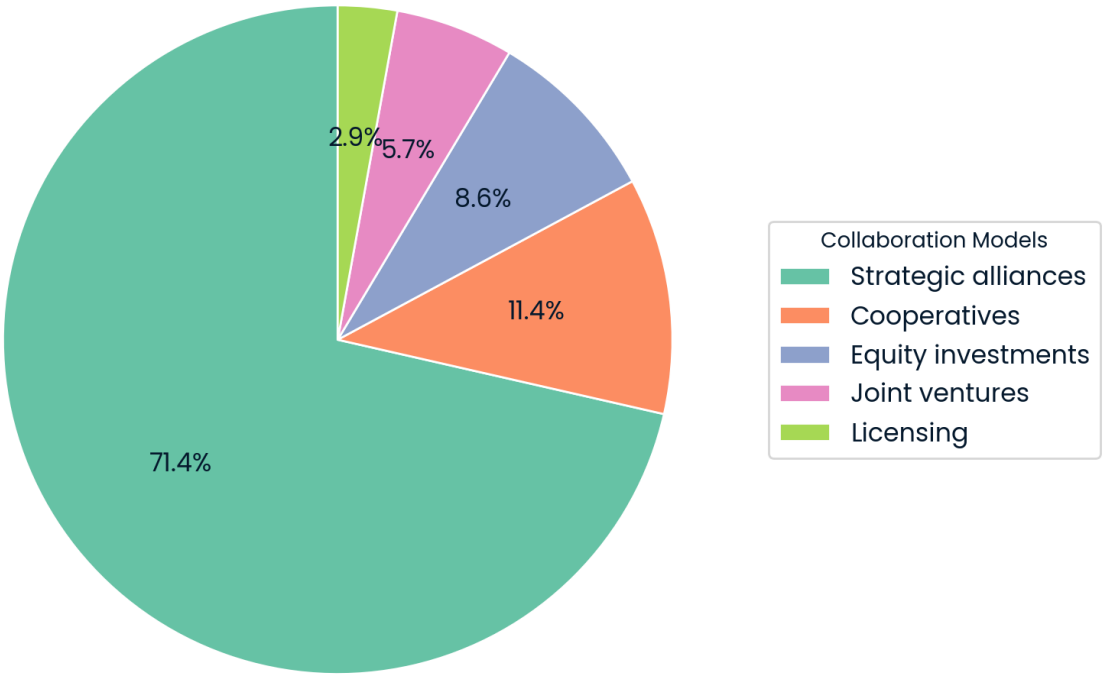
Chart 30 - Effectiveness of OI Activities by Metrics Selected as Essential



Source: Author (2024)

Based on the analysis of collaboration models in open innovation (OI), strategic alliances emerge as the most widely implemented model, with 71.4% of respondents indicating its use (Chart 31). This model spans from simple service contracts to more complex market entry agreements, a factor highlighted in the qualitative interviews as well. Other frequently used models include cooperatives, which often involve smaller businesses pooling resources for shared ventures, and equity investments, recognized as one of the most efficient models according to qualitative insights. Licensing is also used, though less prominently.

Chart 31 - Most Frequently Implemented Collaboration Models.



Source: Author (2024)

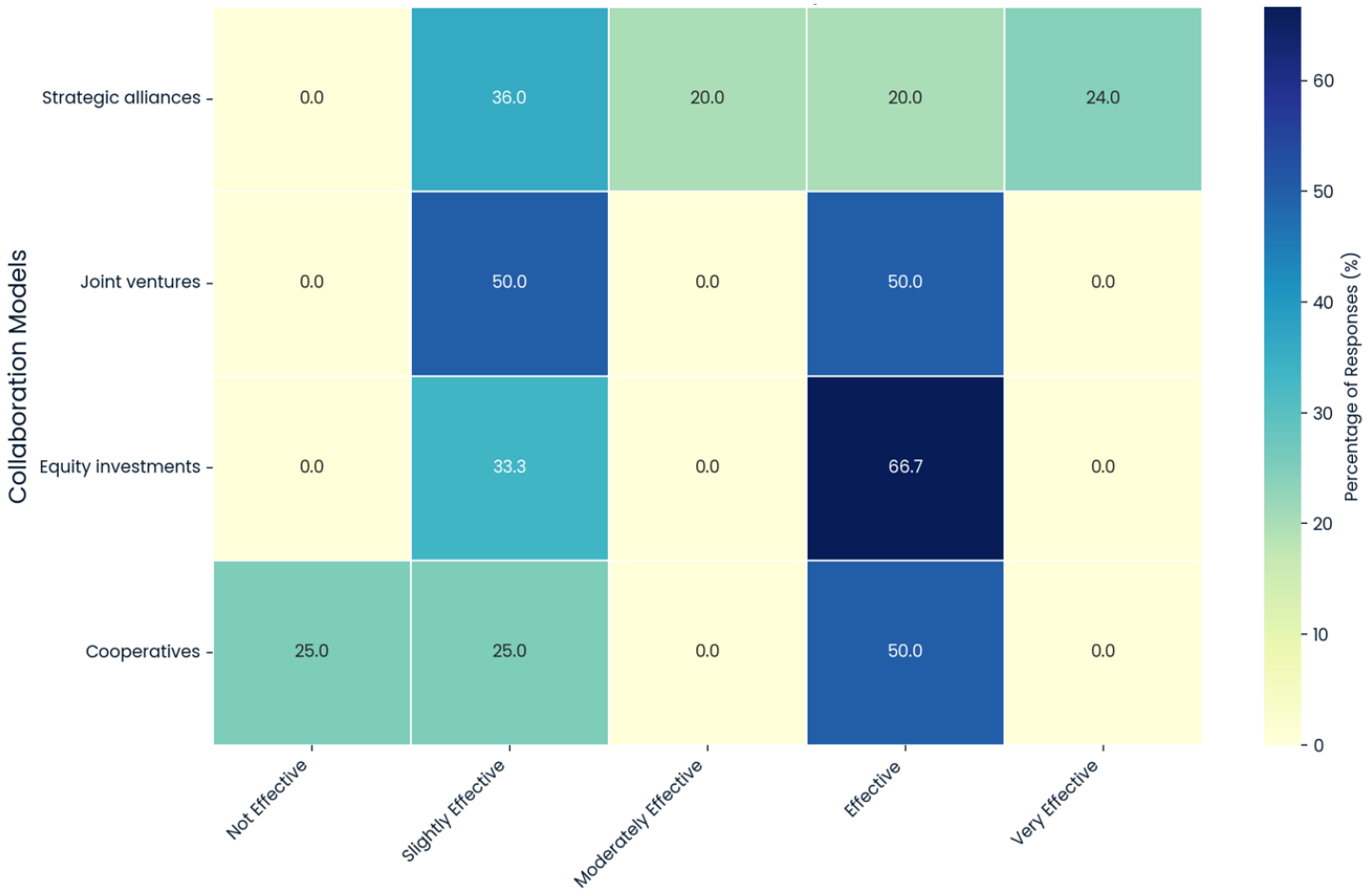
Examining the efficiency of these models in OI activities reveals that equity investments are perceived as the most effective, with the majority of respondents rating it as highly or very efficient (Chart 32). This aligns with the qualitative data suggesting that equity investments bring a higher level of impact and success in OI processes. Strategic alliances, while widely used, show a broader spectrum of opinions regarding their effectiveness, indicating a model that is versatile and adaptable across different types of collaborations but potentially inconsistent in outcomes.

All four frequently implemented models contribute positively to effective OI processes, yet equity investments stand out as particularly effective, both in enabling impactful OI processes and as a collaboration model on its own merits (Chart 33). This emphasis on equity investments underscores the value of deeper financial commitments and shared stakes in achieving meaningful innovation outcomes, corroborating existing literature on the importance of financial alignment in collaborative innovation efforts (Chesbrough, 2003; Gawer & Cusumano, 2014).

Chart 32 - Efficiency of Collaboration Models in OI Activities

Source: Author (2024)

Chart 33 - Effectiveness of OI Activities by Collaboration Model



Source: Author (2024)

The inclusion of sustainability goals in open innovation (OI) activities shows a varied distribution across frequency levels, with a general trend of increased incorporation as OI maturity levels rise. This suggests that as companies advance and establish more structured and mature OI processes, they are better positioned to address sustainability strategically rather than as a secondary, operational concern.

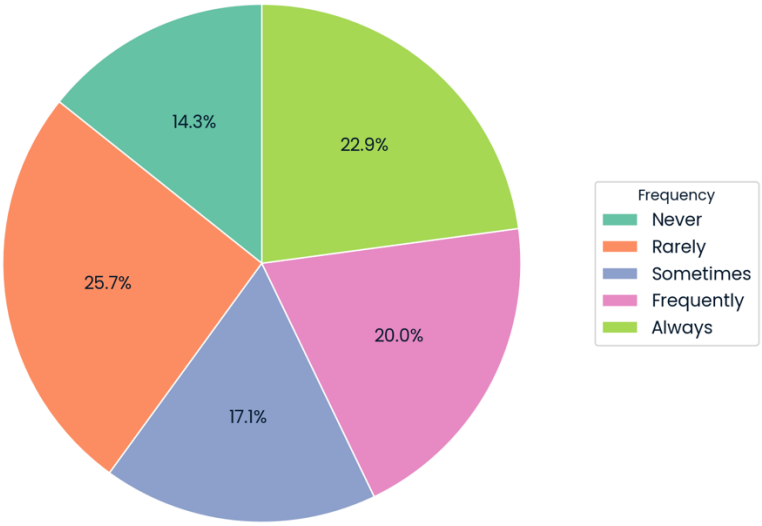
In terms of frequency, we see a relatively balanced distribution: 22.9% of respondents “always” include sustainability goals, while 25.7% “rarely” incorporate them (Chart 34). This balance indicates that while sustainability is a recognized objective, it is not universally prioritized across all organizations.

The trend becomes more distinct when analyzed by maturity level (Chart 35) Companies at maturity level 5, for example, demonstrate a significant commitment to sustainability, with 75% of respondents at this level frequently or always including sustainability goals in their OI activities. At maturity level 4, 55.5% of respondents report the same frequency of inclusion. This pattern reflects the notion that as OI

processes become more defined and robust, organizations are more likely to integrate broader, strategic objectives like sustainability into their innovation frameworks.

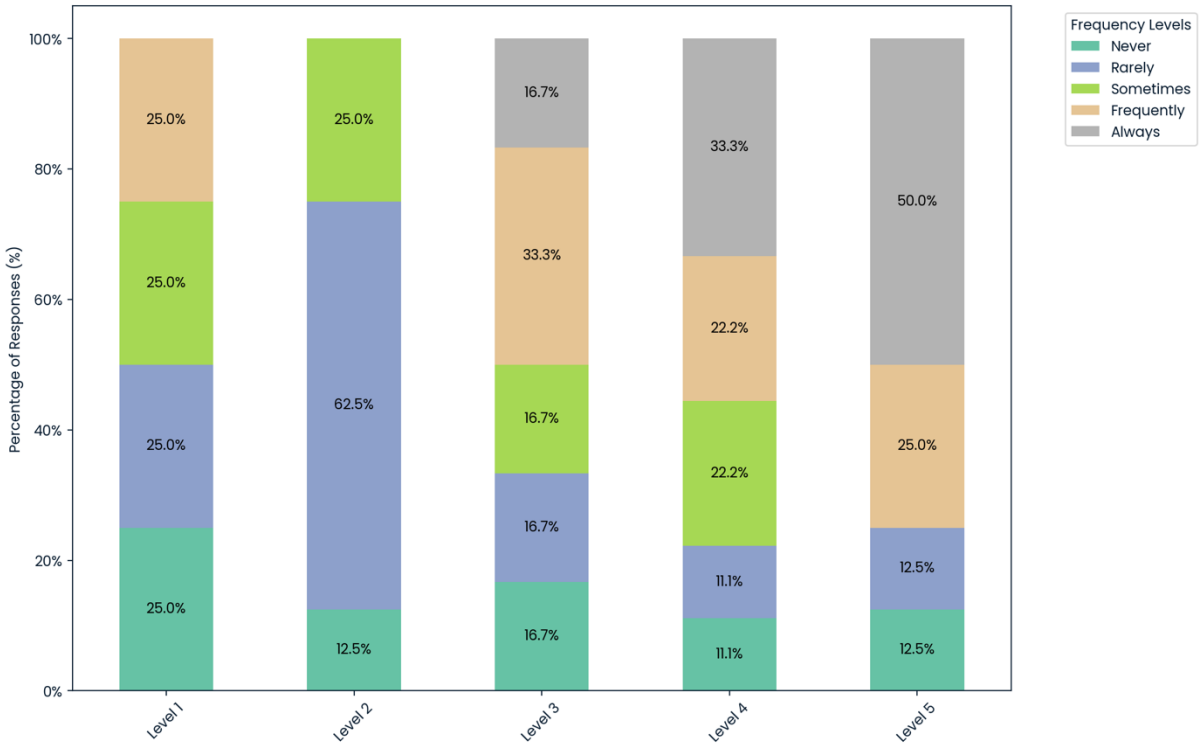
These findings align with established research that highlights the correlation between process maturity and the ability to pursue complex, non-operational goals within OI frameworks (Chesbrough, 2006; Tidd & Bessant, 2013). This progression underscores the importance of maturity in driving not just innovation outcomes, but also in embedding values like sustainability into innovation practices.

Chart 34 - Frequency of Including Sustainability Goals in OI Activities



Source: Author (2024)

Chart 35 - Frequency of Sustainability Goals Inclusion by Maturity Level in OI



Source: Author (2024)

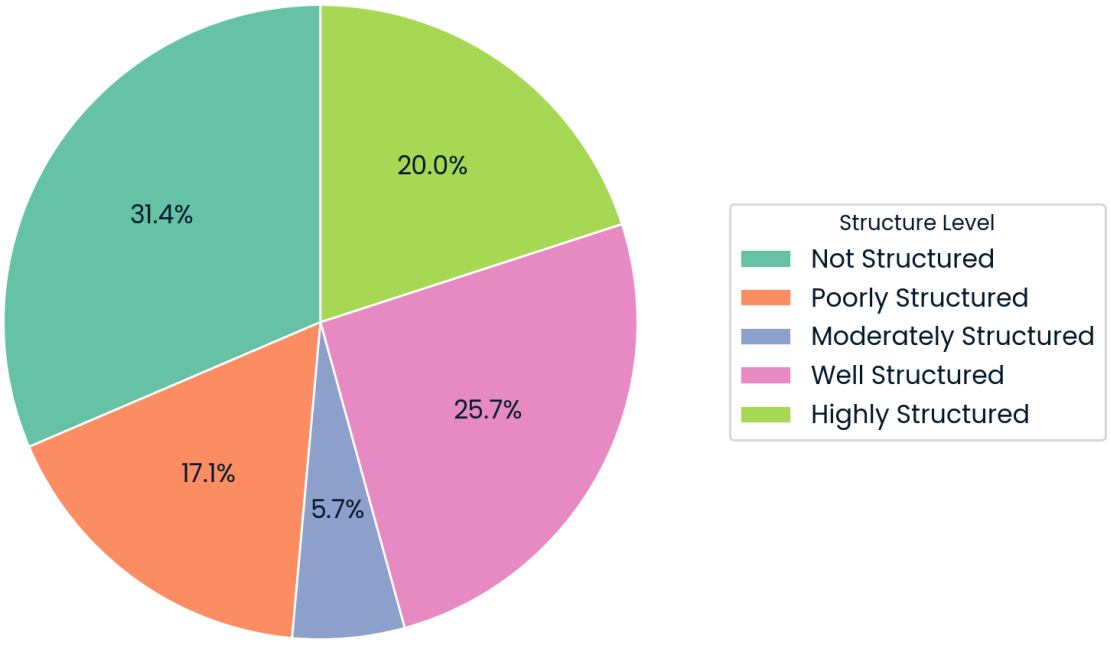
In examining the structure of intellectual property (IP) protection within open innovation (OI) collaborations, we see considerable variability, reflecting different strategic approaches to IP management across maturity levels and attitudes towards external integration. Chart 34 shows that while 31.4% of participants have no structured IP protection, a notable 20% have highly structured IP protection processes in place. This lack of uniformity might reflect varied organizational readiness to integrate structured IP policies, which can depend on OI experience and strategic goals in innovation (Chesbrough, 2003; West & Bogers, 2014).

Looking at maturity levels in Chart 35, we observe that as organizations advance in maturity, there is a clear increase in structured IP protection. Specifically, Level 5 organizations show that 50% have well-structured or highly structured IP protection, while 77.8% of Level 4 organizations fall into these categories. This trend highlights the correlation between organizational maturity and the development of robust IP structures, suggesting that as firms become more experienced in OI, they recognize the importance of safeguarding intellectual assets (Gassmann; Enkel, & Chesbrough, 2010).

Chart 36 reveals how attitudes towards integration impact IP protection structures. Organizations that are strongly welcoming to external innovations exhibit higher levels of structured IP protection, with 72.8% reporting well-structured or highly structured systems. Conversely, those with a neutral or mixed attitude towards integration show only 16.7% in these categories. This data suggests that openness to external collaboration is accompanied by a need for more stringent IP frameworks, possibly due to increased risk exposure when integrating external ideas and technologies (Adner, 2006; Enkel et al., 2011).

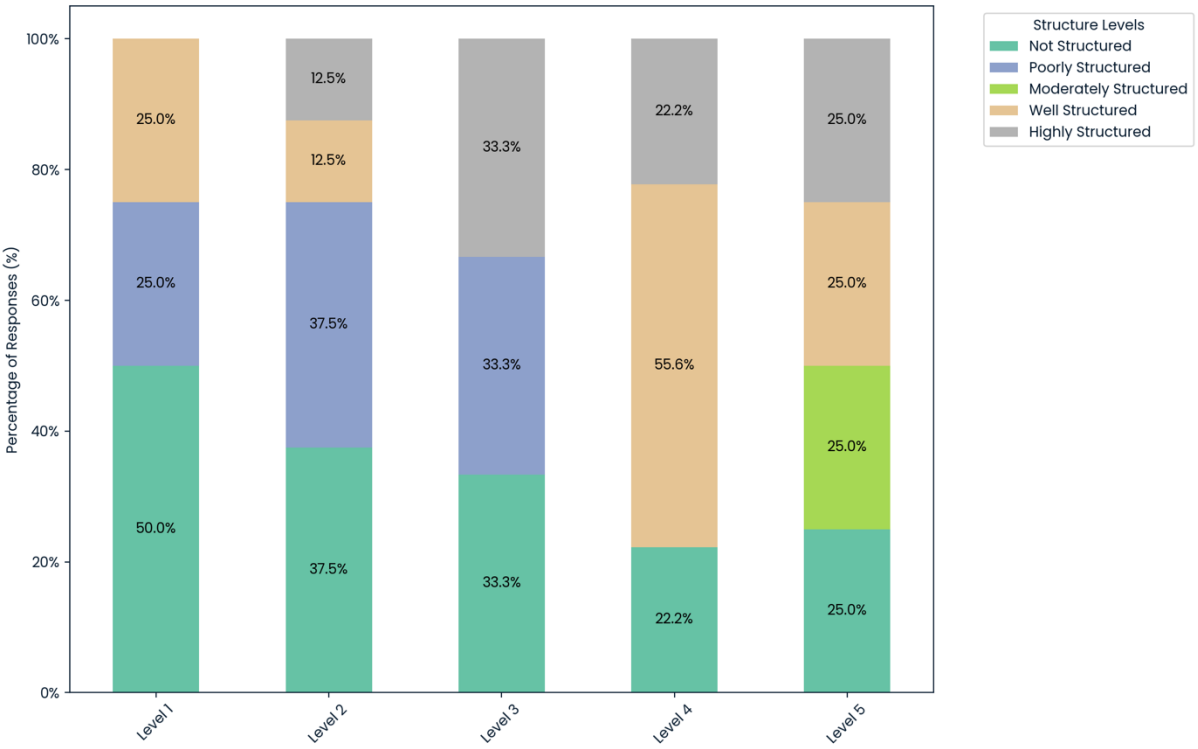
Lastly, Chart 37 indicates a strong relationship between IP protection structure and the perceived effectiveness of OI activities. In cases where OI processes are deemed very effective, 71.4% of respondents have well or highly structured IP protection in place, compared to none in the “not effective” category. This underscores the role of structured IP policies as a potential driver of OI success, as robust IP management can encourage greater external collaboration by mitigating risks associated with intellectual property sharing (Pisano, 2015; Schilling, 2020).

Chart 36 - Intellectual Property Protection in OI Collaborations.



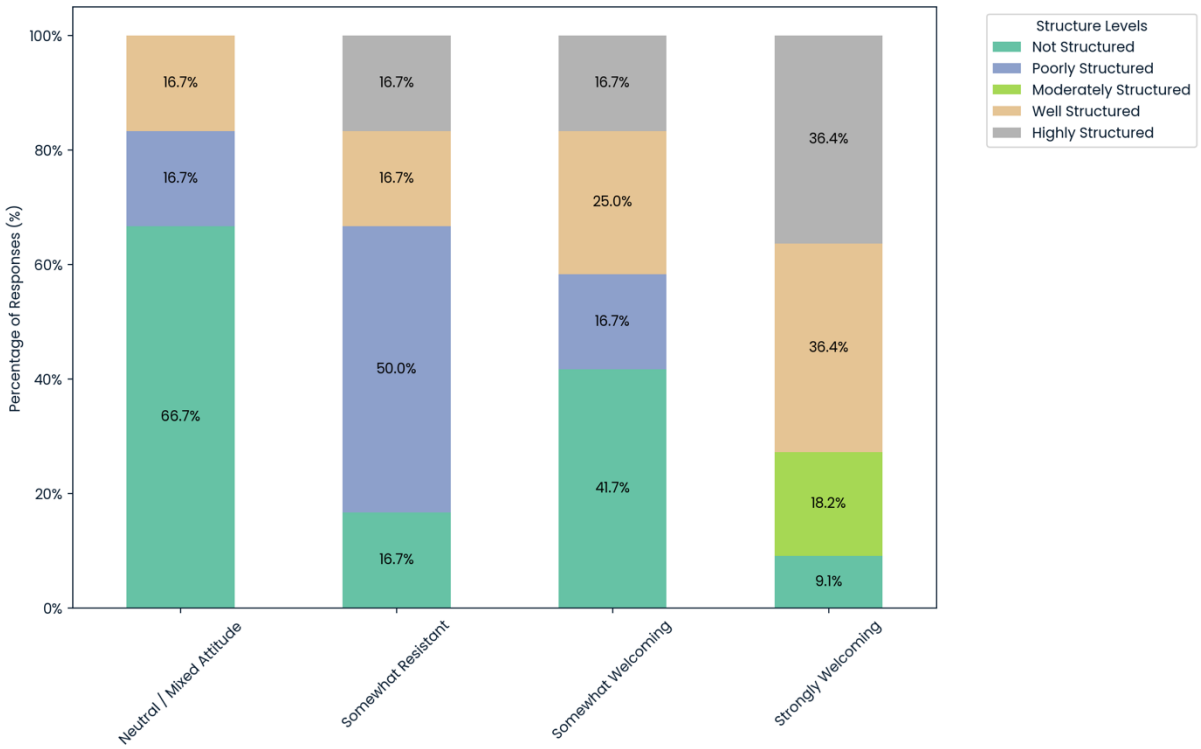
Source: Author (2024)

Chart 37 - Intellectual Property Protection by Maturity Level in OI



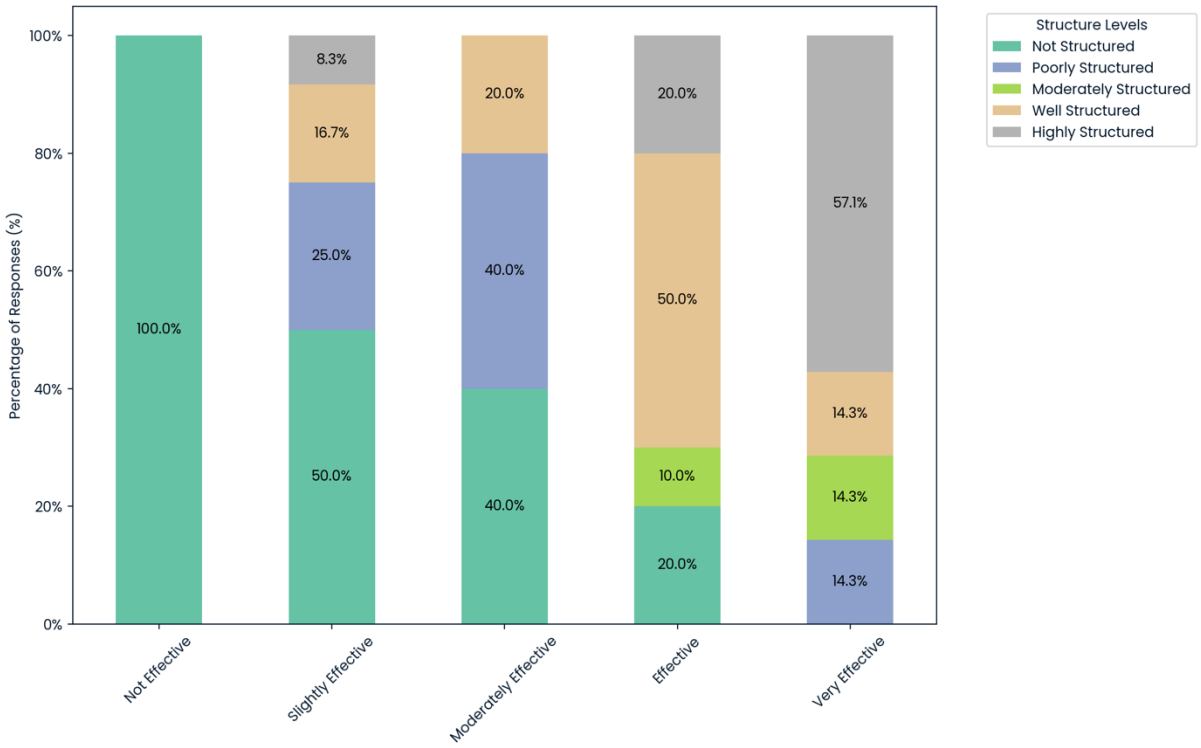
Source: Author (2024)

Chart 38 - Intellectual Property Protection by Attitude to Innovation



Source: Author (2024)

Chart 39 - Intellectual Property Protection by Effectiveness of OI



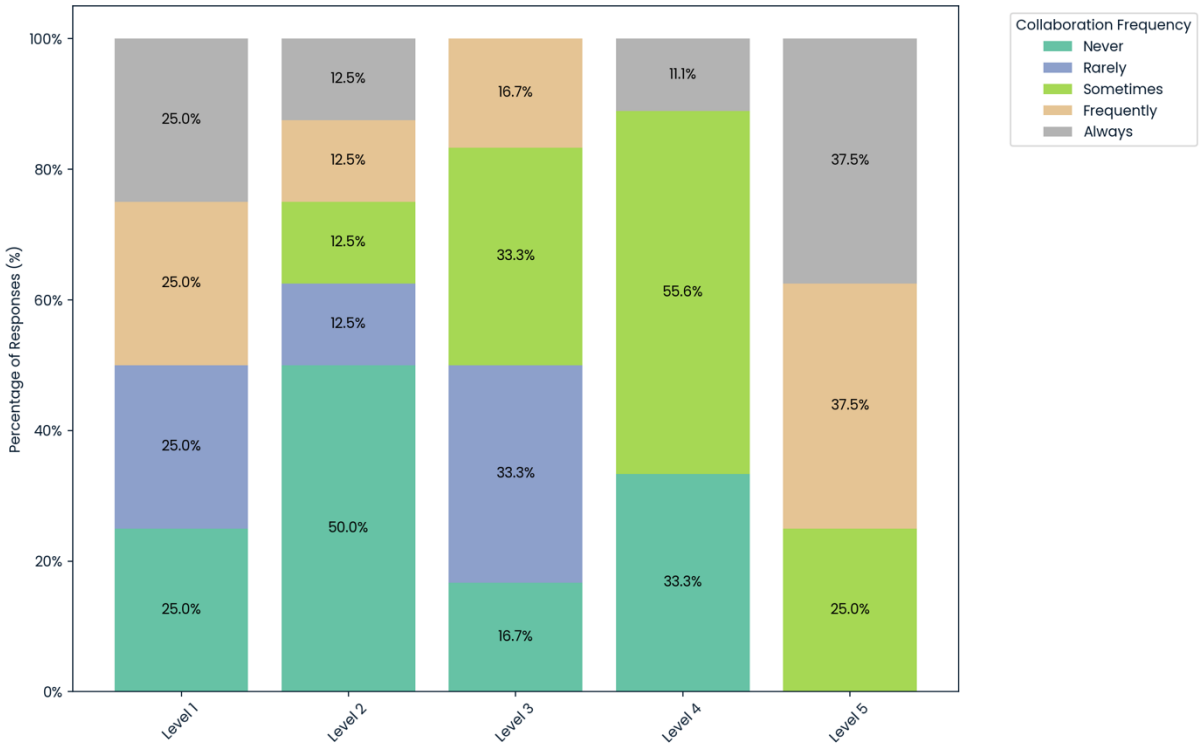
Source: Author (2024)

In analyzing the level of collaboration with universities among different stakeholders in open innovation processes, we observe that this form of partnership is primarily pursued by startups and consultancies, as shown in Chart 39. This trend aligns with the notion that smaller, more agile organizations are often more open to exploring novel solutions within academic settings. Furthermore, as the maturity level in open innovation increases, companies are more likely to engage in university partnerships, as indicated in Chart 38. At maturity Level 5,75% of respondents report always collaborating with universities, suggesting that well-defined innovation processes facilitate these interactions.

This pattern highlights the strategic importance of academic partnerships for mature organizations seeking early-stage solutions that align with their technological needs. According to Chesbrough (2003), collaboration with universities can provide companies with access to groundbreaking research and ideation phases, enhancing their innovation pipeline. Additionally, respondents noted in interviews that university collaborations often offer a unique opportunity for firms to secure intellectual property advantages early in the solution development cycle.

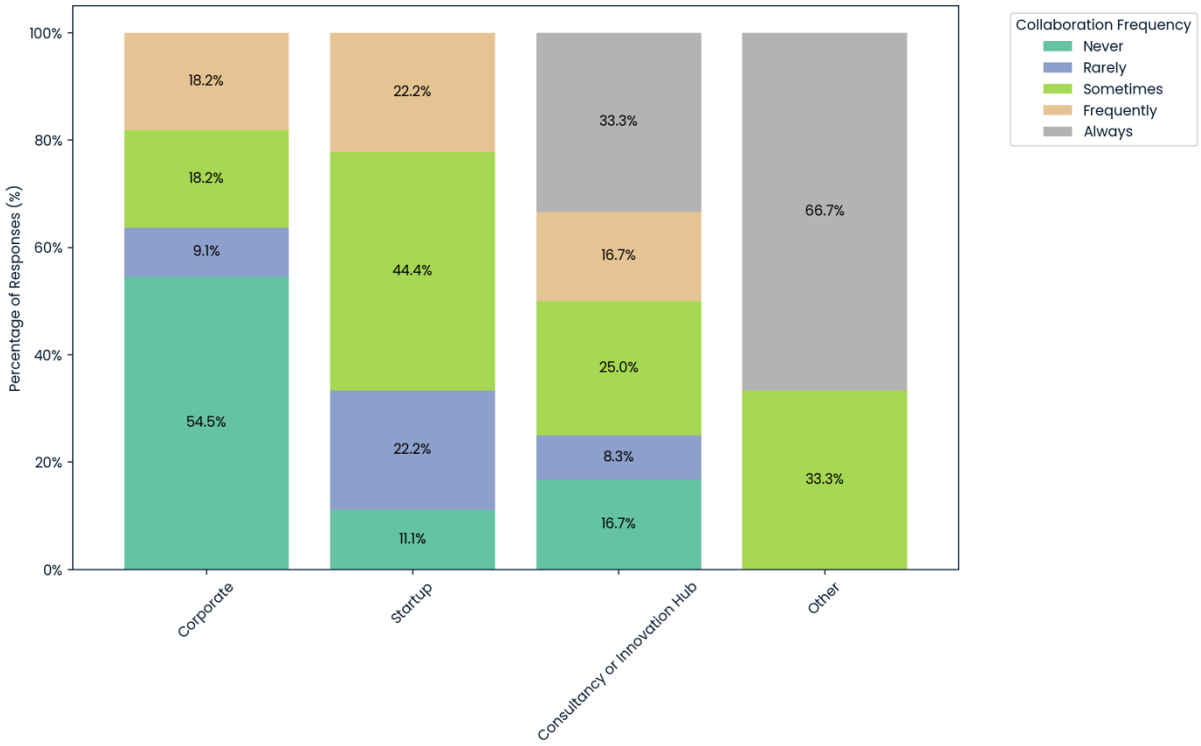
The data also reveals that contact with universities becomes more structured and frequent at higher maturity levels, similar to sustainability goals, which tend to be incorporated only after organizations have established clear objectives and processes. This insight reflects the strategic prioritization of partnerships, with academic collaboration seen as a secondary but impactful approach that organizations pursue once they reach a level of stability and structured innovation processes (Schilling, 2020; West & Bogers, 2014).

Chart 40 - Collaboration with Universities by Maturity Level in Open Innovation



Source: Author (2024)

Chart 41 - Collaboration with Universities by Organization Type



Source: Author (2024)

Open innovation (OI) has increasingly been recognized as a viable long-term strategy by organizations seeking sustained competitive advantage. As seen in Chart 40, 71.4% of respondents believe that OI is either likely to endure or will endure significantly. This high level of confidence aligns with the notion that OI serves as a strategic approach that enhances resilience and adaptability, consistent with the insights of Chesbrough (2003) and Gawer & Cusumano (2014). As organizations expand their reliance on external knowledge sources, their perception of OI as a sustainable, enduring model reflects a deep understanding of its role in fostering continuous innovation and meeting evolving market demands.

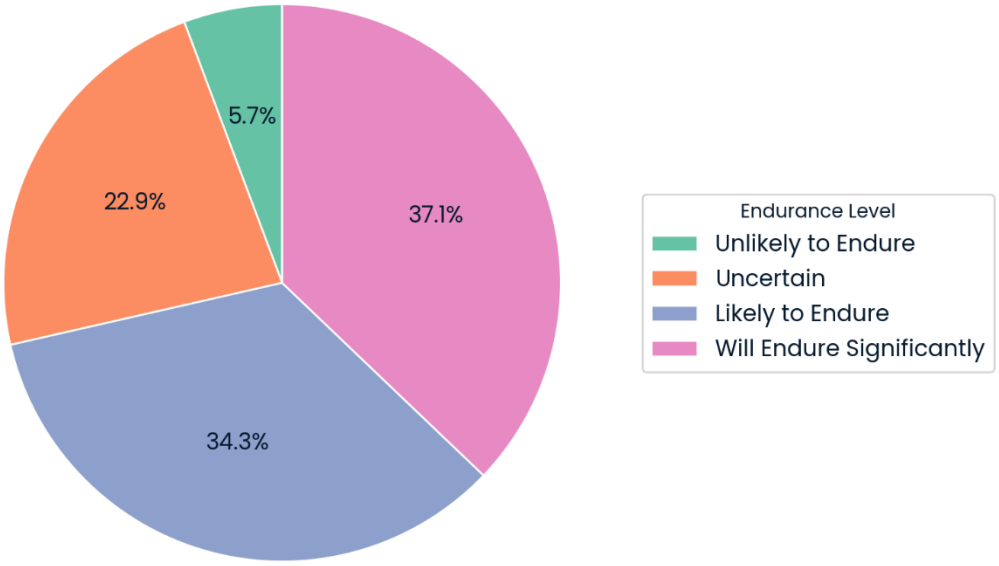
Chart 41 provides further insight by examining beliefs about OI's endurance across different organization types. Corporations, startups, and innovation hubs exhibit notable confidence, with 63.7%, 66.6%, and 75%, respectively, viewing OI as a model likely to endure. This distribution suggests that while corporations might prioritize OI for risk mitigation and strategic partnerships, startups and innovation hubs leverage it to overcome resource constraints and scale their market reach (Adner, 2006). Innovation hubs, which show the highest level of confidence, are likely viewed as

intrinsic to their mission of fostering collaborative environments and facilitating connections between diverse stakeholders.

Chart 42 reveals the connection between OI maturity levels and beliefs in its long-term viability. Respondents at higher maturity levels (levels 4 and 5) express the most confidence, with 100% of level 4 and 87.5% of level 5 respondents indicating that OI is likely to endure or will endure significantly. Specifically, 55.6% of level 4 respondents and 50% of level 5 respondents believe OI will endure significantly. This trend underscores that as organizations advance their OI capabilities and establish more structured and sophisticated processes, they are more likely to view OI as an essential, enduring element of their innovation strategy. Structured OI initiatives support organizations in addressing complex challenges and enable a shift from tactical to strategic innovation (Pisano, 2015).

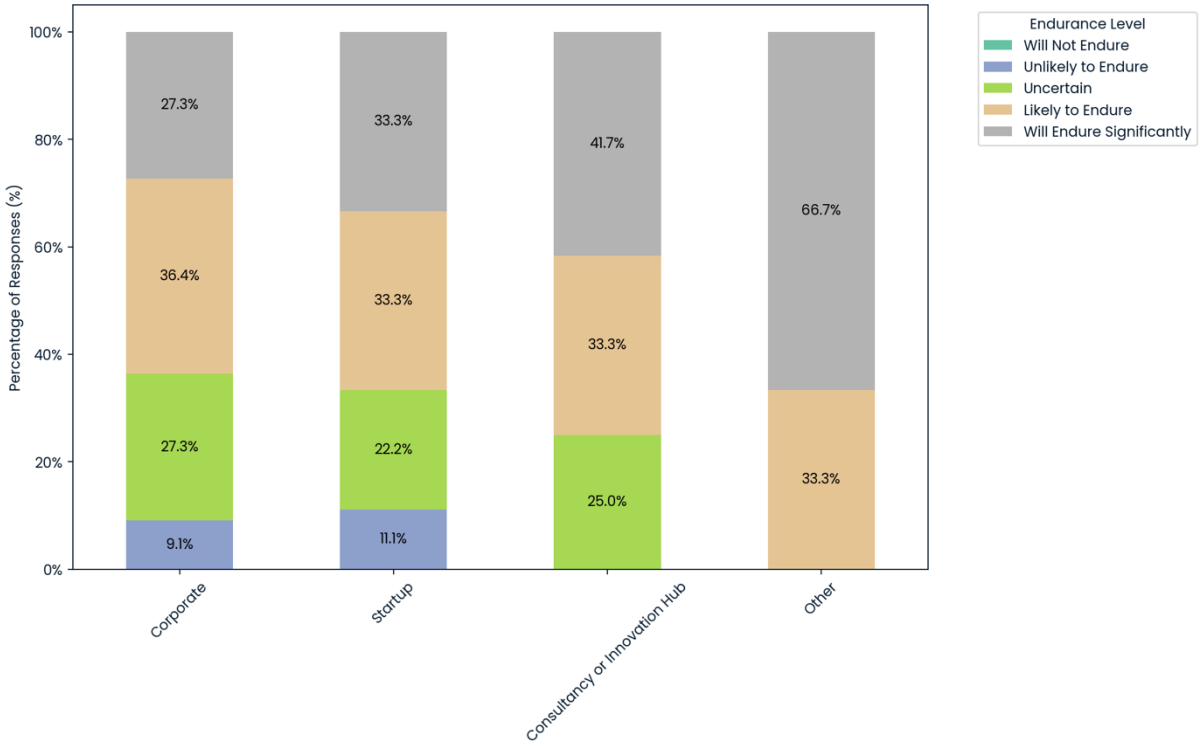
The correlation between OI maturity and confidence in its endurance illustrates that organizations with advanced OI practices are more prepared to integrate it as a fundamental part of their long-term strategic vision. This alignment between maturity and confidence reflects a broader shift toward embedding OI within the organizational culture, thereby enabling sustainable growth and resilience in an ever-evolving market landscape.

Chart 42 - Endurance of Open Innovation as a Long-Term Strategy



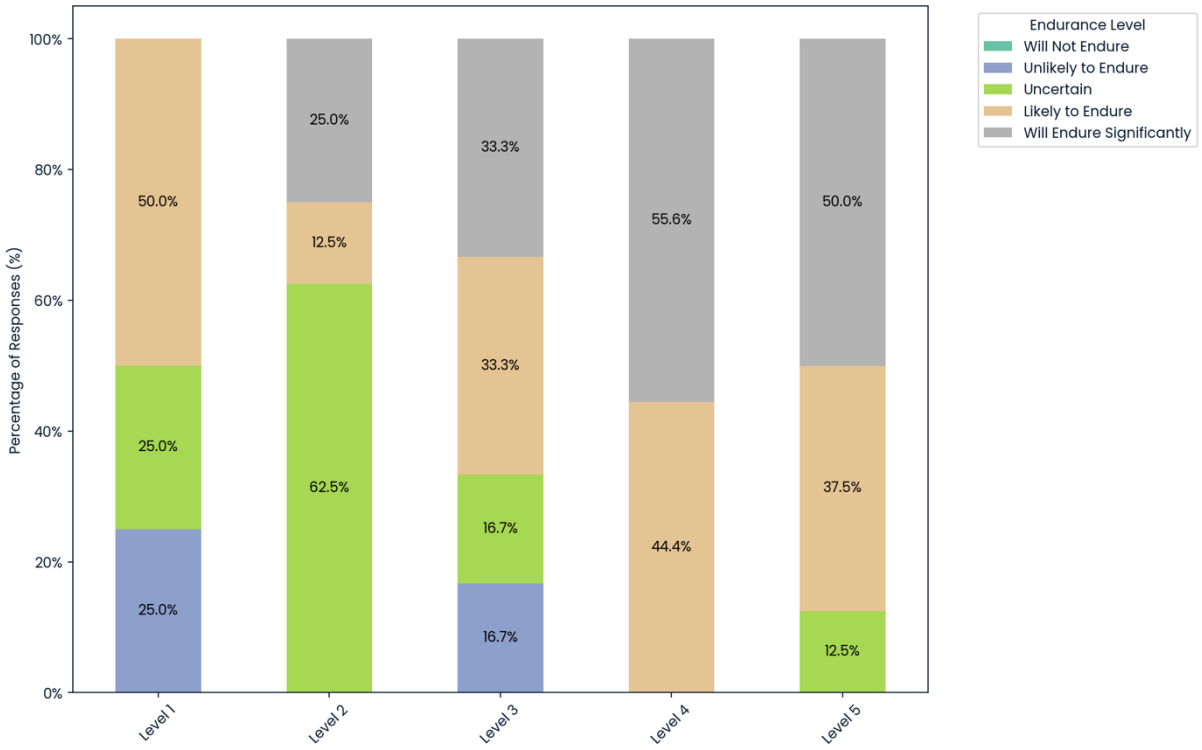
Source: Author (2024)

Chart 43 - Endurance of OI as a Long-Term Strategy by Organization Type



Source: Author (2024)

Chart 44 - Endurance of OI as a Long-Term Strategy by Maturity Level



Source: Author (2024)

The results from both qualitative and quantitative analyses emphasize the challenges and opportunities inherent in open innovation. Organizations vary significantly in their maturity and ability to integrate open innovation practices effectively. Insights from both interviews and surveys show that strategic alignment, technological adoption, and well-defined processes are crucial to achieving successful outcomes in innovation efforts.

These findings set the stage for the following discussion, where we delve deeper into the implications of the results. The discussion will explore how these insights can inform practical strategies for enhancing open innovation, address current challenges, and identify areas for future improvement.

5 DISCUSSION

The analysis of open innovation (OI) practices reveals the nuanced challenges, and strategic benefits organizations encounter as they advance in OI maturity. Key findings underscore inefficiencies, especially in early-stage OI implementations, where processes often lack structure and strategic alignment. This is particularly evident in the integration of sustainability goals, which mature as organizations reach higher levels of OI development. For instance, at maturity Levels 4 and 5, 75% and 55.5% of organizations, respectively, include sustainability objectives in OI activities, indicating that well-defined processes enable a shift from operational to strategic goals (Chesbrough, 2006; Tidd & Bessant, 2013).

A notable maturity gap exists across organization types: corporations rarely reach Level 5 maturity, with lower integration of OI processes, while startups exhibit a broader distribution across maturity levels, likely due to their adaptability and innovation-centered cultures. Corporations, however, face pronounced OI challenges, with 72.7% rating it as “challenging” or “very challenging” (Chart 6). This contrasts with startups, 66.6% of which perceive OI as slightly or moderately challenging, underscoring their structural and cultural alignment with rapid innovation.

Higher maturity levels correlate with greater effectiveness in OI activities. Organizations at Levels 4 and 5 report higher effectiveness, while 54.6% of corporations with lower maturity levels rate OI as ineffective or only slightly effective. Notably, 85.8% of respondents with highly effective OI activities frequently use AI, highlighting its role in boosting OI effectiveness (Chart 24). AI usage is particularly high among startups and consultancies, with 33.3% and 58.3% reporting frequent use, demonstrating their proactive adoption of advanced technologies to enhance OI.

Intellectual property (IP) protection frameworks are integral to successful OI, as structured IP processes foster partnerships by securing external knowledge transfer without compromising proprietary assets. At Level 4, 77.8% of organizations report structured IP frameworks, and 72.8% of entities with a welcoming attitude toward external knowledge also have well-defined IP processes, reinforcing the role of secure IP management in collaborative success (Chesbrough, 2003; Gassmann et al., 2010).

The study also highlights critical metrics— “Return on Investment” (ROI), “Pain Point Solved,” “Time-to-Market,” and “Delivery Quality”—as foundational indicators linking structured OI processes with high-impact outcomes. "Pain Point Solved," rated

as essential by 62.9%, and ROI, by 45.7%, emphasize the strategic focus on result-oriented indicators, particularly in organizations with mature OI processes (Chart 29).

Finally, the study shows that 71.4% of respondents view OI as likely or very likely to endure as a long-term strategy. Confidence is strongest among innovation hubs and organizations at Levels 4 and 5, reflecting the perception of OI as a sustainable, competitive strategy. At Level 4, 100% of respondents believe in OI's longevity, highlighting the alignment between structured OI processes and organizational commitment to external collaboration as a path for ongoing innovation.

In conclusion, these findings reveal that advancing OI maturity is essential for overcoming early inefficiencies and achieving strategic goals. Mature OI frameworks enable a balanced approach to time-to-market, cost management, and sustainable development while securing intellectual property. These insights emphasize the importance of structured OI approaches that not only drive operational efficiency but also strengthen an organization’s capacity for strategic innovation, effectively integrating objectives like sustainability and advanced technologies such as AI and Big Data.

6 CONCLUSION

This innovative work on open innovation provides a comprehensive examination across multiple stakeholders, offering valuable insights into the impacts of emerging technologies and how these will likely shape the future of OI practices, what could be called Open Innovation 4.0. Key findings reveal the most significant inefficiencies facing large corporations in implementing open innovation, particularly high- and medium-impact challenges that directly affect OI adoption and effectiveness. Drawing from transcribed interviews with representatives from major corporations (names withheld for confidentiality), these inefficiencies can be categorized based on their influence on OI processes, distinguishing between structural and cultural barriers.

High-Impact Inefficiencies include rigid hierarchical structures that hinder stakeholder management, creating communication gaps that delay innovation cycles (Chesbrough & Tucci, 2020). Additionally, internal resistance from traditional departments slows OI integration, with risk aversion frequently cited as a barrier to adopting external innovations (Randhawa et al., 2016). Bureaucratic processes are another high-impact obstacle, particularly in the context of Proofs of Concept (POCs), where lengthy approval cycles impede collaboration with agile startups (Veneziani & Vaz, 2023). Sector-specific requirements also add challenges: in industries such as pulp and paper, the need for tailored solutions limits the utility of standardized innovations (Holzmann, 2014). Lastly, limited startup density in fields like energy reduces available OI partnerships, narrowing the diversity of ideas and potential solutions (Bertello et al., 2023).

Medium-Impact Inefficiencies further complicate the innovation pipeline. Issues like process agility highlight how standardized corporate procedures can delay the implementation of collaborative projects with startups, which require a faster response (Arvaniti et al., 2022). Additionally, expectation alignment between corporations and startups often leads to friction, as differences in goals reduce the effectiveness of collaborations (Chesbrough, 2003). Slow technology adoption, especially regarding emerging tools like AI and Big Data, limits the potential benefits of OI by failing to support agile environments (Greco et al., 2022). Lastly, cultural gaps between innovation teams and traditional departments create barriers to the acceptance of new practices and ideas, as corporate and startup operational norms often clash (Radziwon et al., 2023).

These insights reveal the layered complexity corporations face in optimizing their OI frameworks, where high-impact inefficiencies present substantial barriers to achieving seamless collaboration, and medium-impact challenges add friction to the innovation process. Addressing these issues with targeted strategies may improve the overall effectiveness of open innovation in corporate settings.

The analysis emphasizes the impact of OI metrics, showcasing the value of investments in structured OI practices to achieve superior outcomes. Qualitative and Quantitative insights and underscore the relevance of metrics such as Return on Investment (ROI), Pain Point Solved, and Time-to-Market, which are identified as critical in assessing the value of OI activities. Recent corporate successes highlight the practical benefits of using these metrics, reinforcing the notion that adopting a metrics-driven approach to OI can yield innovative and effective solutions.

A framework (Table 8) is a suggested approach for advancing open innovation (OI) maturity, divided into three phases based on grouped maturity levels. Levels 1 and 2 focus on establishing foundational OI capabilities with process-focused metrics. Level 3 represents a transitional phase, concentrating on optimizing collaboration quality and timeliness. Levels 4 and 5 emphasize outcome-driven metrics, such as ROI and knowledge transfer, to measure the strategic impact of OI efforts. Each phase also integrates advanced tools like AI and Big Data to support targeted activities, such as solution sourcing, market research, and creating intelligent prompts for current market conditions and corporate strategies.

Table 8 - Open Innovation Framework by Maturity Level

Maturity Levels	Focus Area	Primary Metrics	Recommended Activities	Suggested Use of AI & Big Data
Levels 1 & 2	Foundational Process	Number of Ideas Generated, Number of Involvements in OI, Team Diversity	Establish core OI capabilities, focus on increasing engagement and initial idea generation	Basic AI for sourcing potential ideas and basic data analysis on team composition
Level 3	Process Optimization	Time-to-Market, Delivery Quality, Team Background	Strengthen external collaboration, improve efficiency in project delivery	AI for refining market research, Big Data for analyzing project timelines and delivery metrics
Levels 4 & 5	Strategic Outcomes	Return on Investment (ROI), Pain Point Solved, Knowledge Transfer, Amount of Investment Received in the Solution	Focus on high-impact outcomes and strategic alignment with business goals	Advanced AI for developing tailored insights, Big Data for predictive analytics and investment tracking

Source: Author (2024)

This three-phase framework helps companies tailor their OI initiatives according to their maturity stage, promoting a structured evolution from foundational process metrics to strategic, high-impact metrics. By aligning technology use with maturity, organizations can maximize the effectiveness of their OI activities.

To enhance Open Innovation (OI) effectiveness, large corporations should adopt best practices that foster strategic alignment, support collaboration, and promote sustainable innovation. These recommendations aim to streamline OI processes and encourage a balanced innovation culture.

a) Create a Comprehensive Startup Database: Include essential details like company name, sector, challenges addressed, contacts, country of operation, and recent funding to facilitate targeted partnerships.
b) Participate in Innovation Ecosystems: Engage actively in industry events, conferences, and ecosystems to stay connected with trends and innovation opportunities.

c) Build Partnerships with Innovation Hubs and Consultancies: Collaborate with hubs and consultancies for process improvements and to gain valuable market insights.
d) Encourage a Dual Innovation Culture: Foster both top-down executive support and bottom-up employee engagement to create a culture that values external and internal innovation.
e) Use AI and Big Data: Leverage AI for sourcing solutions and assessing trends, while using Big Data to refine market research and adapt OI strategies in real-time.
f) Define Clear OI Success Metrics: Track metrics such as ROI, time-to-market, and knowledge transfer to measure OI effectiveness and communicate its value organization-wide.
g) Establish Knowledge-Sharing Platforms: Create an internal platform to share insights and lessons learned from OI projects, promoting continuous learning across departments.
h) Prioritize High-Impact Partnerships: Focus resources on partnerships that promise measurable value, strategic alignment, and long-term impact.

In summary, these best practices provide a structured approach to building resilient, efficient OI processes, helping large corporations stay competitive and innovative in dynamic markets. By that we can cite the 3 most representative topics for this research:

a) The study demonstrates that organizations at higher OI maturity levels use AI and Big Data more effectively, enhancing OI outcomes and decision-making, as to be called Open Innovation 4.0. The gathered interview and market research data reinforces the role of these technologies in supporting agile, metrics-driven innovation.
b) Addressing structural and operational inefficiencies, this research provides valuable insights into the benefits of developing well-structured OI practices, particularly in achieving key outcomes like ROI, time-to-market, and knowledge transfer.
c) The maturity-based framework developed in this study offers corporations a practical roadmap to align performance metrics with maturity stages, facilitating

targeted improvements in OI processes and supporting broader strategic objectives, including sustainability.

Open Innovation 4.0 represents a paradigm shift in innovation practices, characterized by the integration of advanced digital technologies such as Artificial Intelligence (AI), Big Data, and automation to enhance collaboration, knowledge transfer, and decision-making processes. This new approach emphasizes the use of data-driven insights, real-time adaptability, and sustainable practices to address structural and cultural barriers within organizations. By leveraging these technologies, Open Innovation 4.0 aims to streamline stakeholder engagement, improve efficiency, and align innovation strategies with a wider range organizational goals, intending to transform it into an agile, scalable, and impactful innovation process.

It can be confirmed the importance of structured OI practices for organizational innovation, offering clear strategies and recommendations for corporations aiming to enhance their OI maturity and effectiveness. The findings contribute to the literature and provide actionable strategies for the field, supported by relevant data, analysis, and market insights.

Finally, Table 9 compares the conclusion and recommendation of this work with other literature, and what this research bring as new for the academy.

Table 9 – Comparison of Research and other Literature Conclusion

Reference	Similar Conclusion	New Conclusion by this Work
Adner (2006) - Match your innovation strategy to your innovation ecosystem. Harvard Business Review, v. 84, n. 4, p. 98.	Innovation Ecosystem connection is important to OI, Maturiy needs to be assigned, Stakeholder management is a risk into a successful Open Innovation process	AI and Big Data importance and effectiveness are key to the future of Open Innovation
Arvaniti et al. (2022) - A new step-by-step model for implementing open innovation. Sustainability, v. 14, n. 10, p. 6017.	Collaboration and stakeholder management are important for open innovation success. Organizational maturity and resource alignment impacts in implementation readiness.	Step-by-step model provides a structured approach. Highlights the use of digital tools and focus on sustainability outcomes.
Bessant et al. (2005) - Managing innovation beyond the steady state. Technovation, v. 25, n. 12, p. 1366-1376.	Adaptability and learning are essential for better results in innovation. Stakeholder collaboration and organizational maturity key for managing innovation.	Sustainability as a key driver for innovation maturity. Introduces specific frameworks for navigating instability.

Tidd & Bessant (2013) - Managing innovation: integrating technological, market and organizational change. John Wiley & Sons.	Innovation management requires a structured approach integrating technological, market, and organizational change. Emphasis on building dynamic capabilities and organizational readiness to handle uncertainties.	Extensive coverage of open innovation, digital innovation, and sustainability-led innovation.
Chesbrough (2003) - Open innovation: The new imperative for creating and profiting from technology. Harvard Business School.	Open innovation emphasizes leveraging both internal and external ideas to accelerate innovation and commercialization. Highlights the shift from closed to open innovation and its role in increasing efficiency and competitiveness.	Expanded focus on AI and Big Data as essential enablers for open innovation. Introduction of maturity models and sustainability-driven innovation, which are not core parts of Chesbrough's framework
Chesbrough (2006) - Open business models: How to thrive in the new innovation landscape. Boston: Harvard Business Press.	Open business models rely on leveraging internal and external innovation for commercialization. Highlights the importance of intellectual property management and the necessity for adaptable business models in innovation.	Greater focus on AI and Big Data as drivers for open innovation. Introduction of sustainability and maturity models as elements in innovation processes. Advanced use of metrics for assessing and enhancing innovation readiness.
Chesbrough & Brunswicker (2014) - A fad or a phenomenon?: The adoption of open innovation practices in large firms. Research-Technology Management, v. 57, n. 2, p. 16-25.	Open innovation adoption is widespread in large firms and increasingly supported by management. Emphasis on inbound and outbound practices, with collaboration being a key success factor.	Emphasis on AI and Big Data as tools for decision-making and efficiency in open innovation. Focus on sustainability and metrics for assessing innovation readiness and maturity.
Chesbrough (2019) - Open innovation results: Going beyond the hype and getting down to business. Oxford University Press.	Emphasizes that generating technology alone is insufficient; it must be disseminated and absorbed to realize full value	Emphasis on AI and Big Data as tools for decision-making and efficiency in open innovation. Focus on sustainability and metrics for assessing innovation readiness and maturity.
Enkel, Bell & Hogenkamp (2011) - Open innovation maturity framework. International Journal of Innovation Management, v. 15, n. 06, p. 1161-1189.	Open innovation maturity requires structured metrics to evaluate progress. Emphasizes the role of organizational climate, partnership capacity, and internal processes in achieving effective open innovation.	Integration of AI and Big Data as tools for enhancing maturity in open innovation. Sustainability as a core dimension in innovation processes. Proposes specific maturity models for digital transformation.

Greco et al. (2022) - The fine line between success and failure: an analysis of open innovation projects. European Journal of Innovation Management, v. 25, n. 6, p. 687-715.	Highlights the duality of success and failure in open innovation projects. Emphasizes the importance of partner selection, risk management, and stakeholder collaboration for project outcomes.	Incorpores AI and Big Data as enablers for open innovation success. Introduce structured maturity models and sustainability as core dimensions of open innovation.
West & Bogers (2017) - Open innovation: current status and research opportunities. Innovation, v. 19, n. 1, p. 43-50.	Open innovation requires integrating inbound, outbound, and coupled knowledge flows across organizational boundaries. Highlights opportunities for linking open innovation to absorptive capacity, ecosystems, and business models.	AI and Big Data as enablers for managing open innovation complexity. Introduces sustainability and structured maturity models as key aspects of innovation processes.

Source: Author (2024)

To gain a more detailed understanding of the limitations presented in this work and to consider the author's perspectives for future research, it is recommended to:

a) Analyze other geographic regions to understand variations in open innovation practices across different cultural and economic contexts.
b) Examine specific sectors, such as energy and pulp and paper, could provide valuable insights into the unique challenges and opportunities for OI in industries with specialized requirements.
c) Investigate specific technologies, like blockchain and artificial intelligence, within OI processes may reveal how these tools enhance collaboration and knowledge transfer.
d) Study cultural transformation towards innovation in companies could show that as more sectors adopt an innovative mindset, the costs associated with innovation tend to decrease, making it more accessible and effective across various business types.

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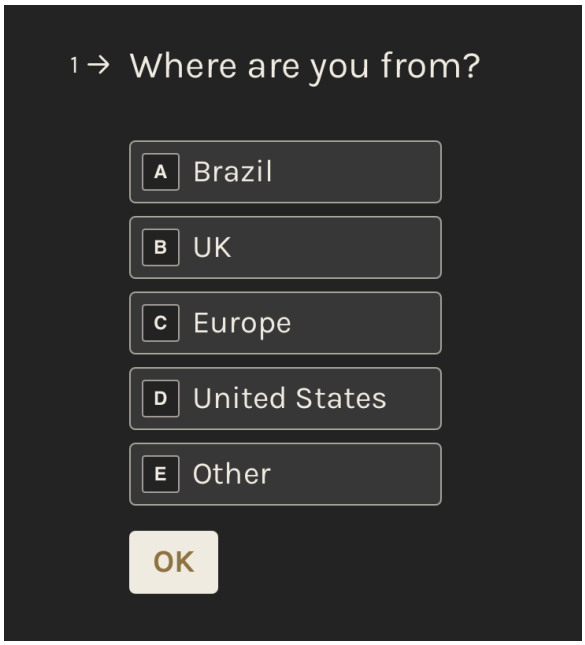
APPENDIX A

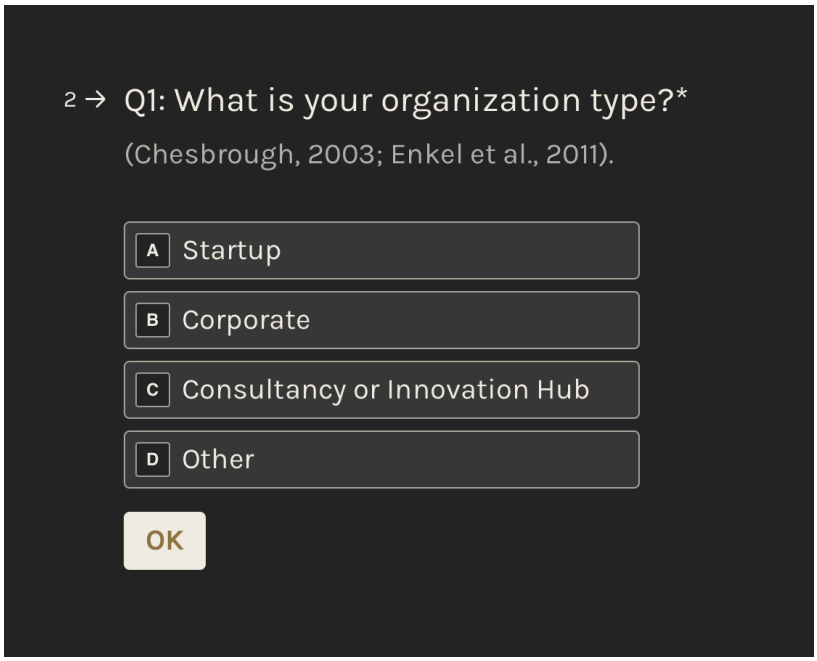
Images from the questionnaire:

Figure A1 - Question 1 from the Questionnaire



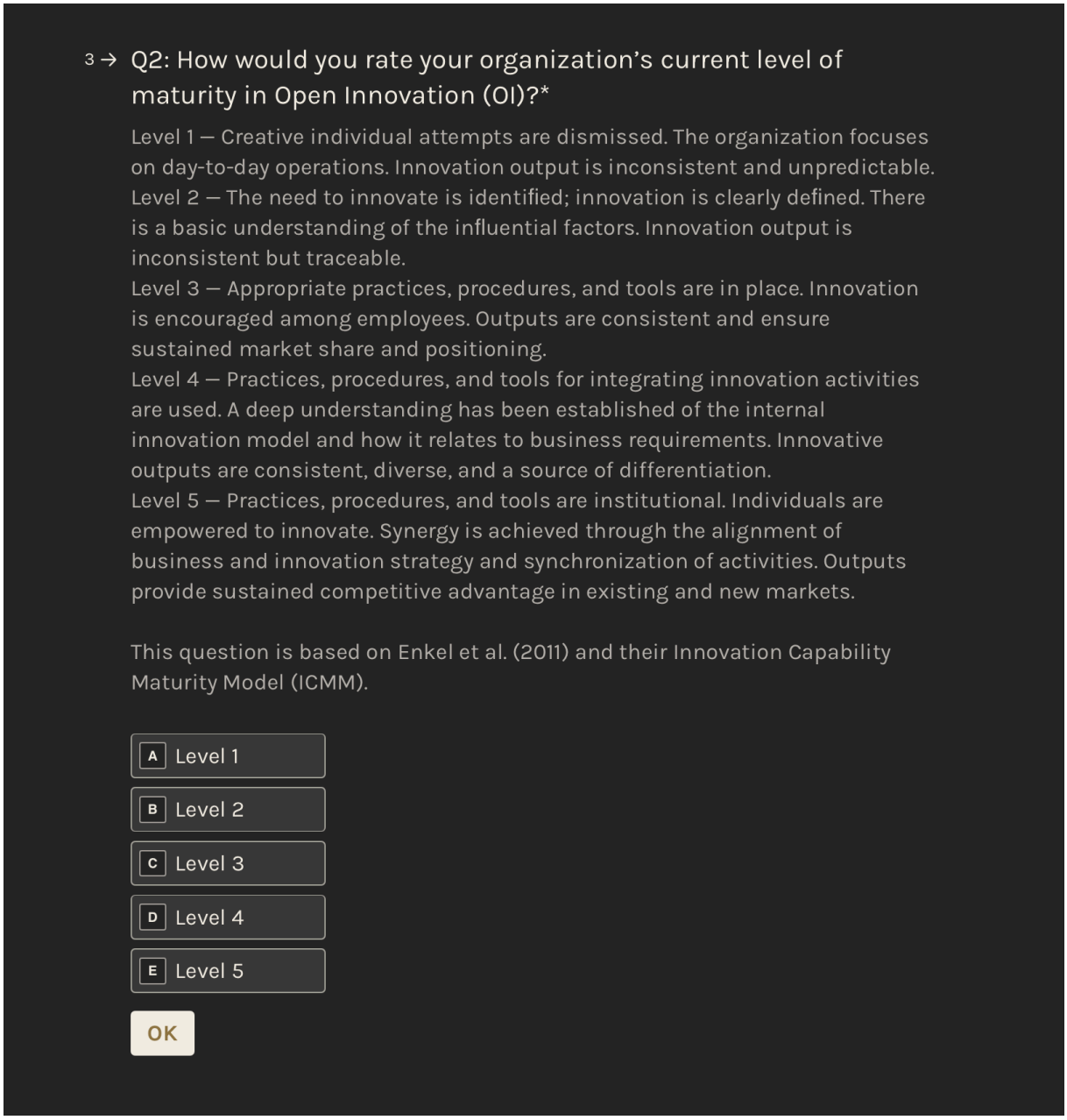
Source: Author (2024)

Figure A2 - Question 2 from the Questionnaire



Sources: Author (2024)

Figure A3 - Question 3 from the Questionnaire



Source: Author (2024)

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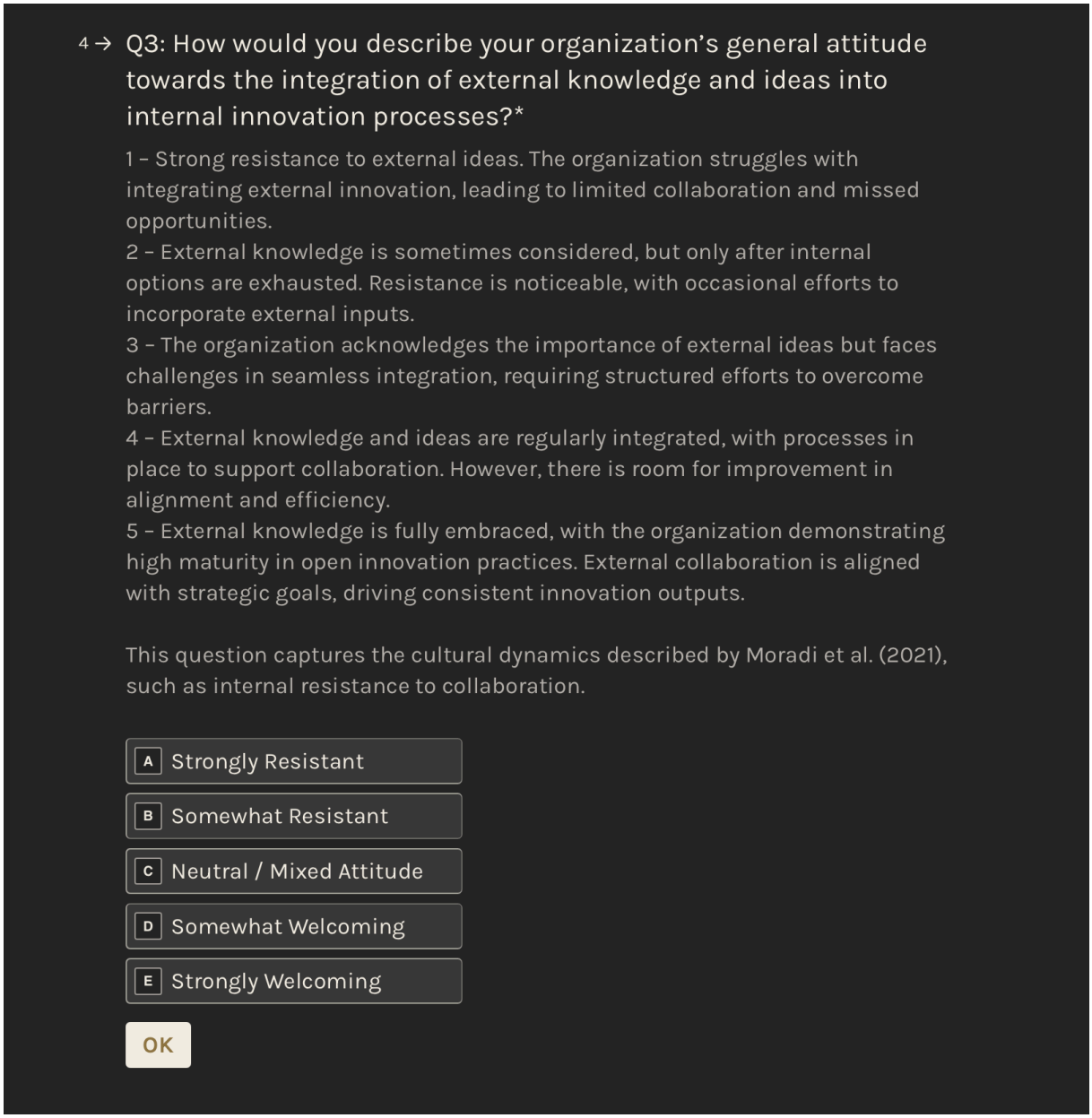

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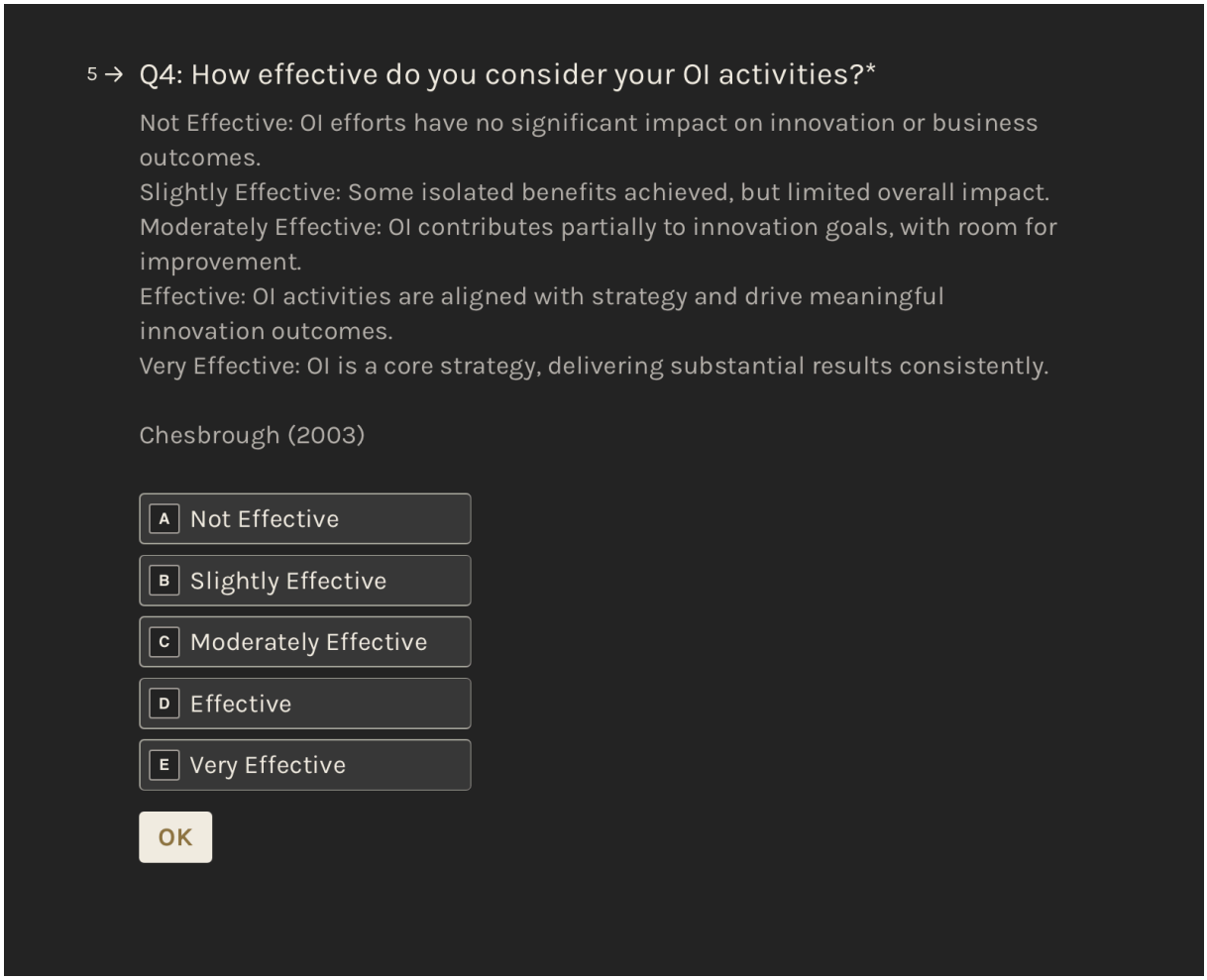

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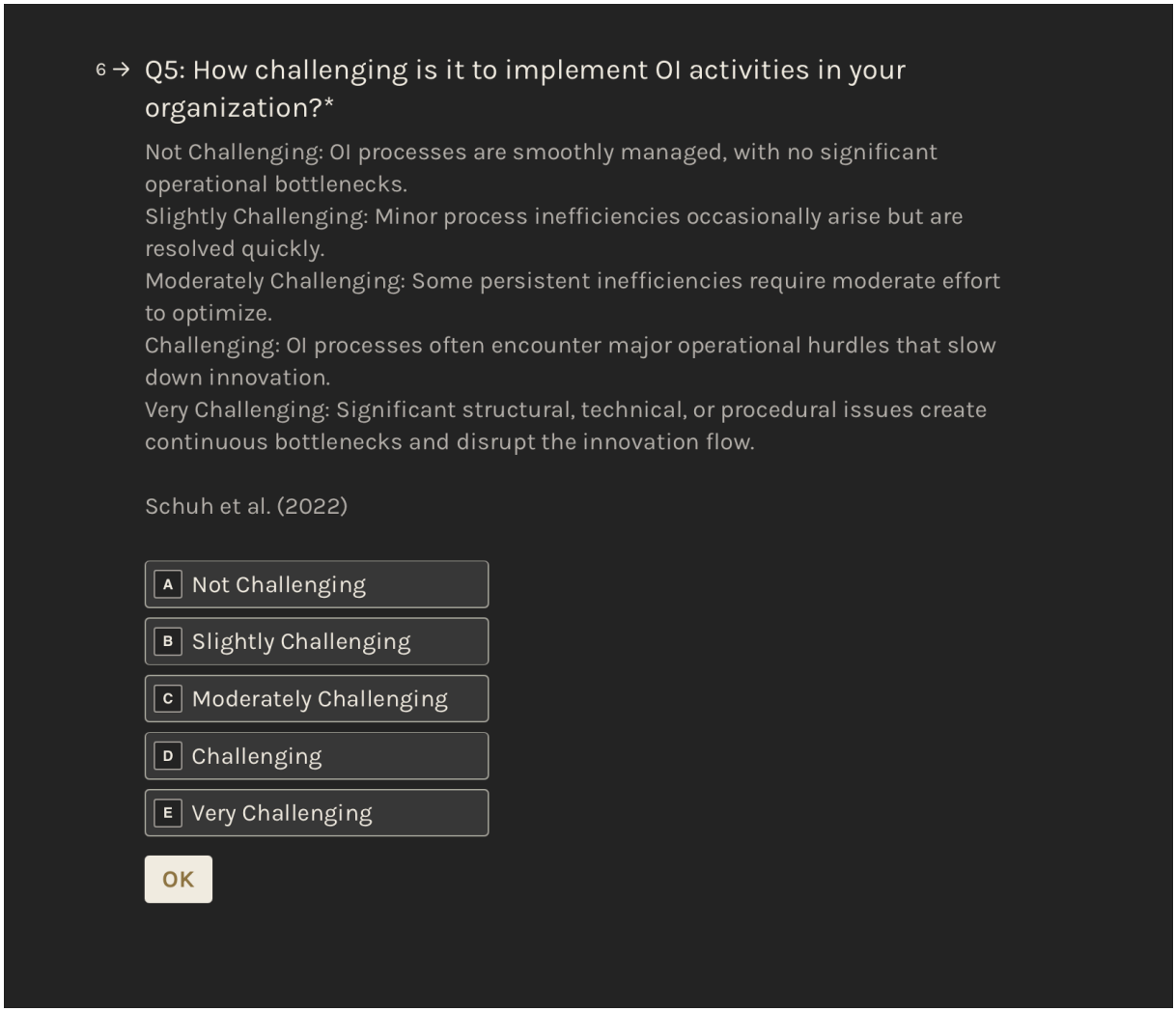

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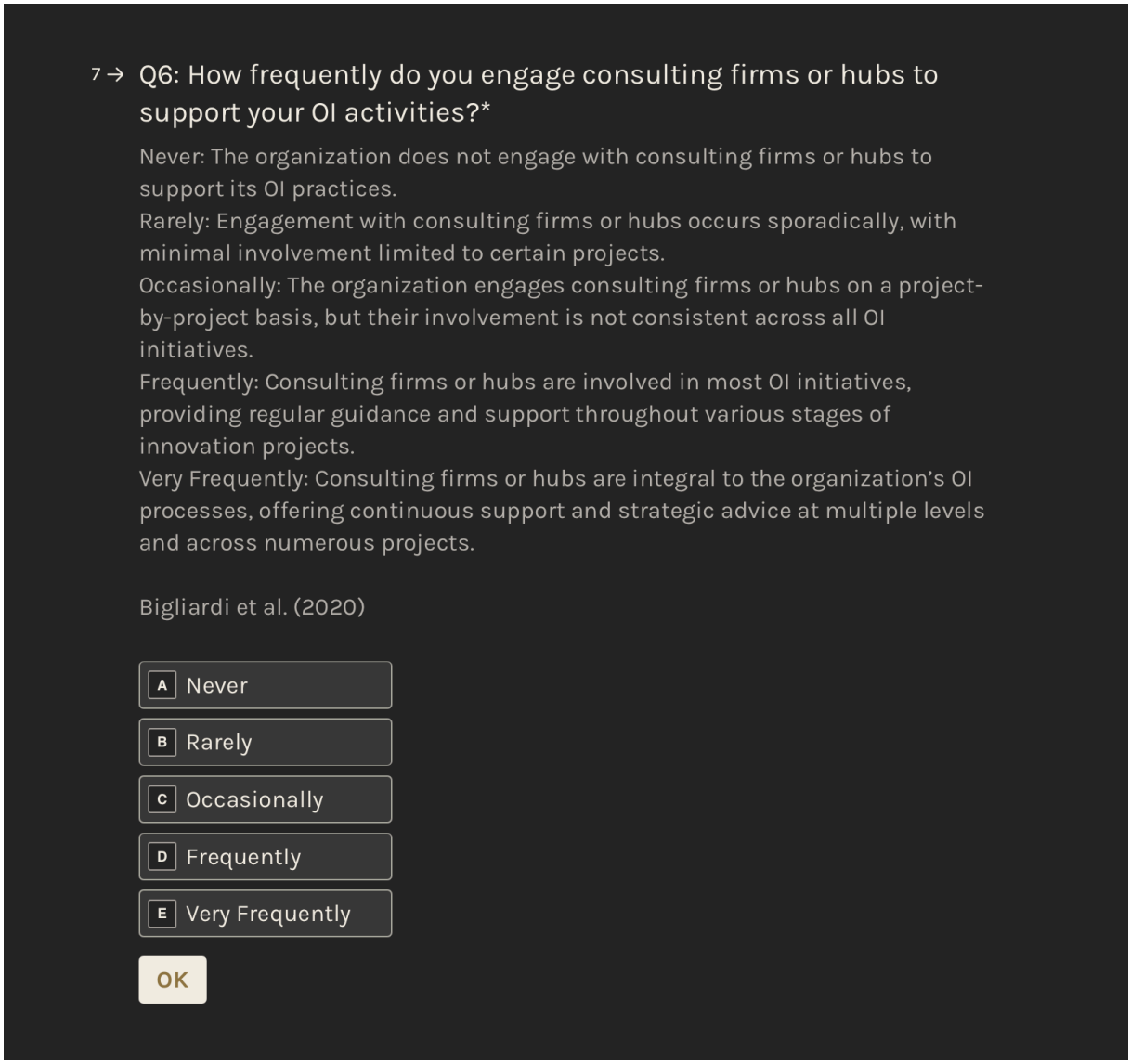

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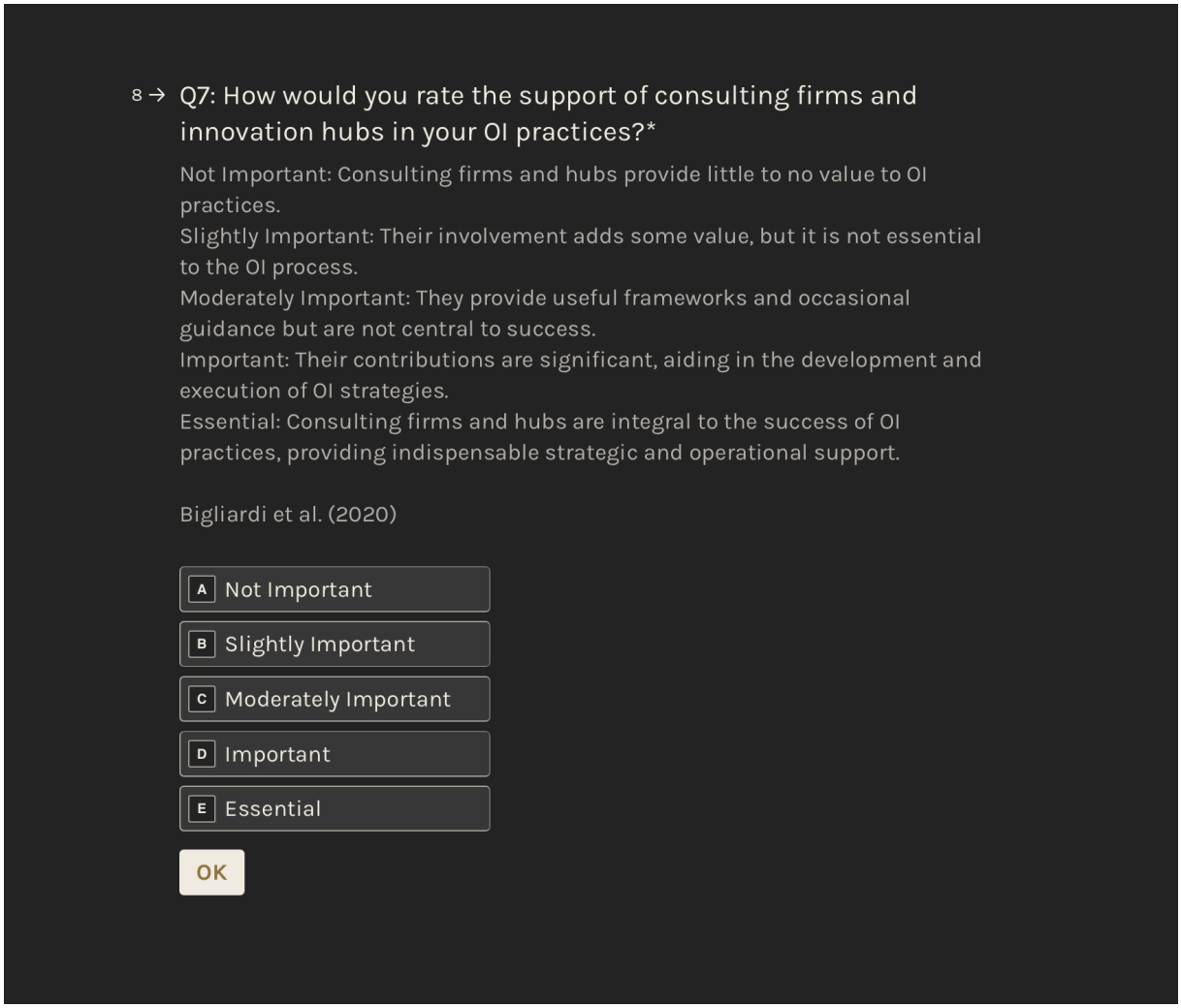

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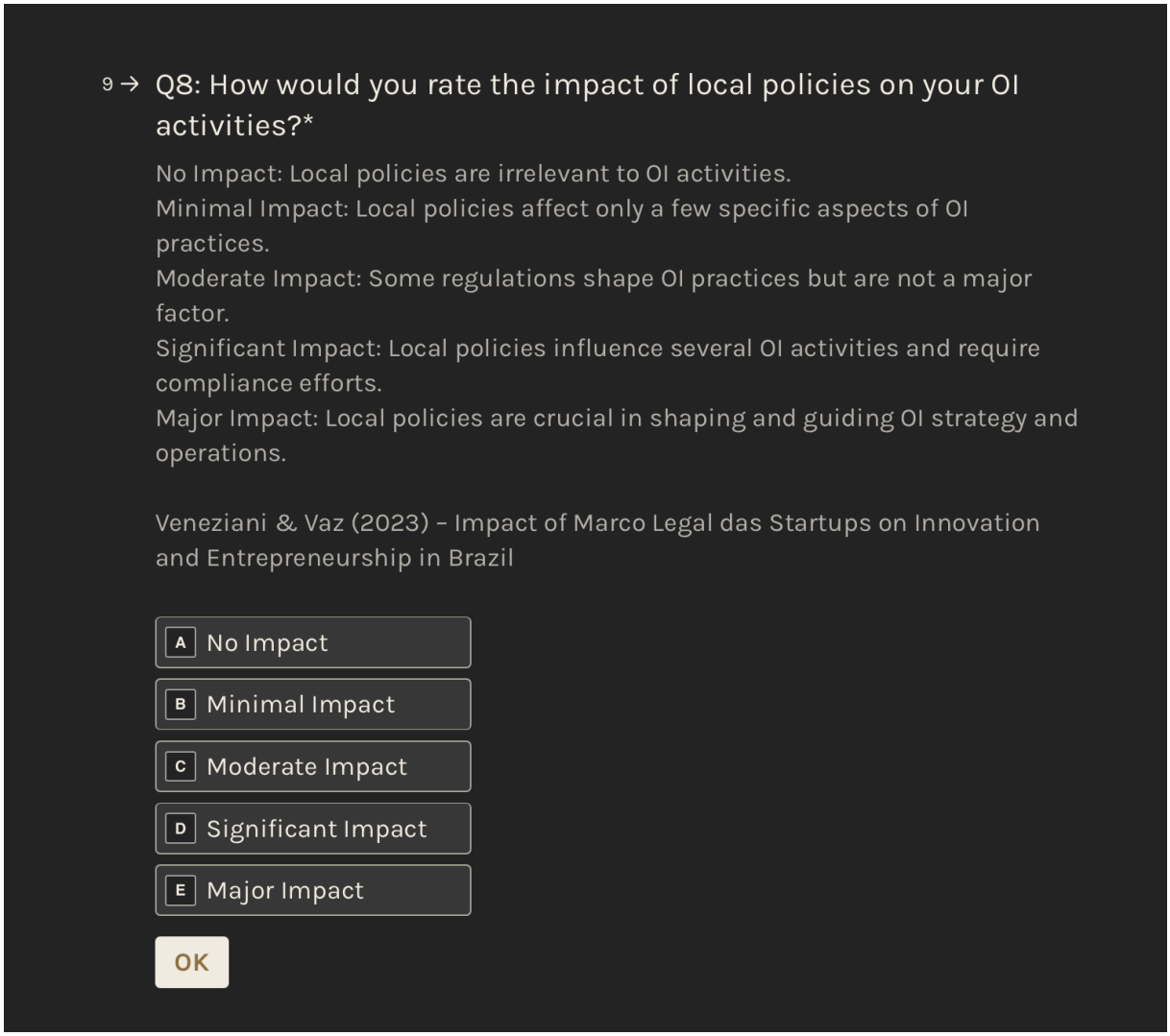
Figure A9 - Question 9 from the Questionnaire

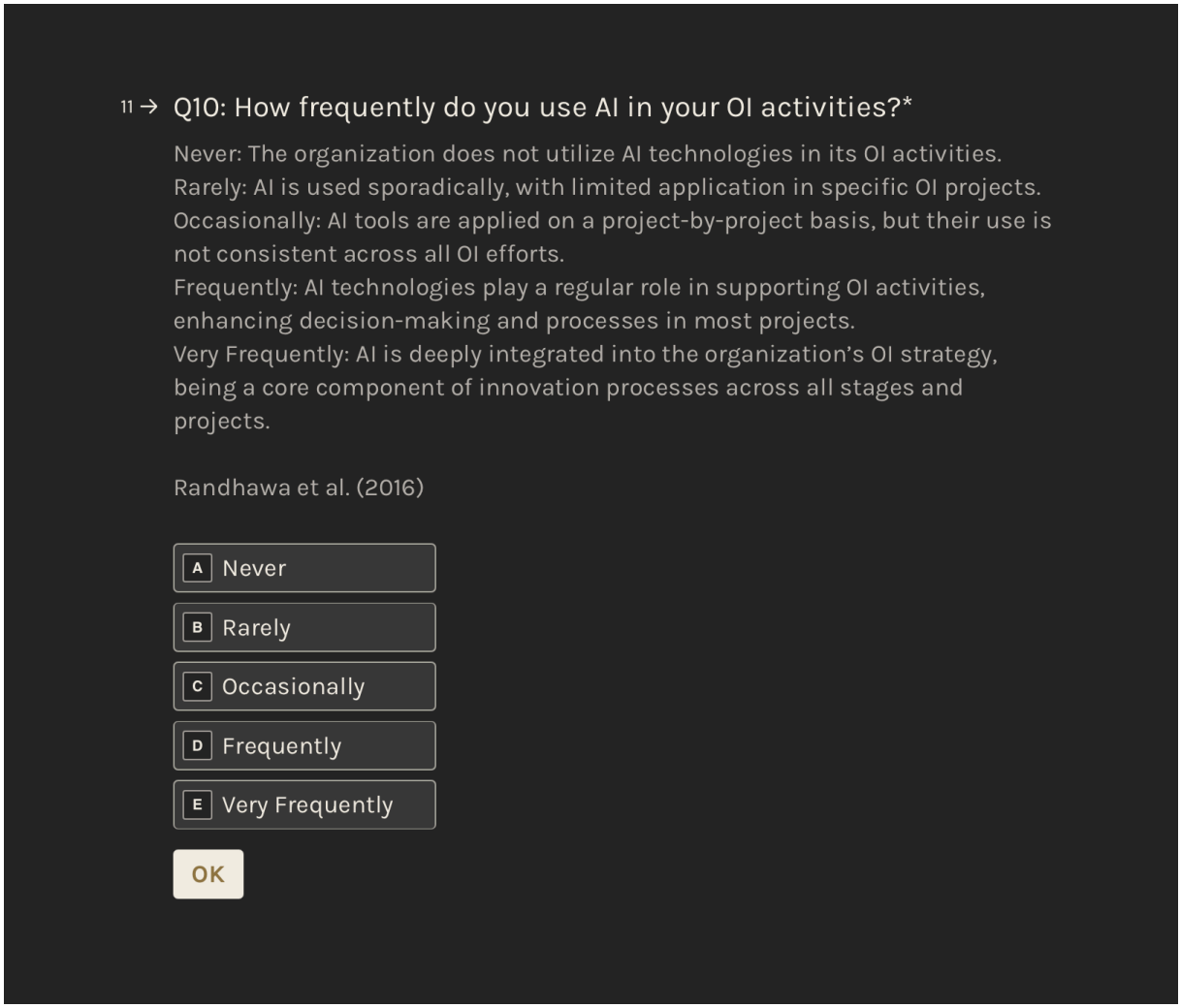


Source: Author (2024)

Figure A10 - Question 10 from the Questionnaire

Source: Author (2024)

Figure A11 - Question 11 from the Questionnaire



Source: Author (2024)

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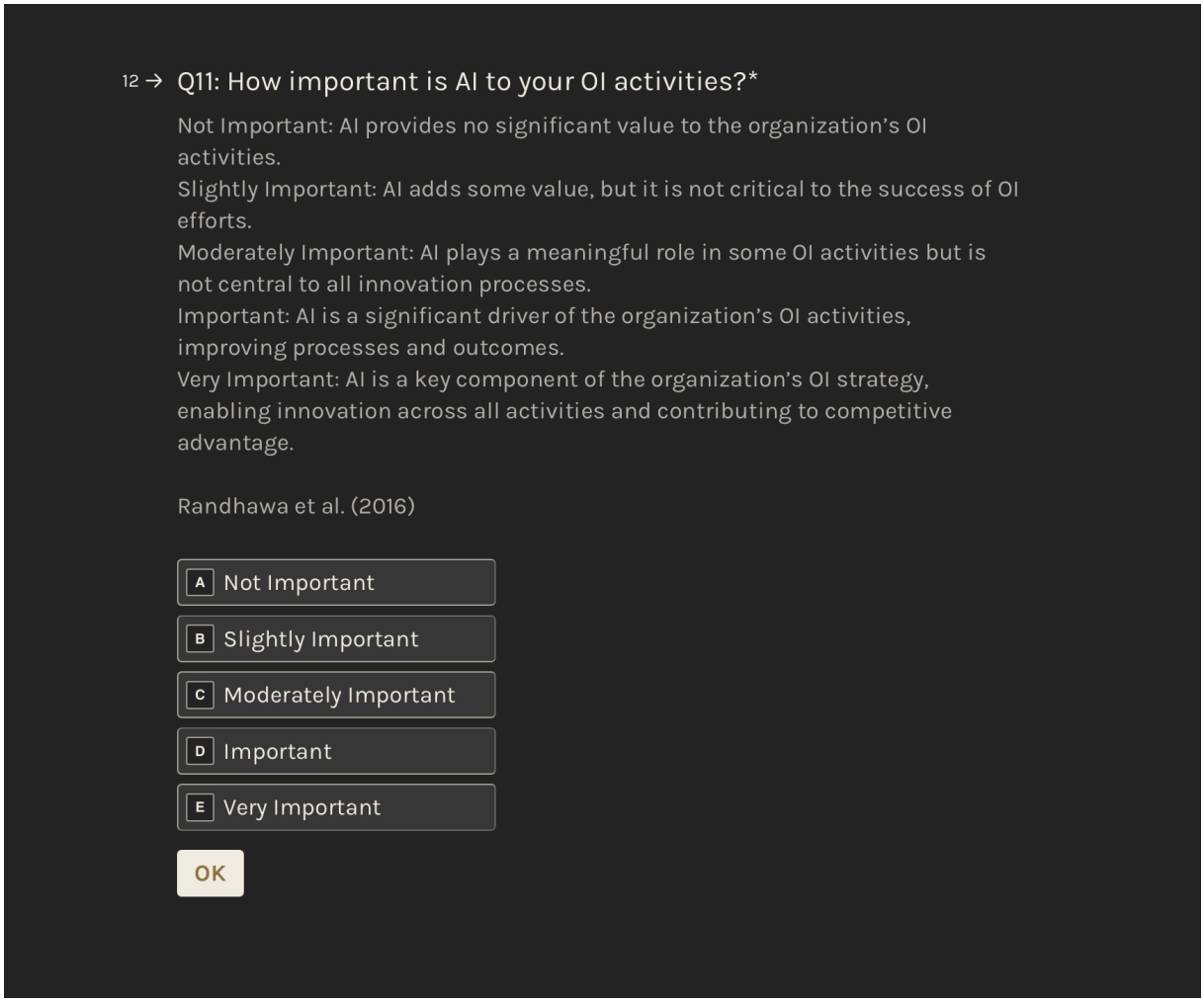

Source: Author (2024)

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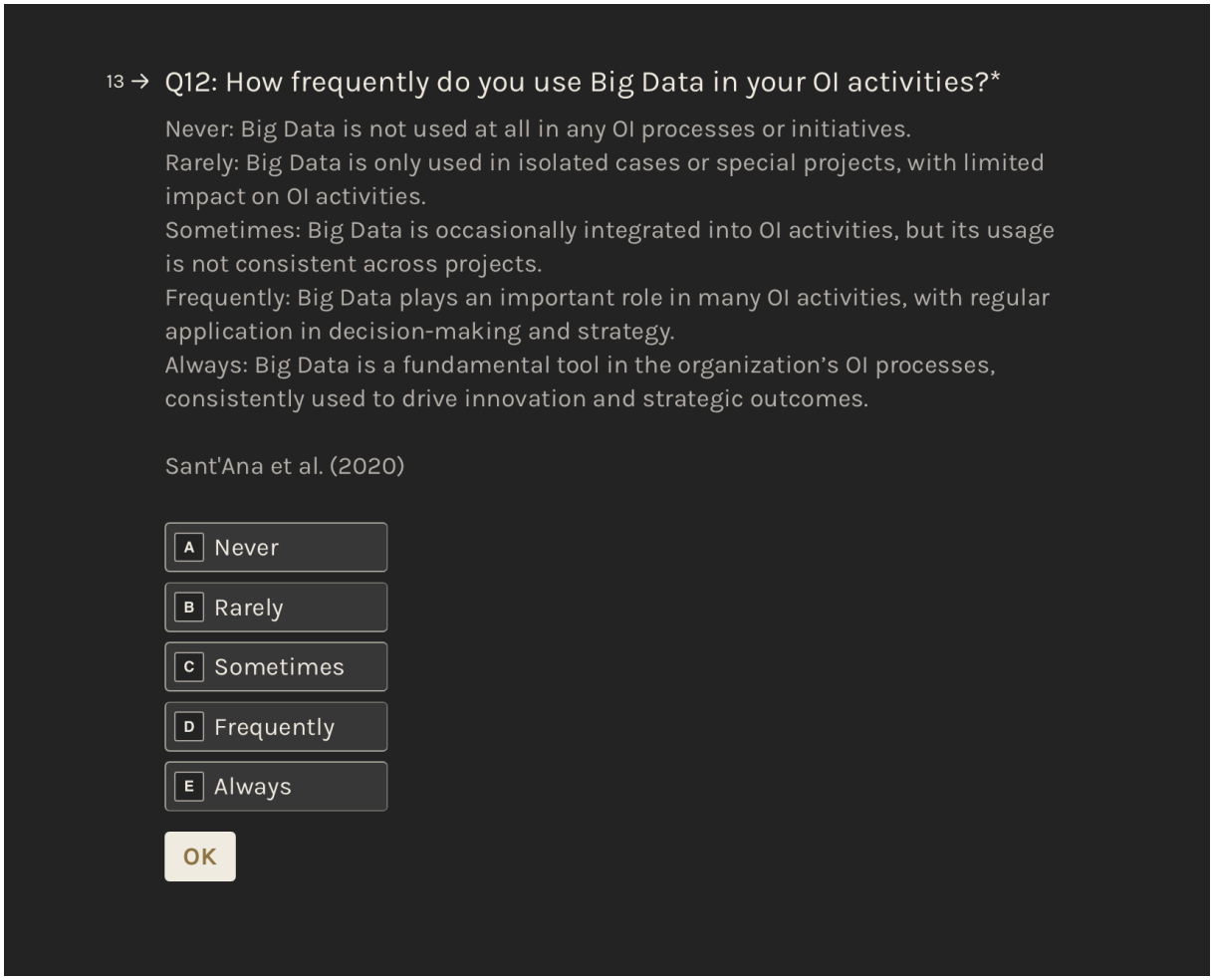

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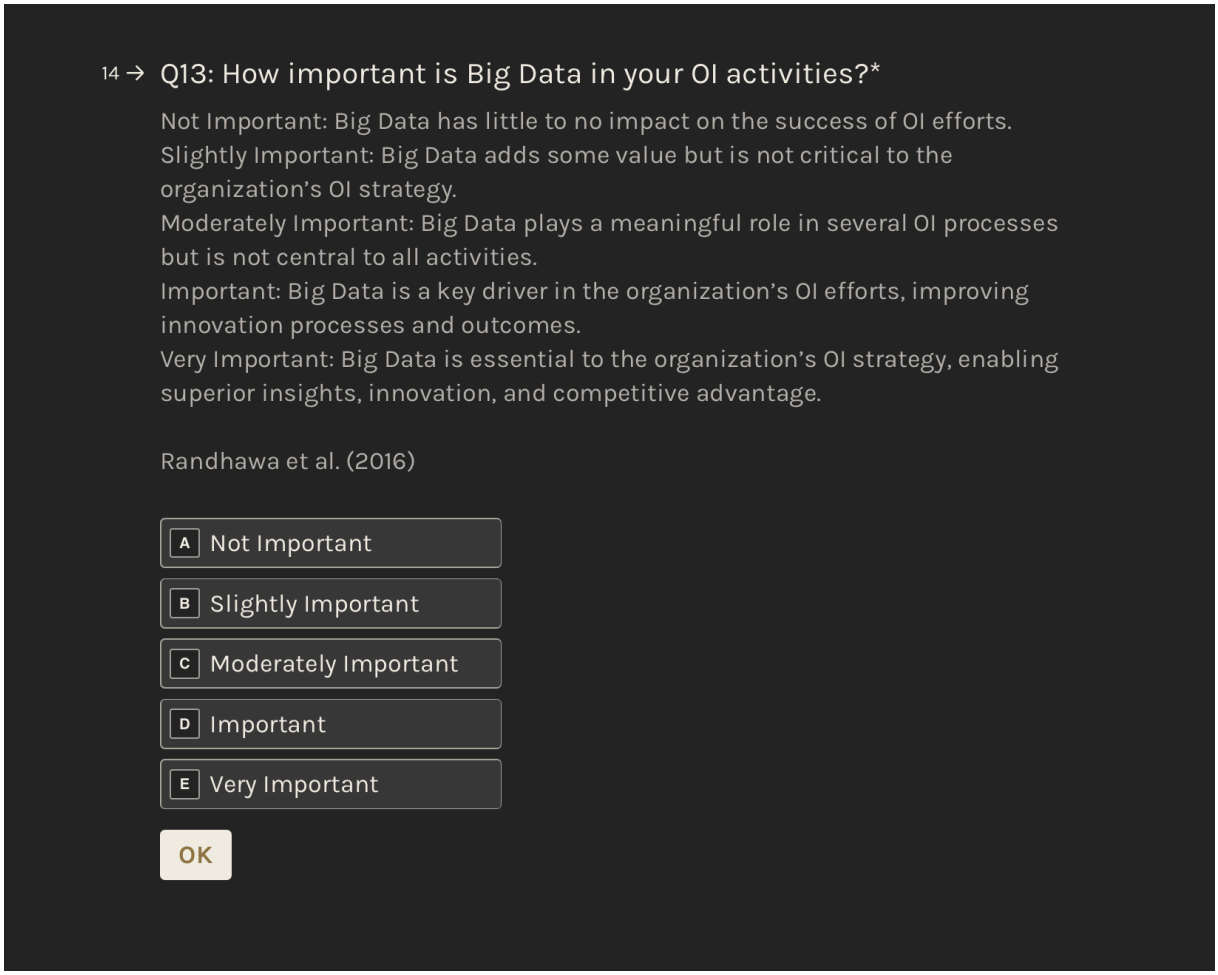

Source: Author (2024)

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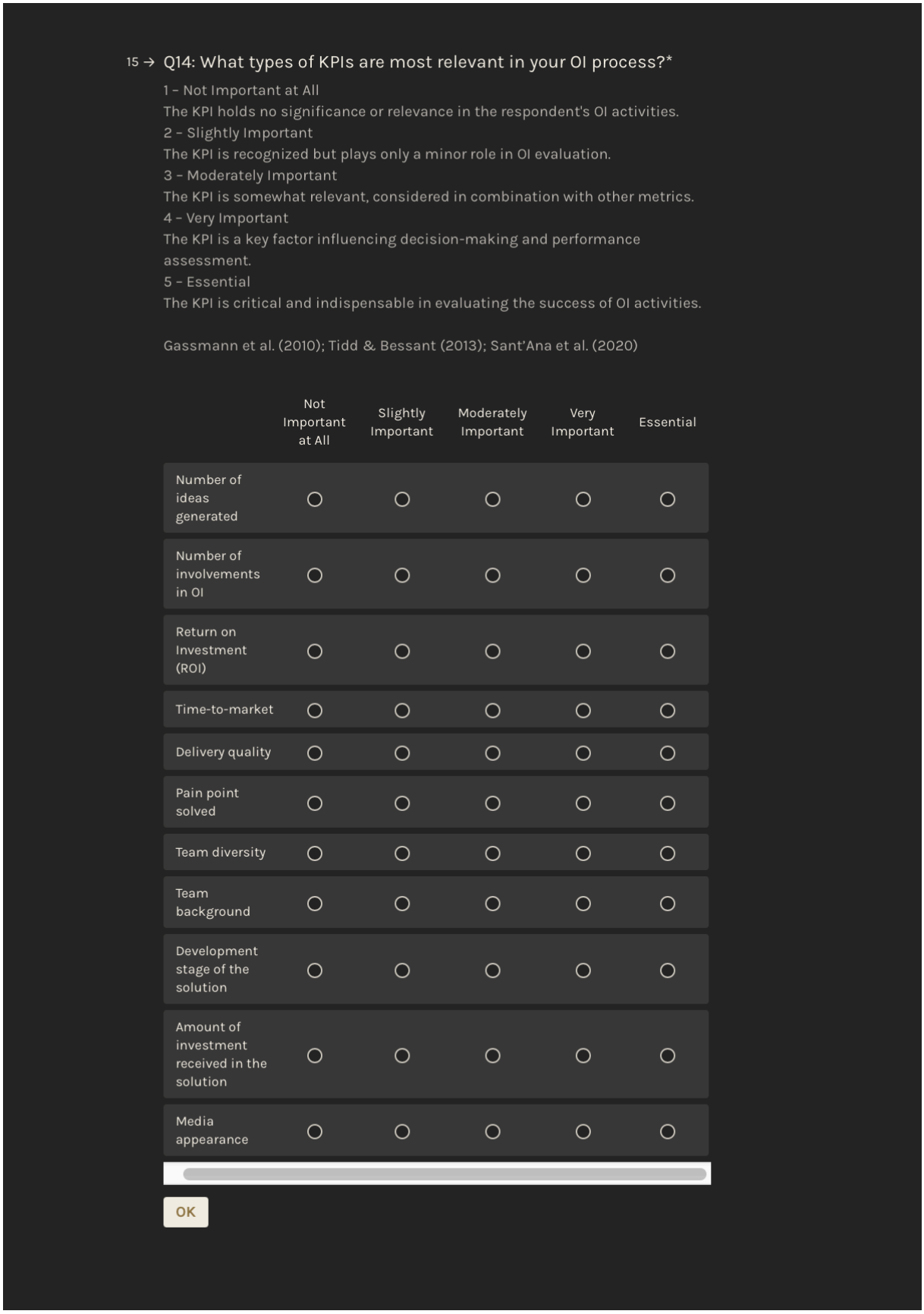

Source: Author (2024)

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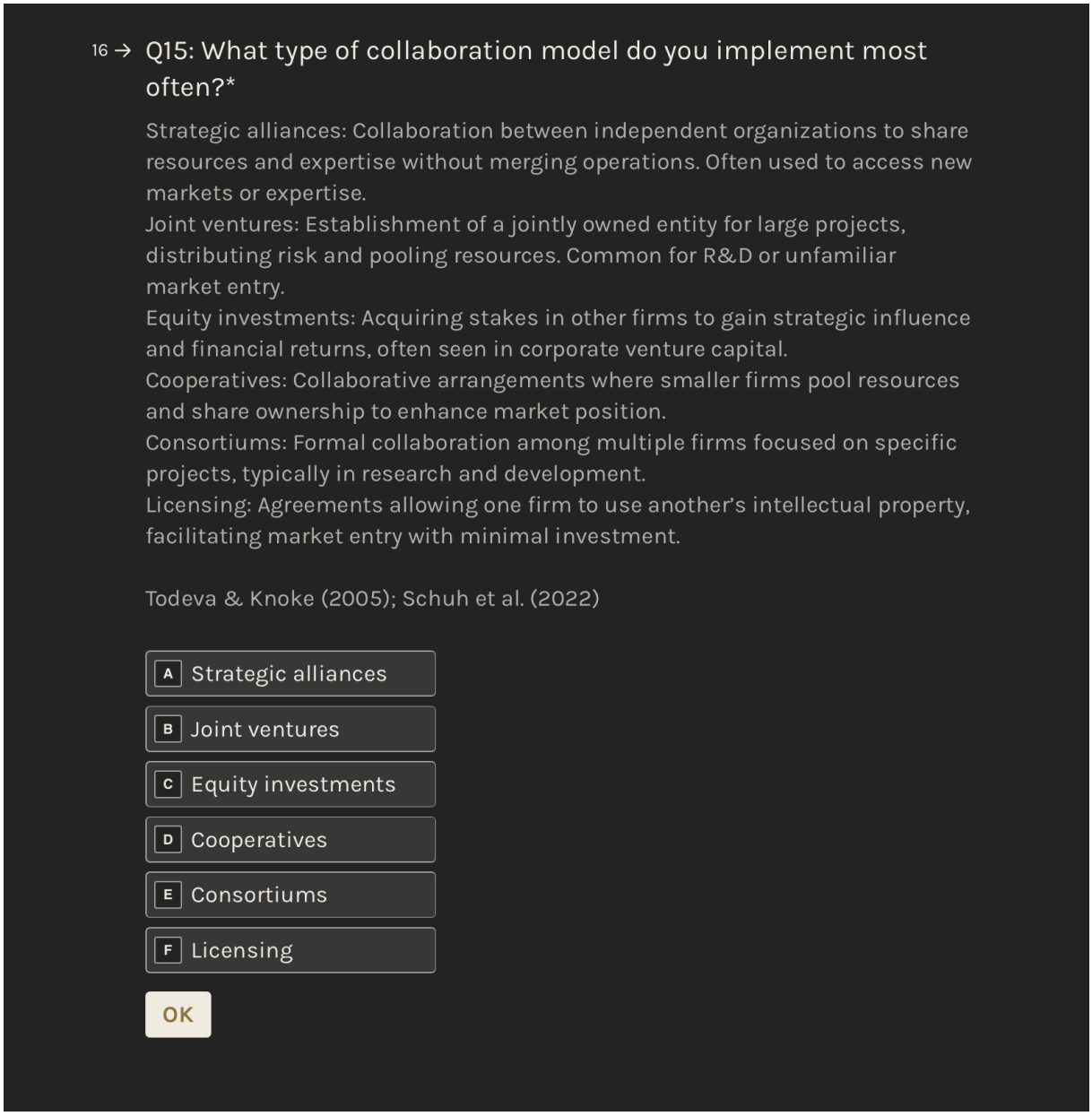

Source: Author (2024)

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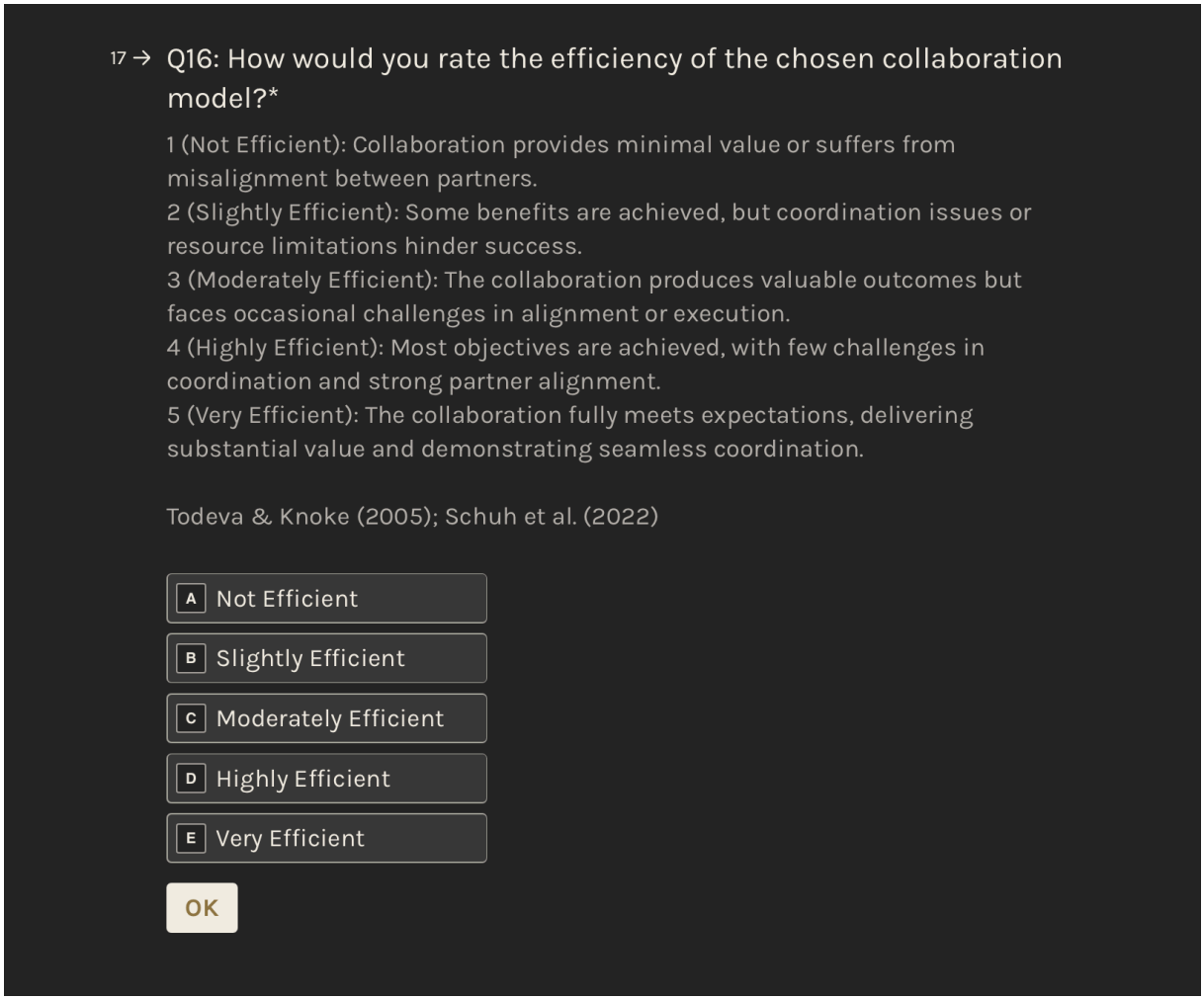

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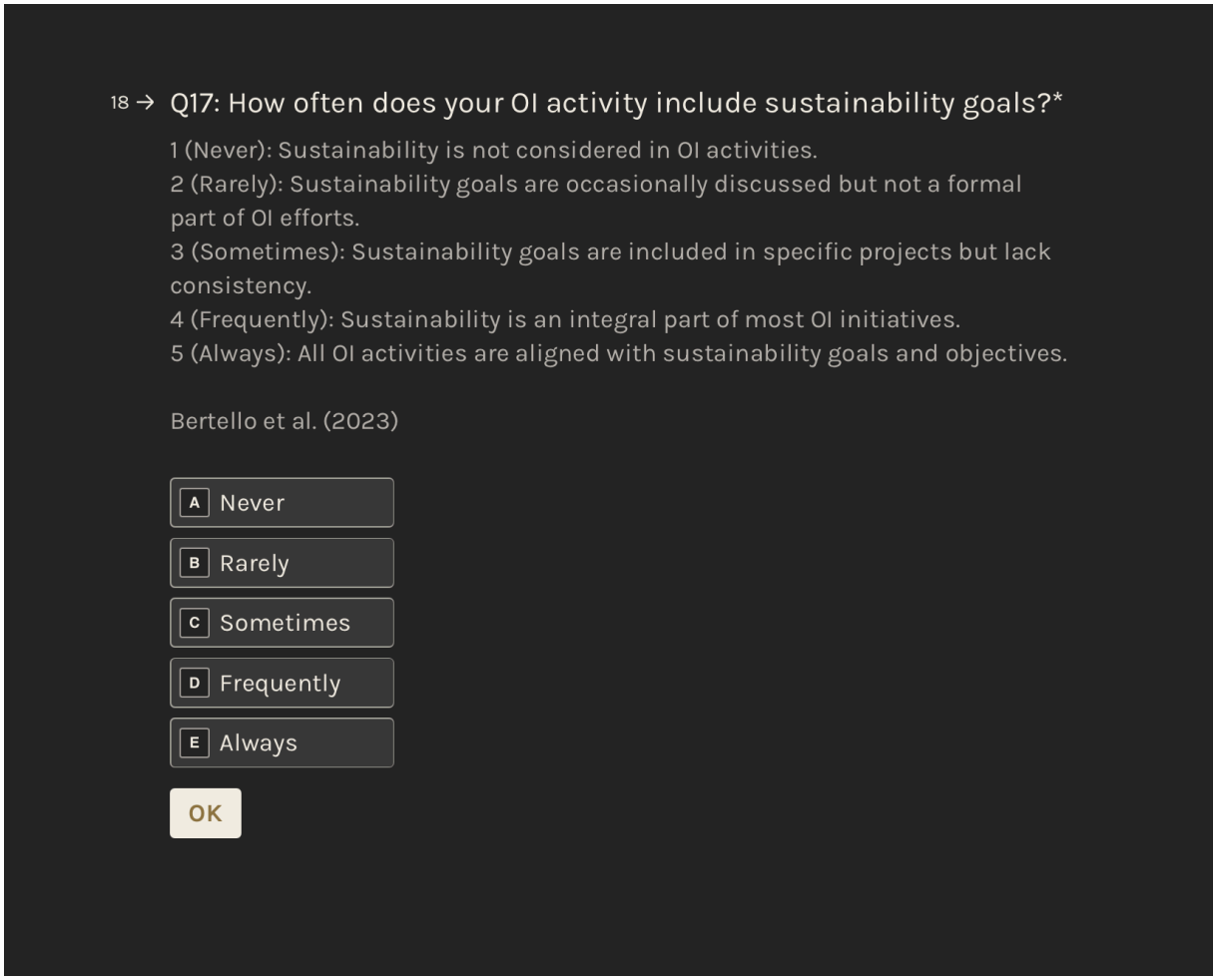
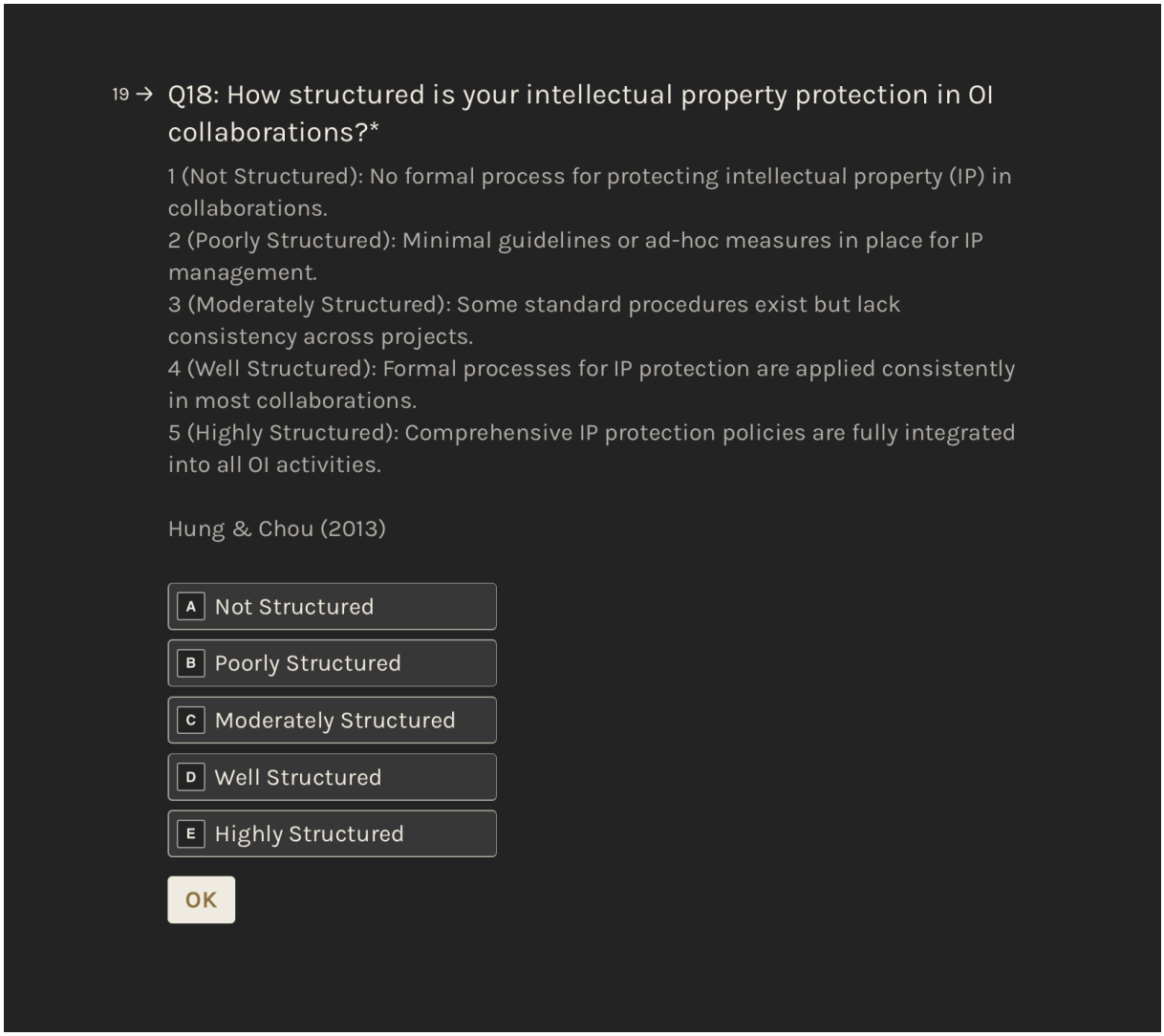


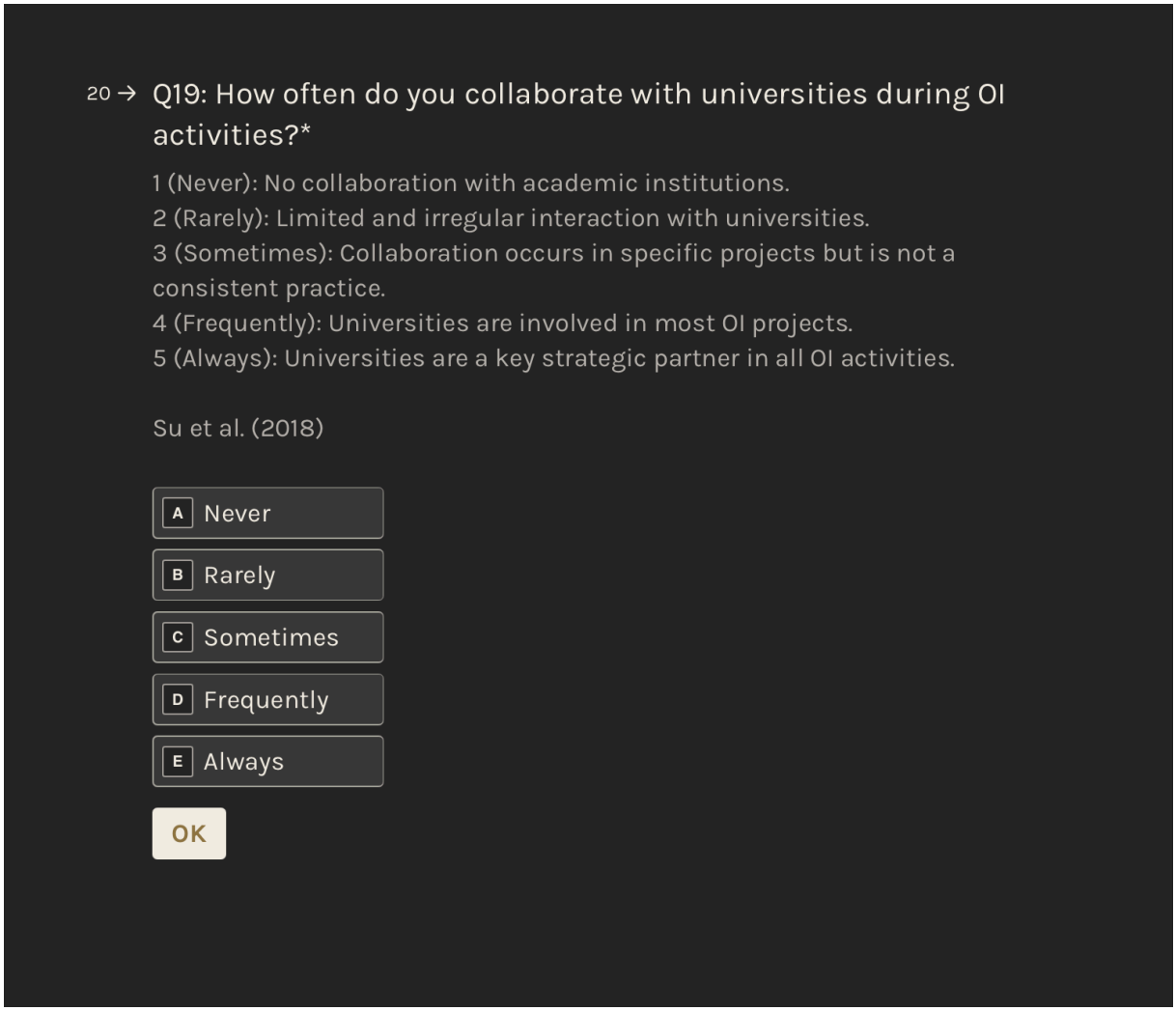
Source: Author (2024)

Figure A19 - Question 19 from the Questionnaire



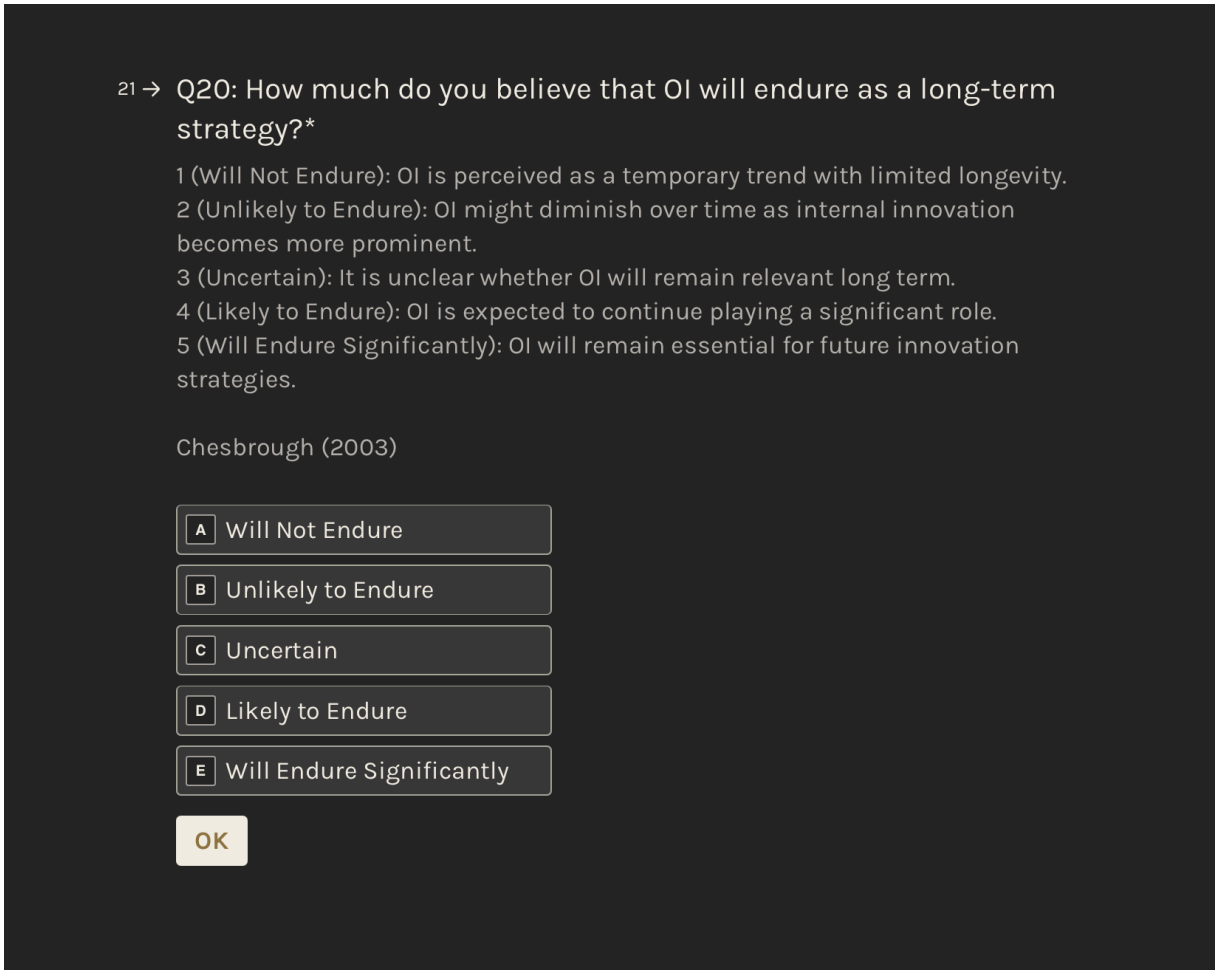
Source: Author (2024)

Figure A20 - Question 20 from the Questionnaire



Source: Author (2024)

Figure A21 - Question 21 from the Questionnaire



Source: Author (2024)