



João Carlos Cordeiro Soares

**The role of private consultants  
as innovation intermediaries  
in technology transfer**

**Universidade do Minho**  
Escola de Engenharia







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**The role of private consultants as innovation  
intermediaries in technology transfer**

Doctoral Thesis

Doctoral Program in Industrial and Systems Engineering

Work performed under the supervision of:

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January, 2024

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## **ACKNOWLEDGEMENTS**

I would like to express my sincere gratitude to my two supervisors, Professor Fernando Romero, and Professor Manuel Lopes Nunes, for their unwavering patience, guidance, and support throughout the five years it took to conduct this research. Their expertise and feedback have been invaluable in shaping the direction of my thesis.

I extend heartfelt gratitude to Professor Ana Cristina Braga for her invaluable support. Despite not being her student, she generously devoted her time, attention, and expertise to guide me through the statistical software challenges I encountered.

I would also like to appreciate my wife's role, who has supported and motivated me throughout this journey. Her love, encouragement, and understanding have been instrumental in keeping me focused and motivated.

I am also deeply grateful to the participants of my interviews, who generously gave their time and shared their valuable insights, even amidst the challenges posed by the COVID-19 pandemic. Their contributions have been crucial in providing me with a deeper understanding of the topic.

Finally, I would like to thank the private consulting firms that opened their doors and trusted me with access to their data and knowledge. Their cooperation and willingness to share their expertise have been instrumental in providing me with the necessary information to complete this research.

Once again, I would like to express my sincere gratitude to all those who have contributed to this thesis. Without your support, this work would not have been possible.

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## **O papel dos consultores privados como intermediários de inovação em transferência de tecnologia**

### **RESUMO**

Os domínios de sistemas de inovação e transferência de tecnologia (TT) têm evoluído consideravelmente nas últimas décadas. O dinamismo dos mercados, em especial, considerando face a uma perspectiva de inovação aberta, têm resultado numa maior complexidade daquele que é o processo de inovação, bem como do próprio papel dos agentes envolvidos na sua implementação. Novos intermediários de TT têm vindo a emergir para dar resposta a estas dinâmicas e novas lacunas por responder. Ainda assim, o conhecimento sobre o agente intermediário e o seu papel está ainda restringido a uma dimensão meramente conceptual, apesar da multiplicidade de agentes já a atuar sob este papel. Empresas de consultoria em gestão e inovação têm vindo cada vez mais a atuar como intermediários no Sistema Nacional de Inovação (SNI). Esta investigação procurou aprofundar o conhecimento relativo a este papel dos consultores privados enquanto intermediários de inovação em TT. Foram conduzidas entrevistas semiestruturadas a agentes do SNI com vista ao registo das suas experiências e perceções. Posteriormente, cinco hipóteses puderam ser formuladas e testadas através da condução de análise estatística a um arquivo de projetos de TT de uma consultora privada alvo de caso de estudo. Compilou-se uma lista estruturada de treze papéis/especializações que o intermediário de inovação pode desenvolver. A consultora privada demonstrou ter um papel significativo enquanto intermediário de inovação, em seis dos treze papéis compilados. Fatores adicionais foram ainda identificados por contribuírem para o papel do consultor privado, sendo o mais significativo a sua proatividade na origem de projetos de TT. Adicionalmente, registaram-se casos de colaboração direta entre a consultora privada e outros intermediários tradicionais a atuar nos projetos de TT. Por fim, uma comparação entre papéis desempenhados por ambos intermediários revelou tanto casos de sobreposição como de mútua exclusividade. As conclusões do estudo contribuem para a compreensão das consultoras e do seu papel em TT. Além disso, os resultados abrem caminho a uma discussão sobre o posicionamento do papel destes consultores privados dentro das complexas dinâmicas no SNI. Pretende-se dar um passo para o formal reconhecimento deste novo tipo de intermediário e consequentemente da atualização das políticas de inovação que regulam a TT e o marketing de inovação e dos resultados de I&D.

**Palavras-chave:** Sistemas de Inovação, Intermediação, Consultoria, Transferência de tecnologia.

## **The role of private consultants as innovation intermediaries in technology transfer**

### **ABSTRACT**

Innovation systems (IS) and technology transfer (TT) fields have been undergoing considerable changes throughout the last few decades. The dynamics of markets' functioning, especially considering an open innovation perspective, add a new complexity layer to fully understand the innovation process and its stakeholder's role in implementing it in the market. New TT intermediaries have been emerging to tackle these dynamics and new unanswered gaps. However, the understanding of the intermediary and its role is somehow still conceptual despite the multiplicity of agents operating under the role. Private innovation and management consultancy firms have been increasingly providing services as intermediaries within national innovation systems (NIS). This study aims to further develop the understanding of private consultants' role as innovation intermediaries in TT. Initially, exploratory semi-structured interviews were conducted with Portuguese NIS agents to collect and discuss experiences and perceptions. Five hypotheses were afterwards formulated and tested through a statistical analysis conducted on an archive with TT projects of a Portuguese private consultancy firm which was the case study subject. A framework was developed comprising thirteen role specializations an innovation intermediary can have. The private consultancy demonstrated to play a significant role as an innovation intermediary, particularly in six of these thirteen roles' specialisations. Other additional variables were also found to be key factors contributing to the private consultant's role, being the most relevant to their proactivity in originating TT projects. Moreover, TT projects in which the private consultancy directly collaborated with other traditional intermediaries were registered. Still, a comparison of the roles played by both intermediaries found cases of overlapping and mutual exclusivity within the same TT projects. The study findings contribute to the understanding of the role of private consultancies in TT projects. Also, the results lay a foundation for further discussion regarding the positioning of private consultants' role within the complex relationships and dynamics of NIS, in particular, with other traditional intermediaries. Intrinsically, the findings intent to be a step further in the recognition of this new kind of intermediary and, consequently, the improvement of innovation policies regulating TT and the marketing of innovation and R&D results.

**Keywords:** Innovation Systems, Intermediation role, Consultants, Technology Transfer.



## CONTENTS

|  |     |
|--|-----|
| Acknowledgements .....                               | iii |
| Resumo.....  | v   |
| Abstract.....  | vi  |
| List of tables.....                                  | xii |
| List of figures .....                                | xiv |
| List of abbreviations and acronyms .....             | xv  |
| Chapter 1. Introduction and Thesis overview.....     | 2   |
| 1.1 The research background.....                     | 2   |
| 1.2 The researcher motivation.....                   | 3   |
| 1.3 The research problem .....                       | 4   |
| 1.4 The research strategy.....                       | 6   |
| Chapter 2 - Literature Review .....                  | 9   |
| 2.1 Introduction.....                                | 9   |
| 2.2 Innovation .....                                 | 11  |
| 2.2.1 The concept of Innovation .....                | 11  |
| 2.2.2 Innovation Systems (IS) .....                  | 14  |
| 2.2.2.1. A systemic approach to innovation .....     | 14  |
| 2.2.2.2. National Innovation Systems (NIS).....      | 17  |
| 2.2.2.3. The Triple-Helix framework .....            | 23  |
| 2.2.2.4. The Open Innovation model (OI) .....        | 26  |
| 2.2.2.5. Innovation Policymaking .....               | 32  |
| 2.2.3 The Portuguese innovation system .....         | 34  |
| 2.2.3.1 Characterization of the Portuguese NIS ..... | 34  |
| 2.2.3.2 Financial innovation incentives .....        | 37  |
| 2.3 Technology Transfer (TT).....                    | 40  |
| 2.3.1 Transferring technology and innovation .....   | 40  |
| 2.3.2 Challenges to Technology Transfer .....        | 42  |
| 2.3.3 Key components of the TT concept .....         | 44  |
| 2.3.3.1 Sources and Receivers of the technology..... | 45  |
| 2.3.3.2 Object (or Technology).....                  | 45  |
| 2.3.3.3 Intermediaries (or mediators) .....          | 47  |

|  |  |    |
|--|--|----|
| 2.4  | Intermediation and Intermediaries.....             | 48 |
| 2.4.1  | Technology Transfer intermediation.....            | 48 |
| 2.4.2  | Understanding intermediaries and their role.....   | 52 |
| 2.4.3  | Intermediary organizations .....                   | 53 |
| 2.4.3.1  | Private Intermediaries.....                        | 58 |
| 2.4.3.2  | Consulting firms as innovation intermediaries..... | 60 |
| 2.5  | Private Consulting firms.....                      | 61 |
| 2.5.1  | Innovation and management consulting .....         | 61 |
| 2.5.2  | Consulting Industry in Portugal.....               | 64 |
| 2.5.3  | Consultants' role in Technology Transfer .....     | 66 |
| 2.6  | Literature Review conclusions .....                | 68 |
| Chapter 3 - The Roles of an Innovation Intermediary..... |  | 71 |
| 3.1  | Policy & Strategy (PS).....                        | 74 |
| 3.2  | Mediation & Mobilization (MM) .....                | 74 |
| 3.3  | Knowledge Diffusion & Support (KDS) .....          | 75 |
| 3.4  | Funding & Finance (FF).....                        | 75 |
| 3.5  | Technology Scouting & Market Foresight (TSMF)..... | 76 |
| 3.6  | Design & Idealization (DI) .....                   | 76 |
| 3.7  | Brokering & Gatekeeping (BG).....                  | 77 |
| 3.8  | Project Management & Assessment (PMA).....         | 78 |
| 3.9  | Financial & Technical Feasibility (FTF).....       | 78 |
| 3.10   | Accreditation & Quality (AQ) .....                 | 79 |
| 3.11   | Intellectual Property & Rights (IPR).....          | 79 |
| 3.12   | Implementation & Knowledge Transfer (IKT) .....    | 80 |
| 3.13   | Marketing & Business Development (MBD) .....       | 80 |
| Chapter 4 – Methodology.....                             |  | 83 |
| 4.1  | Qualitative research methods .....                 | 83 |
| 4.2  | Quantitative research methods.....                 | 86 |
| 4.3  | Combination of research methods.....               | 88 |
| 4.4  | Research Plan .....                                | 90 |
| 4.4.1  | Semi-structured Interview .....                    | 92 |
| 4.4.1.1  | Interview script design .....                      | 93 |

|           |  |     |
|-----------|--|-----|
| 4.4.1.2   | Sample definition.....   | 95  |
| 4.4.1.3   | Interview process.....   | 95  |
| 4.4.1.4   | Content results analysis.....                                      | 97  |
| 4.4.2     | Case study through document analysis .....                         | 99  |
| 4.4.2.1   | Hypotheses formulation.....  | 99  |
| 4.4.2.2   | The case study .....   | 106 |
| 4.4.2.3   | Data collection and processing domains.....                        | 107 |
| 4.4.2.4   | Statistical analysis process .....                                 | 110 |
| Chapter 5 | Qualitative analysis: Interview results.....                       | 114 |
| 5.1       | Perception and experience with public intermediaries .....         | 114 |
| 5.1.1     | Roles and value proposition.....                                   | 115 |
| 5.1.2     | Resources and responsiveness.....                                  | 116 |
| 5.1.3     | Market positioning.....  | 119 |
| 5.2       | Perception and experience with private innovation consultants..... | 122 |
| 5.2.1     | Roles and value proposition.....                                   | 123 |
| 5.2.2     | The emergence of private players.....                              | 129 |
| 5.3       | Role value proposition .....                                       | 131 |
| 5.3.1     | Proactivity.....   | 132 |
| 5.3.2     | Responsibility .....   | 133 |
| 5.3.3     | Competence .....   | 135 |
| 5.3.4     | Relationships (Network) .....                                      | 137 |
| 5.3.5     | Financing.....   | 139 |
| 5.4       | Public and Private intermediaries overlapping scopes .....         | 140 |
| 5.4.1     | A strategic complementarity .....                                  | 141 |
| 5.4.2     | Residual overlapping.....  | 145 |
| 5.5       | External factors.....  | 147 |
| 5.5.1     | The sector of activity and geographic zone .....                   | 148 |
| 5.5.2     | Business Interests .....   | 148 |
| 5.5.3     | Time factors – pace and urgency .....                              | 149 |
| 5.5.4     | Occupation and limitation of stakeholders .....                    | 151 |
| 5.5.5     | Financial resources and the size of companies.....                 | 152 |
| 5.5.6     | Financial opportunities .....                                      | 153 |
| 5.6       | Private intermediaries' recognition in NIS.....                    | 154 |

|   |  |     |
|---|--|-----|
| 5.6.1   | Peer recognition .....   | 155 |
| 5.6.2   | Not properly recognized by NIS .....                                   | 157 |
| 5.6.3   | Distinguishing intermediation roles from consulting services .....     | 161 |
| 5.6.4   | The last line of application for innovation incentive policies .....   | 164 |
| 5.7   | Role Specializations .....   | 165 |
| 5.8   | Preliminary discussion.....  | 168 |
| Chapter 6 - Quantitative analysis: Case study results ..... |  | 173 |
| 6.1   | Sample descriptive analysis.....                                       | 173 |
| 6.1.1   | Sector/Technology Domain .....   | 173 |
| 6.1.2   | Entity originating the project .....                                   | 174 |
| 6.1.3   | Contact of the Source .....  | 176 |
| 6.1.4   | Contact of the Recipient .....   | 177 |
| 6.1.5   | Projects within the consultant's network.....                          | 178 |
| 6.1.6   | Key Motivations for consultant involvement .....                       | 179 |
| 6.1.7   | Collaboration with other intermediaries .....                          | 181 |
| 6.1.8   | Roles performed by the private consultant.....                         | 182 |
| 6.1.9   | Roles performed by other traditional intermediaries.....               | 185 |
| 6.2   | Statistical Analysis – Testing Hypothesis .....                        | 189 |
| 6.2.1   | Roles played by private consultants - H1 Tests .....                   | 189 |
| 6.2.1.1   | Funding & Finance.....   | 189 |
| 6.2.1.2   | Project Management & Assessment .....                                  | 190 |
| 6.2.1.3   | Technology Scouting & Market Foresight .....                           | 191 |
| 6.2.1.4   | Design & Idealization .....  | 192 |
| 6.2.1.5   | Financial & Technical Feasibility .....                                | 193 |
| 6.2.1.6   | Marketing & Business Development .....                                 | 194 |
| 6.2.2   | Projects within the Consultant' Network – H2 Tests .....               | 194 |
| 6.2.3   | Involvement of private consultants – H3 Tests .....                    | 196 |
| 6.2.3.1   | Looking for financing options .....                                    | 197 |
| 6.2.3.2   | Came due to Good References .....                                      | 197 |
| 6.2.3.3   | Looking for Project Management support .....                           | 198 |
| 6.2.3.4   | Looking for Partners/Contacts.....                                     | 199 |
| 6.2.3.5   | Looking for Technical Know-how.....                                    | 200 |
| 6.2.4   | Collaborative projects with Traditional Intermediaries – H4 Tests..... | 200 |

|  |   |     |
|--|---|-----|
| 6.2.5  | Role's comparison between intermediaries – H5 Tests ..... | 202 |
| 6.2.5.1  | Mediation & Mobilization.....                             | 203 |
| 6.2.5.2  | Funding & Finance.....                                    | 204 |
| 6.2.5.3  | Design & Idealization .....                               | 205 |
| 6.2.5.4  | Brokering & Gatekeeping .....                             | 206 |
| 6.2.5.5  | Project Management & Assessment .....                     | 206 |
| 6.2.5.6  | Financial & Technical Feasibility .....                   | 207 |
| 6.2.5.7  | Intellectual Property & Rights.....                       | 208 |
| Chapter 7 - Research discussion and Key findings ..... |   | 210 |
| 7.1  | Results overview.....                                     | 210 |
| 7.2  | Discussing the research hypotheses.....                   | 213 |
| 7.2.1  | Discussing Hypothesis H1 .....                            | 213 |
| 7.2.2  | Discussing Hypothesis H2 .....                            | 215 |
| 7.2.3  | Discussing Hypothesis H3 .....                            | 216 |
| 7.2.4  | Discussing Hypothesis H4.....                             | 217 |
| 7.2.5  | Discussing Hypothesis H5 .....                            | 218 |
| 7.3  | Key Findings.....   | 220 |
| Chapter 8 - Conclusions and Future developments .....  |   | 224 |
| 8.1  | Conclusions.....  | 224 |
| 8.2  | Limitations and Future developments.....                  | 226 |
| 8.2.1  | Discussing limitations .....                              | 226 |
| 8.2.2  | Future developments.....                                  | 227 |
| Scientific Publications .....                          |   | 229 |
| References .....                                       |   | 230 |
| Annex I – Interview guide .....                        |   | 259 |
| Annex II – SPSS Outputs.....                           |   | 262 |

## LIST OF TABLES

|   |     |
|---|-----|
| Table 1 – Research objectives formulation.....  | 5   |
| Table 2 - Activities of consultants in technology transfer.....   | 66  |
| Table 3 – The thirteen intermediary's role specializations.....   | 72  |
| Table 4 - Qualitative Research - Pros and Cons.....   | 85  |
| Table 5 - Quantitative research - Pros and Cons.....  | 87  |
| Table 6 - Research Methodologies - Comparative analysis .....   | 89  |
| Table 7 - Interview script design.....  | 93  |
| Table 8 – Interview sample characterization matrix.....   | 96  |
| Table 9 - Interview content codification .....  | 98  |
| Table 10 - Sample data variables to be collected and analysed.....                                      | 108 |
| Table 11 - Statistical tests selection by Hypothesis .....  | 110 |
| Table 12 – Results of the assisted list of intermediary's role specializations .....                    | 166 |
| Table 13 – Key roles comparison - Case study sample VS Interview's assisted list .....                  | 185 |
| Table 14 - Distribution table - Role of Funding & Finance.....  | 190 |
| Table 15 - Distribution table - Role of Project Management & Assessment.....                            | 190 |
| Table 16 - Distribution table - Role of Technology Scouting & Market Foresight.....                     | 191 |
| Table 17 - Distribution table - Role of Design & Idealization.....                                      | 192 |
| Table 18 - Distribution table - Role Financial & Technical Feasibility.....                             | 193 |
| Table 19 - Distribution table - MBD role.....   | 194 |
| Table 20 - Crosstabulation – The existence of Previous Interactions .....                               | 195 |
| Table 21 - Distribution table - Motivation of looking for financial options.....                        | 197 |
| Table 22 - Distribution table - Motivation by WOM and Good References.....                              | 198 |
| Table 23 - Distribution table - Motivation of looking for Project Management support.....               | 198 |
| Table 24 - Distribution table - Motivation of Looking for Partners/Contacts .....                       | 199 |
| Table 25 - Distribution table - Motivation of Looking for Technical Know-how .....                      | 200 |
| Table 26 - Distribution table - TT projects in collaboration with other traditional intermediaries..... | 201 |
| Table 27 - McNemar's contingency paired table 2x2 - Example.....  | 203 |
| Table 28 - Contingency table between intermediaries - Mediation & Mobilization .....                    | 204 |
| Table 29 - Contingency table between intermediaries – Funding & Finance.....                            | 204 |
| Table 30 - Contingency table between intermediaries - Design & Idealization.....                        | 205 |
| Table 31 - Contingency table between intermediaries - Brokering & Gatekeeping.....                      | 206 |

|  |     |
|--|-----|
| Table 32 - Contingency table between intermediaries - Project Management & Assessment.....   | 207 |
| Table 33 - Contingency table between intermediaries - Financial & Technical Feasibility..... | 207 |
| Table 34 - Contingency table between intermediaries - Intellectual Property & Rights .....   | 208 |

**LIST OF FIGURES**

Figure 1 - Research synopsis ..... 7

Figure 2 – Technology-push perspective ..... 16

Figure 3 - Demand-pull perspective ..... 17

Figure 4 - Elements of NIS ..... 19

Figure 5 - Planned Economy NIS..... 21

Figure 6 - Market economy NIS..... 22

Figure 7 - Triple-Helix model..... 24

Figure 8 - Closed Innovation paradigm ..... 26

Figure 9 - Open Innovation paradigm ..... 28

Figure 10 – Sector/Technology domains of the TT projects in the sample..... 174

Figure 11 - Type of entities responsible for originating the TT projects ..... 175

Figure 12 - Entity in the TT projects responsible for the technology source contact..... 176

Figure 13 - Entity in the TT projects responsible for the technology recipient contact..... 177

Figure 14 - Existence of previous interaction with the private consultants ..... 178

Figure 15 - Key motivations/reasons leading the contact or involvement of private consultants..... 179

Figure 16 - Participation of other intermediaries alongside the private consultant ..... 182

Figure 17 - Roles performed by the private consultant (case study firm) in the sample ..... 183

Figure 18 - Traditional intermediaries’ roles (subsample)..... 186

Figure 19 - Private consultant roles (subsample)..... 188



## **LIST OF ABBREVIATIONS AND ACRONYMS**

AQ - Accreditation & Quality

ANI – National Innovation Agency (Portugal)

BG - Brokering & Gatekeeping

CRM - Customer Relationship Management

DI - Design & Idealization

EEC - European Economic Commission

EU - European Union

FF - Funding & Finance

FTF - Financial & Technical Feasibility

ICT - Information and Communication Technologies

IKT - Implementation & Knowledge Transfer

IP - Intellectual Property

IPR - Intellectual Property & Rights

IS - Innovation Systems

ITT - Innovation and Technology Transfer

KDS - Knowledge Diffusion & Support

KIBS - Knowledge Intensive Business Services

KTT - Knowledge and Technology Transfer

MBD - Marketing & Business Development

MM - Mediation & Mobilization

NIS - National Innovation Systems

OECD - Organisation for Economic Co-operation and Development

OI – Open Innovation

ORT - Organizations for Research and Technology

PMA - Project Management & Assessment

PC – Private Consultant

PS - Policy & Strategy

R&D - Research and Development

ROI - Return on the Investment

SME - Small and Medium Enterprises

TI – Traditional Intermediary

TIC - Technology Interface Centre

TRL - Technology Readiness Level

TSMF - Technology Scouting & Market Foresight

TT - Technology Transfer

TTO - Technology Transfer Office

UNCTAD - United Nations Conference on Trade and Development

UNIDO - United Nations Industrial Development Organization

WOM – Word of Mouth

**CHAPTER 1**  
**INTRODUCTION AND THESIS OVERVIEW**

# CHAPTER 1. INTRODUCTION AND THESIS OVERVIEW

## 1.1 The research background

The fields of Innovation Systems (IS) and Technology Transfer (TT) have generated more literature than ever before over the last few decades. However, the constant dynamism of markets, particularly when viewed from an open innovation perspective, adds a new layer of complexity to the understanding of the innovation process. The rise of new market needs, agents, and mechanisms within IS creates new systematic gaps, which are increasingly viewed by private innovation management consulting organizations as market opportunities to sell highly specialized and knowledge-intensive business services (KIBS).

In the current context of Open Innovation (OI), IS dynamics combine various players with distinct external support roles, such as suppliers, clients, competitors, research institutes, universities, consulting firms, and other public organizations. From these dynamics, TT stakeholders constantly seek knowledge access and external information, which is facilitated by the growing involvement of innovation intermediaries. These intermediaries are also responsible for constantly maintaining networks, sourcing market intelligence and technology knowledge, as well as facilitating access to other players and funding programs (Chesbrough et al., 2006).

The concept of the “innovation intermediary” is defined as an entity with a systematic key role as a mediator or broker in the various dimensions of the innovation process between two or more parties. Activities performed by this agent typically focus on gathering and providing knowledge, brokering negotiations and contracts between parties, playing an active mediator and go-between within networks, building project consortiums and partnerships, advising and consulting in support of decision-making, obtaining funding, and monetizing innovation outcomes (Howells, 2006; Silva et al., 2018). Howells (1999, 2006) highlights the systemic value that innovation intermediaries generate in IS and innovation policies, due to their catalysing effect on the connectivity and relationship dynamics of system agents. The same author has been emphasizing the increasing growth in the number, and range, of these intermediary players within the systems. In particular, the emergence of private players, such as consultants and Knowledge-Intensive Business Services (KIBS), who privatized the intermediation role, selling it to the market as a specialized value-added service. This almost rampant growth of entities with some intermediary role in Innovation and Technology Transfer (ITT) makes these agents too significant and too wide to be ignored by the system (Dalziel, 2010).

The figure of the innovation intermediary has always had a significant relationship with the TT literature, with some mentions of private consultants' participation. Several authors have been exploring

the multiplicity of specializations and dimensions that can configure what is referred to as the “role” of intermediation. However, different typologies of intermediary organizations/entities may have different roles and, therefore, cannot be compared (Agogu e et al., 2017; Howells, 2006; Pinto et al., 2015; Pinto, 2018; Silva et al., 2018).

In particular, the Portuguese National Innovation System (NIS) is mostly governed by public and academic entities (Duarte & Carvalho, 2020; Laranja, 2007; Santos, 2016; Sim oes, 2003). However, there has been a multiplication in the number of private consulting firms operating in it in recent decades. These firms provide a wide range of services to businesses, mostly from a market-pull perspective (Jun & Ji, 2016; Laranja, 2009). Thus, this new figure of private consultant positions itself as an unofficial innovation intermediary within the NIS, with its particular role and positioning when participating in TT projects (Basu & Taylor, 2010; Bessant & Rush, 1995; Costa et al., 2021; Tether & Tajar, 2008).

In the literature, there are several mentions and approaches to the topic of innovation intermediaries. However, consultants, who see themselves as innovation intermediaries, tend not to be the focus of research and publications. Despite this, the relevance of consultants can be recognized from the point of view of innovation policies and systems, as the number of consultants in this role has been increasing (Klerkx et al., 2015; Klerkx & Leeuwis, 2008, 2009). Nevertheless, there is still a lack of proper depth in the literature regarding an understanding of what “technology transfer intermediation” is, as well as the real role and positioning of these key intermediary agents within the innovation system (Howells, 2006; Klerkx & Leeuwis, 2009; Silva et al., 2018).

## **1.2 The researcher motivation**

The researcher started his career in the manufacturing industry, focusing primarily on designing and launching new products supported by R&D project outcomes from consortiums involving various companies, universities, R&D centres, and consulting firms. With a formal education background in design engineering, product marketing, and project management, the researcher's last decade has been dedicated to the innovation consultancy industry. As a senior innovation strategy consultant, the researcher has professionally worked on the idealization, planning, financing, and management of national-scale projects in domains such as digital transformation, innovation, and TT.

The researcher's close and regular collaboration with companies, business/sectoral associations, universities, and R&D centres provided him with a unique perspective on the reality of innovation consultancy in Portugal. Furthermore, there is an increasing need to clarify the current role of private consulting firms in fostering ITT. The sale and supply of services by consultants that, in theory, should be

offered openly and free of charge in the NIS by traditional (i.e., public) intermediaries is a recurrent scenario. Additionally, public, and semi-public organizations, such as universities, R&D centres, Technological Interface Centres (TIC), and business associations, have been collaborating more closely and even demanding private consultant services. These experiences led the researcher to fundamental questions regarding the role of the private consultant as an innovation intermediary participating in TT processes and how it is perceived in the NIS.

From the researcher's point of view, gaining a further understanding of the role of the consultant in the Portuguese NIS may contribute to a step further towards the formal recognition of private consultancy firms as accredited intermediaries. Moreover, it will enable the transfer of knowledge and good practices from private organizations to be implemented in traditional public and academic intermediaries operating in the NIS.

### **1.3 The research problem**

The research presented in this document takes an IS perspective, where cooperation between agents is considered a crucial factor in the system's proper functioning (Hidalgo & Albors, 2008; Pollard, 2006, 2015). However, cooperation between agents can often have flaws, and both scientific and political literature on IS suggests the need for intermediation organizations to facilitate cooperation between agents (Klerkx & Leeuwis, 2009). Different types of intermediary organizations, both inside and outside of innovation systems, have been identified (Betz et al., 2016; Suvinen et al., 2010; Tether & Tajar, 2008). However, the role of each of these intermediaries and how they can cooperate to enhance TT effectiveness and synergies are not easily understood (Randhawa et al., 2018).

The innovation intermediation literature is highly fragmented and scattered, making it difficult to define concretely “the role” of the intermediary and what this concept entails (Soares et al., 2020). Traditionally, intermediaries served the purpose of mediating contacts, relationships, and negotiations of technology and knowledge between sources and recipients (Betz et al., 2016). However, with the development of the literature, it became clear that the concept of “role” is much more complex, requiring different specializations to respond to various projects, technology fields, regions, economies, and stakeholders.

As a result, several authors have contributed to adding functions, activities, and role specializations to the concept of the intermediation role. Nevertheless, understanding the intermediation's role specializations is complicated by the numerous entities and organizations that can perform intermediation roles (Howells, 2006; Shearmur & Doloreux, 2019). Private consultants, for instance, tend

to operate outside the formal IS and play roles generally intended for traditional intermediaries, making their role, and positioning, not yet fully understood.

This research focuses on the private innovation consultant as a particular type of TT intermediary that is somewhat neglected in the scientific literature (Dias et al., 2017), despite their proven contribution to fostering innovation and accelerating new products to the market (Colombo et al., 2015). Moreover, the existing literature still lacks a proper in-depth comprehension of private consultants, including empirical validation of the role these agents play as intermediaries of innovation (Dias et al., 2017),

This research aims to further develop practical knowledge and address the insufficient understanding of the role of private consultants as innovation intermediaries in TT. Due to the lack of sufficient literature to sustain the definition of the research gap, an interactive research approach as followed as explained in the next sub-chapter (1.4 The Research Strategy). The research starting point was deployed from the need deepen the knowledge on the role private consultants might have as innovation intermediaries within processes of technology transfer.

Table 1 – Research objectives formulation

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**Research Question 1: What is the role of the private consultant in technology transfer projects?**

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**Objective 1:** Identify the key roles played by private consultants in TT projects.

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**Objective 2:** Identify what key motivations may constitute a value proposition leading the involvement of consultants in TT projects.

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**Research Question 2: How is private consultants' role positioned when compared to traditional intermediaries on NIS?**

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**Objective 3:** Understand whether there is a complementary or overlapping interaction between the roles of traditional intermediaries and private consultants in TT projects.

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## 1.4 The research strategy

The research is positioned at the intersection of several fields, combining knowledge and perspectives from economics, industrial policy, innovation systems, and technology transfer. Furthermore, this set of research fields tends to combine the use of quantitative and qualitative components, presenting various challenges in data collection and analysis. The strategic basis of this research followed a line of inductive research (Saunders et al., 2009), beginning with research questions and objectives and followed by the collection of empirical data. This data was then used to generate hypotheses and test them to produce and discuss findings.

For this reason, the research followed a mixed strategy, divided into two consecutive phases:

1. **Qualitative Research** - The first phase focused on qualitative research, combining inputs collected in the literature review to design qualitative and exploratory research, namely semi-structured interviews. The results of this empirical data collection were analysed to propose five research hypotheses and consecutively feed the methodological design of the quantitative research.
2. **Quantitative Research** – Following the hypotheses formulated as a result of the qualitative research, the quantitative research took place using empirical data collected from an archive of a case study consultancy firm. The data was used to conduct a series of descriptive analyses and statistical tests designed to accept or reject the hypotheses previously formulated and, thus, infer a set of findings (i.e., theory).



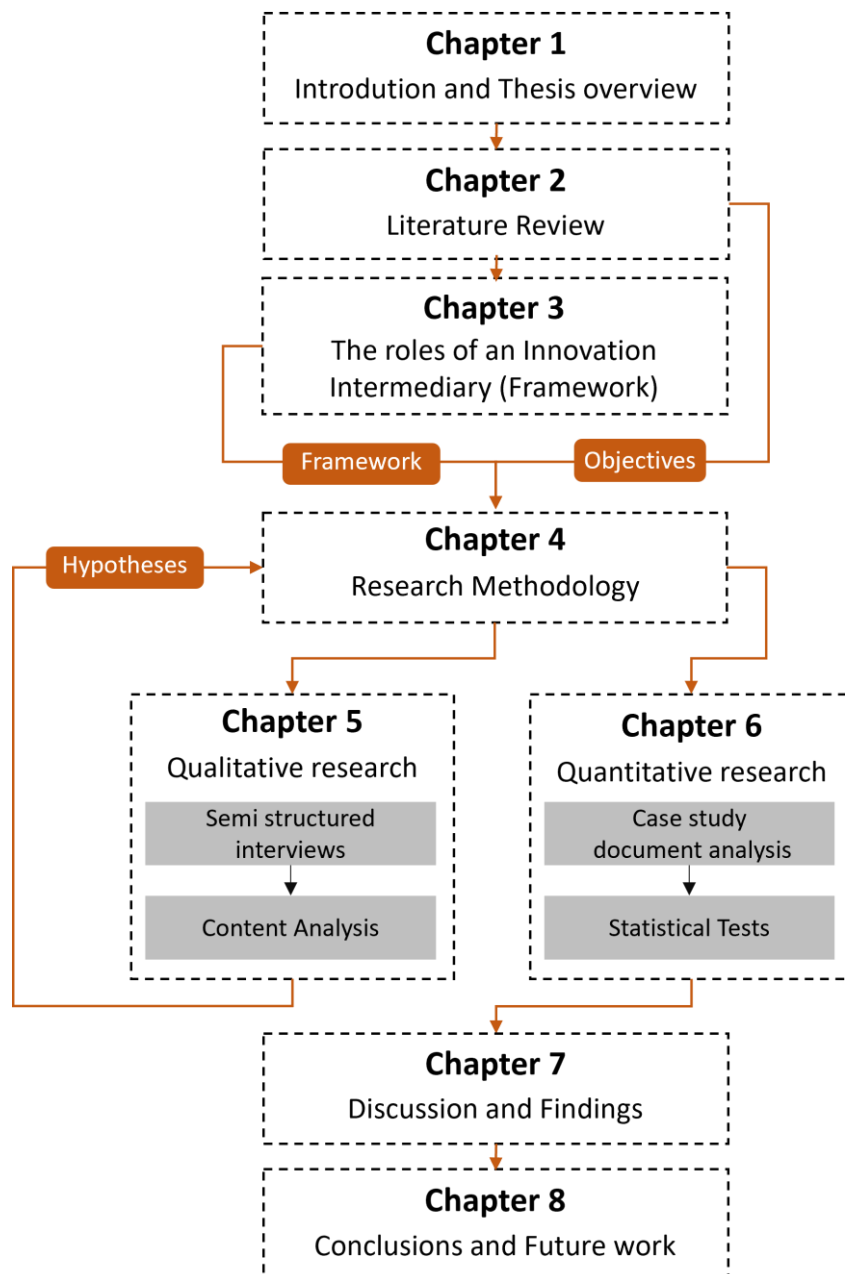


Figure 1 - Research synopsis

This strategic looping structure, as depicted in the research synopsis (Figure 1), aims to maximize the potential of each research approach and, consequently, enhance the scientific quality of the resulting findings. The outcomes obtained from the exploratory phase in Chapter 5, conducted through qualitative research methodology, serve as the basis for formulating hypotheses, which in turn become the key input for designing the research methodology employed in the case study (refers to Chapter 6).

**CHAPTER 2**  
**LITERATURE REVIEW**

## CHAPTER 2 - LITERATURE REVIEW

### 2.1 Introduction

In the last three decades, world markets have evolved towards a knowledge-based economy paradigm (Arvanitis & Woerter, 2009; Bessant & Rush, 1995; Sung et al., 2003; Van der Jagt et al., 2020; Zartha Sossa et al., 2021) where technological knowledge stands out with great importance in the training and growth of businesses across sectors (Bessant & Rush, 1995; Giuri et al., 2019; Laroche & Amara, 2011; Soete & Weel, 1999).

This prominent role of knowledge and technology in promoting the economic and productive development of societies is mentioned in various fields of research, from economics and management to innovation and sociology (Lynn et al., 1996; Nambisan et al., 2019; Reddy & Zhao, 1990; Zartha Sossa et al., 2021). Reddy and Zhao (1990) also highlighted on market strategies that prioritize the emergence of new technologies, as they can serve as a means of differentiation and enhancing competitiveness. The world economic development, which is increasingly technological (Gerli et al., 2021; Gopalakrishnan & Santoro, 2004; Valdez-Juárez & Castillo-Vergara, 2021), has generated difficulties for companies and organizations with fewer capabilities and resources, as they find it harder to keep up with the level of innovation in the market (Diener & Piller, 2010; Sherwood & Covin, 2008). For this reason, companies are forced to leave their comfort zone and look externally for opportunities to obtain technological and innovative knowledge (Arvanitis & Woerter, 2009; Bessant & Rush, 1995; Gopalakrishnan & Santoro, 2004; Sherwood & Covin, 2008; Zahra & Nielsen, 2002).

This new paradigm where the factors of knowledge and technology are highly regarded has potentiated new strategic relationships between private agents (i.e., industry) and academia (Janssen et al., 2019; Lai, 2011; Santoro & Bierly, 2006), and even with public organizations dedicated to research (Arvanitis & Woerter, 2009). The academia recognizes the economic value of the results of their R&D projects, and the high potential for capitalizing on their knowledge (Etzkowitz & Zhou, 2008; Etzkowitz & Leydesdorff, 2000; Good et al., 2018). Likewise, companies have also realized the positive impact of being in proximity to the academic knowledge output (Laroche & Amara, 2011). Specifically, to foster innovation in their value proposition and consequent economic results (Arvanitis & Woerter, 2009). Over time, agents involved in generating technological knowledge, as well as potential recipients, have increasingly devoted themselves to developing strategies and methodologies aimed at enhancing collaboration among them (Arvanitis & Woerter, 2009; Teixeira & Mota, 2012).

In this new collaborative reality, Technology Transfer (TT) has gained a new and major relevance (Al-Surmi et al., 2019; Arvanitis & Woerter, 2009; Duan et al., 2010). This collaboration is expected to

create opportunities for the transfer and absorption of knowledge and technology from the academia to the industry, spanning various fields and perspectives (Bessant & Rush, 1995). However, technologies and technological knowledge should not be solely viewed from the perspective of their economic benefits for private companies. The adoption of new technologies brings advantages to society as a whole, such as enhancing day-to-day experiences, promoting environmental sustainability, and improving both quality of life and economic growth (Arvanitis & Woerter, 2009; Bessant & Rush, 1995; Lai, 2011). For its importance, innovation and technology have become central points in the political agenda of economies all around the world (Arvanitis & Woerter, 2009).

Advancements in different academic fields have highlighted the potential to enhance innovation and technological capabilities by establishing and nurturing relationships between academia and industry (Debackere & Veugelers, 2005). The intensity of these interactions and the process of knowledge absorption by the receiving agents have a pervasive impact on the performance of markets and economies (Debackere & Veugelers, 2005; Good et al., 2018).

Recognizing the beneficial impact of such interactions on national economies, policymakers and governments have recently placed greater emphasis on investing to create incentives, policies, and regulations aimed at enhancing the relationship between academia and industry (Lai, 2011). Despite the increased attention given to this issue, many economies, particularly those in the developing world, still face challenges in the identification of appropriate sources of technology to meet the specific requirements of their industrial organizations. This underscores the importance of building international relationships at the Innovation and Technology Transfer (ITT) level (Barros et al., 2014; Liang et al., 2015).

University-industry interrelationships have been through developments and improvements, mainly driven by the ever more complex Innovation Systems (IS) with tripartite relationships between university, industry, and government (Cai & Etzkowitz, 2020; Etzkowitz & Leydesdorff, 2000). Countries and global markets have been promoting the development of knowledge-based economies, through the adoption of a tri-lateral innovation system known as the triple-helix (Cai & Etzkowitz, 2020; Etzkowitz, 2003). Revolving around three strategic domains of an economy – government, academia, and industry – the triple-helix describes a three-way interaction, as well as the necessary relationship challenges resulting from the overlapping of the positioning and performance of each of the three circles (Cai & Etzkowitz, 2020; Etzkowitz & Zhou, 2008; Etzkowitz & Leydesdorff, 2000).

Technology Transfer (TT) has become significant in all technological and scientific domains, from its impact on the industries to its potential to promote the growth of economies and countries. These

impacts highlight the need to identify and examine the critical success factors involved in this process and its relationship through a triple-helix framework, regardless of the field of research. Numerous studies (Bigliardi & Dormio, 2017; Cai & Etzkowitz, 2020; Eveland, 1986; García-Vega & Huergo, 2017; Gopalakrishnan & Santoro, 2004; Motta et al., 2017; Prud'homme et al., 2018; Reddy & Zhao, 1990; Santoro & Bierly, 2006; Sung et al., 2003) have investigated the critical success factors of TT processes between technology sources and receivers. These factors include absorptive capacity, human capital, trust, social connectedness, prior experience with partnerships, technical expertise, and the significance of intermediaries, among others.

Despite the substantial amount of literature dedicated to TT, much of it still tends to focus on case studies within a particular technological sector, region, or national innovation policy, neglecting other important, more transversal dimensions. One such dimension is the role of intermediaries in supporting the TT process, which can significantly contribute to the overall performance of academia-industry relationships and their outcomes.

## **2.2 Innovation**

### **2.2.1 The concept of Innovation**

A review of the literature reveals a clear evolution in the theoretical and practical concepts of innovation, which has increasingly been recognized as a highly dynamic concept over the last few decades. Despite being analysed and discussed from several perspectives and fields of research, the concept of innovation has a complex procedural dimension, and stakeholders often face difficulties in innovating (Aquilani et al., 2017). The expanding sophistication of the innovation concept has led to its incorporation into most scientific domains, making it as transversal as it is complex, and thus, resulting in a multitude of definitions (Edwards-Schachter, 2018).

The concept of innovation gained new relevance from an economic perspective through the work of Schumpeter (1934, 1942), a highly regarded author with numerous publications. Schumpeter differentiates between the concepts of innovation and invention, asserting that while an invention may involve activities of "intellectual creativity", it may not possess any economic value in the market, and thus, cannot be regarded as an innovation. Consequently, innovation is understood as the successful application of an invention in the market, essentially a process aimed at generating economic value (Freeman & Soete, 1997).

Eventually, other perspectives emerged in the literature, with Lundvall et al. (2013, 2002) critically updating Schumpeter's original perspective on the innovation process, stating that it would not

be as linear as the previous author would have it. This is how the evolutionary perspective on innovation has emerged, known in the literature as “neo-Schumpeterian” (Freeman & Soete, 1997), and in which innovation is perceived as a non-linear, complex, and dynamic process, having a set of systemic and natural attributes. Even so, Schumpeter remains a prominent figure in the literature on the economics of innovation (Rogers, 1998). His influence in the last decades of theoretical development in the field is also noticeable (Soete & Weel, 1999). Schumpeter's perspective is that the innovation process results from developments in the economy, which consist of a series of smaller innovations that are incremental in nature but essential to a process of change (OECD, 2005). In 1934, the author presented five types of innovation that are still relevant today:

- A new good;
- The new method of production;
- The new market;
- A new source of supply of raw materials;
- The carrying out of a new organization of any industry.

The creation of new products, as well as improved products, is recognized for its role in fostering economic development (Bratti & Felice, 2012). Bratti and Felice (2012) also highlighted the creation and market launch of innovative products as a key factor in the economic development of countries, recognizing its role in both classical and present literature. Also, product innovation and new production methods (or processes) are of key relevance to the performance development of companies and industries (Atalay et al., 2013; Atkeson et al., 2010). This relevance was also highlighted in Oslo Manual (OECD & Eurostat, 2018). Nevertheless, the significance of innovation extends far beyond the competitive capacity of individual companies. It is a key creative factor for their continuity in the market, due to the dynamism of the economies. Facing recurrent paradigm changes and the evolution of the population's needs, companies find themselves required to constantly update their value proposition (OCDE, 1997). In this way, the application of intensive knowledge and technological capabilities to develop new products and processes proves to be crucial for promoting the competitiveness of any organization (Tidd et al., 2003).

In the literature, there is a recurring overlap between two fields of research: innovation management and technology management (i.e., technology transfer included). Despite this overlap, differences can be highlighted. In the field of innovation management, the study of intermediaries focuses more on intermediaries as organizations and their activities, and the key roles they play. However, technology management remains one of the primary functions of these intermediary agents (Hargadon

& Sutton, 1997; Kidwell, 2013; Macchi et al., 2014). Other authors view public organizations with intermediary roles as a strategy to compensate for the lack of skills in weak support networks of companies and organizations (Gasco-Hernandez et al., 2017; Martin & Scott, 2000; McEvily & Zaheer, 1999; Santos, 2016).

Hargadon and Sutton (1997) who studied a highly innovative design firm's role as an innovation and technology broker, indicated that it was much more than just being a link and a dynamization mediator within networks. The firm's role as broker/intermediary is shown to be beyond knowledge creation and repository. They could also act as strategic support by combining existing ideas and solutions across sectors in order to foster innovation creatively and proactively.

The role of innovation intermediaries can be found across various fields of literature, including innovation and technology management, product development, marketing strategy, and traditional technology transfer. The field of innovation management, in particular, has contributed highly regarded theoretical and practical insights that can be applied to other fields, highlighting the potential for cross-fertilization of ideas and approaches. One example of such contributions is the development of the open innovation (OI) perspective (Chesbrough et al., 2006; Lichtenthaler & Ernst, 2008; Yun et al., 2020), which emphasizes the importance of continuous collaboration and networking management involving multiple players with different roles within the IS. This approach recognizes the complexity of innovation dynamics and the benefits of multiple disciplines and specialized roles, such as creativity and ideation, technological foresight, team coordination, product development, marketing strategy, and production engineering (Lichtenthaler & Ernst, 2008). All of these among other disciplines that, with more or less involvement, participate alongside the support of TT processes (Lichtenthaler & Ernst, 2008; Pollard, 2015).

The literature on business strategy and industrial organization has likewise explored the role of these intermediaries, especially in service innovation, marketing, and Knowledge-Intensive Business Services (KIBS) (Bettencourt et al., 2002; Howells, 2006; Shearmur & Doloreux, 2019; Wood, 2002). Private firms focusing on both hard and soft innovation, have been instrumental in processes of change and innovation in a variety of organizations and industries (Wood, 2002). This was corroborated by the increasing presence of KIBS mentions and participation in IS (Howells, 1999; Muller & Zenker, 2001). Innovation intermediaries are taking on a more proactive and continuous role in enhancing innovation systems, and they are even referred to as "bridges to innovation" within business and manufacturing-related fields (Bessant & Rush, 1995; Lichtenthaler & Ernst, 2008; Lin & Wei, 2018; Rekers, 2016).

Other authors such as Seaton and Cordey-Hayes (1993) have introduced a technology market exploitation perspective to the discussion, emphasizing the importance of developing capabilities and designing value propositions that are aligned with market needs. This perspective can be viewed as a role that relates to product management and marketing, particularly from an industrial marketing strategy point of view, as new technological advancements are turned into marketable products.

### **2.2.2 Innovation Systems (IS)**

The IS literature has also recognized the growth of intermediaries and their roles. Several authors (Intarakumnerd & Chaoroenporn, 2013; Lichtenthaler, 2013; Lynn et al., 1996) have emphasized the crucial role played by intermediary organizations, both private and public, in supporting the links and relationships within innovation networks and systems. These organizations create structures that provide collective support and coordinate the entities responsible for developing core technological innovations. Laursen and Salter (2006) also identified the support provided by external intermediary organizations in the adjustment of innovative technology solutions to current market needs in the manufacturing industry.

With a broader perspective, Van der Meulen and Rip (1998) saw some of these intermediary organizations - specifically public organizations related to academia and research - being involved with more strategic roles, supporting process management from the policymaking to the operational implementation of these policies within the system. Also, some innovation policies are increasingly recognizing the key role played by innovation intermediaries in providing advice and informing policymaking studies (Kivimaa et al., 2019; Russo et al., 2019; Steinmueller, 2009), and their active role in innovation and technology management within complex industry networks (Chesbrough, 2004).

#### *2.2.2.1. A systemic approach to innovation*

The systematization of innovation as a theoretical perspective resulted from a set of approaches that recognised the complexity of innovation processes, and therefore consider them more as a system than a mere set of processes (Dosi et al., 1988; Edquist, 1997; Freeman, 1987, 1988; Lundvall et al., 2002; Lundvall, 1985, 1992; Nelson & Rosenberg, 1993). Several models and theories influence the functioning of IS, including the interactive learning model and evolutionary theory (Lundvall, 1992; Nelson & Winter, 1982). Innovation Systems (IS) combine within themselves a set of economic, social, political, and any other factors that can foster the development, dissemination, and absorption of scientific and technological knowledge (Edquist, 1997, 2001). Even so, it is not possible to identify in the literature a simple and concrete definition for IS.



According to Silva (2003), several systems overlap simultaneously in the innovation process, with different possibilities of interpretation, decision systems, focuses, and rules of communication. This transversality of application from the perspective of IS means that they can exist in larger or smaller dimensions, from international, national, regional, sectorial, or local levels. Following this perspective, the ability of an economy to innovate is influenced not only by the way organizations act in isolation, but also by the way they relate to each other. As components of a collective innovation creation system (Calia et al., 2007; Rycroft & Kash, 2004), they follow a set of complex and dynamic innovation processes (Duarte & Carvalho, 2020; Smith, 2001).

The idea behind an IS concentrates predominantly on the relationships between the players involved in the innovation activities and processes. These are seen as vital to foster the improvement of an economy's innovative capacity, especially in an institutional and political domain (Bogers et al., 2018; Henriques & Larédo, 2013; Schröter, 2009), and thus, increasingly becoming a transversal part of the expected outputs of any IS.

The IS concept becomes then a heuristic approach, conceptualized with a focus on the analysis and understanding of the subsystems, individual players and organizations contributing (i.e., directly, or indirectly) to business innovation and consequent economic development (Samara et al., 2012). These systematic players, innovation players interacting within the systems, come directly from within the companies, universities, and R&D centres. Many times, these interactions are supported by other system players, intermediary organizations, as well as other supporting financial and public institutions operating within the IS (Chaminade & Edquist, 2010; Simões, 2003).

### **Linear innovation models**

For many decades, the discussion about innovation in the literature focused mostly on a linear perspective. From this perspective, the innovation process was perceived as a sequential hierarchy of successive stages (Godinho, 2003). A fact that is currently recognized as outdated.

The use of this linear concept was already severely criticized by Kline and Rosenberg (1986, 1982), who highlighted it as being an oversimplified distortion of the reality of what the innovation process is. The linear perspective considers that the process itself comes from scientific research activities, ignoring that technological knowledge tends to precede scientific knowledge. In addition, it does not include feedback loops and the recurrent setbacks of technological innovation development processes (Kline & Rosenberg, 1986; Rosenberg, 1982).

Even so, the concept of linear innovation is still used by some, as despite its simplicity, it has its merits. The linear approach was afterwards compounded by two perspectives, the so-called “technology-push model” and the “demand-pull model” (Jun & Ji, 2016; Langrish et al., 1972). Two decades later, other authors have thoroughly researched and expanded this subject, Rothwell (1994) being one of the key authors contributing to it.

The first perspective, referred to as “technology-push”, or “science and technology-push”, is driven by scientific and technological breakthroughs. It places significant emphasis on research and development (R&D) activities, as innovation is believed to originate from previous inventions, without market input. According to this perspective (as illustrated in Figure 2), the innovation process primarily centres on the value generated through R&D, which is subsequently introduced (i.e., pushed) to the market to explore potential application opportunities. Authors such as Day (1994) and Rothwell (1994) argue that the competitive performance of a company, in terms of innovation, is directly associated with the quantity and quality of the research department inside such company.

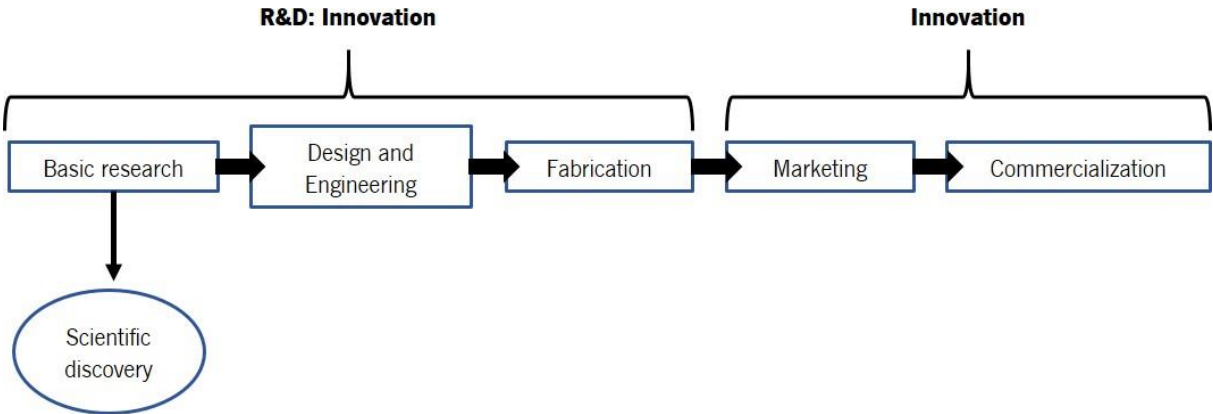


Figure 2 – Technology-push perspective  
 Source: Adapted from Rothwell (1994)

In contrast, the other linear perspective, the “demand-pull” perspective of innovation (a.k.a. market-pull), completely reverses the technology-push perspective. It considers that the first stage of the process is a responsibility of the market, which must express its vision, goals, and needs to stimulate an innovation response. Thus, this “pull” perspective shown below in Figure 3 perceives the innovation process as a natural response to market needs/opportunities (Godinho, 2003; Rothwell, 1994; Silva, 2003).



Figure 3 - Demand-pull perspective

Source: Adapted from Rothwell (1994)

In summary, there are several possible perspectives and approaches to the concept of innovation, leading to different degrees of complexity, different relationships between agents and consequently different essential characteristics. Over the past few decades, National Innovation Systems (NIS) have emerged as the most extensively discussed concept in the realm of IS. This systematic approach is particularly useful in comprehending the intricate relationships and interactions involved in the innovation process (Carlsson et al., 2002). However, due to its complexity, the NIS concept remains ambiguous despite numerous studies. Therefore, it would be beneficial to break down the concept of NIS into its various components to better understand the wide range of activities and players involved in the system's complex processes.

The NIS, as a concept, is intrinsically related to IS, as it describes the functioning of several institutions, public and private, which, jointly or individually, foster the development, dissemination, and absorption of new and innovative technologies, being also influenced by government ideologies. That contributes to innovation policies aimed at improving the efficiency and effectiveness of innovation processes (Simões, 2003).

#### *2.2.2.2. National Innovation Systems (NIS)*

As in any society, the institutional environment is recognised as a determining factor of an economy's competitiveness. Consequently, the interaction and relationship of economic agents involved in activities of creation, development, transformation, and dissemination of technological knowledge must also be considered as so (Freeman, 1995). The functioning of these relationships is described in the literature under the designation of National Innovation System (NIS), which was first introduced by Lundvall (1992), greatly influenced by Lutz (1841), in his publication "The National System of Political Economy".

NIS emphasize that more than protecting and nurturing developing economies and industries, the government must implement policies that foster industrialization and consequently economic growth. One of the main focuses of the NIS policymaking should be to accelerate technological research activities to bring the resulting technologies and knowledge to the market, as soon as possible (Lundvall & Borrás,

2006). In a more modern view, a NIS is framed as a set of private entities (e.g., businesses, research centres, consumers), public entities (e.g., academic, research units), and financial and governmental organizations (e.g., regulatory, social, legal, financial) interacting with each other throughout the innovation process. Oriented to respond to strategic economic goals, it is the NIS's responsibility to foster competitive performance through the creation, development, and dissemination of technological knowledge (Gretchenko, 2008).

NIS are the product of the interaction between three primary societal domains: government, academia, and industry. Consequently, fostering NIS heavily relies on R&D and innovation activities, which are subject to dynamic and complex processes involving various types of agents from all three spheres of society. It is worth noting that in NIS, the relationships between agents are considered more crucial than the actual object of their interaction (Todeva, 2013). For this reason, the level of development of NIS can be determined by the quality and regulation of these same relationships (Motta et al., 2017). The regulation of these relationships can be developed from both political and legal perspectives. Even so, the government often resists the promotion of such regulations, neglecting that their institutional innovation is a first step towards the promotion of technological innovation and their economic development (Johnson, 1992).

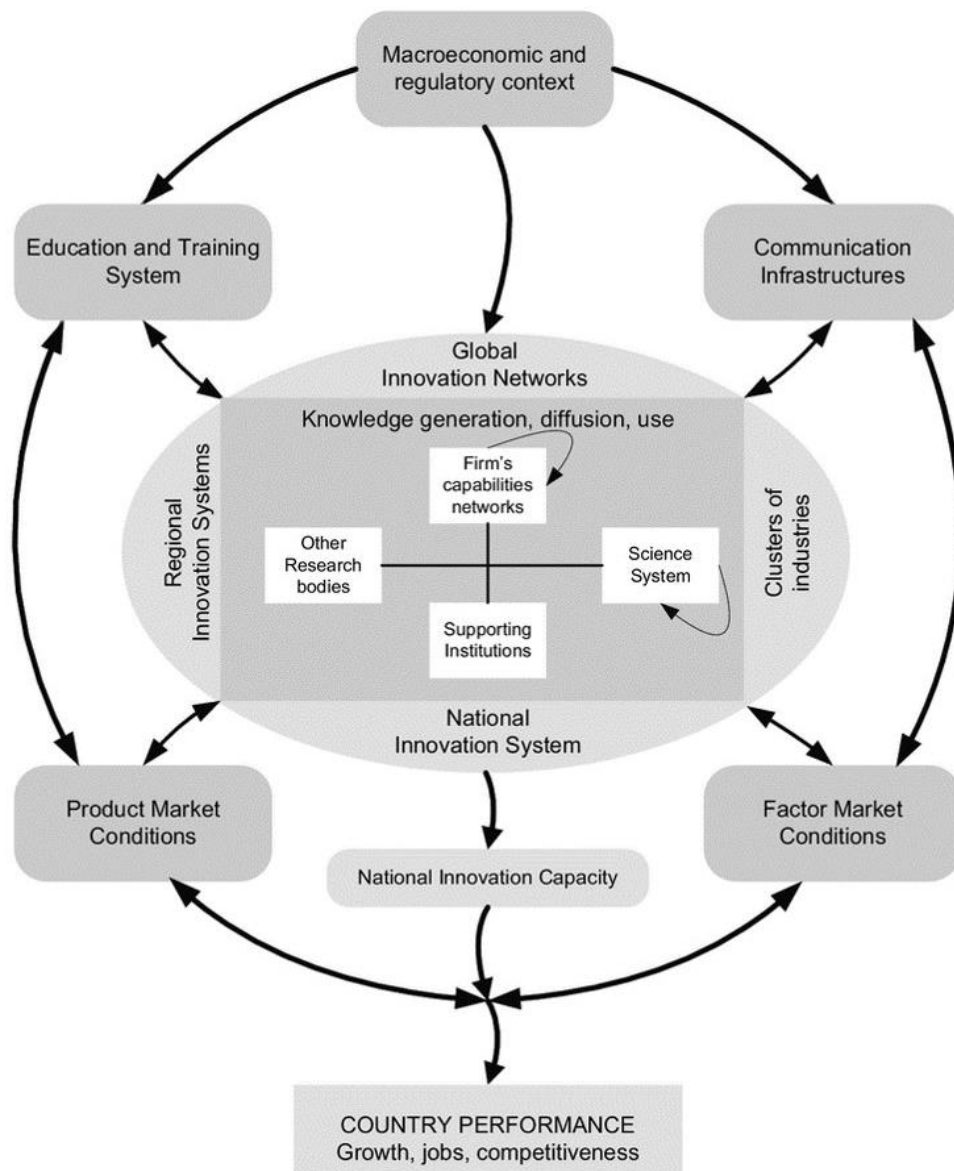


Figure 4 - Elements of NIS

Source: OCDE (1997)

The infrastructure of a NIS is composed of various interconnected organizations that work together to produce and commercialize the outcomes of innovation activities. This infrastructure plays a crucial role in facilitating the efficient development of the NIS at all stages of the innovation process. Its ultimate goal is to create an environment that encourages the dissemination and application of knowledge and technology in the economy and society. Figure 4 illustrates the different elements that constitute the NIS infrastructure, which is characterized by a diverse range of organizations with various origins and functions, all sharing a common interest in innovation.

Key components within any NIS infrastructure are the intermediary and supporting mechanisms and players such as industrial parks, technology hubs, clusters, interface centres or TT centres, consulting

intermediaries and other key supporting KIBS. From a co-creation perspective, all this core infrastructure collaborates continuously with key knowledge sources such as higher education entities and research units, both public and semi-public (Gråsjö et al., 2018). The proper functioning of this dynamic infrastructure is thus ensured by regulatory and innovation policies and incentives (e.g., financial incentives), identified in the literature as being the leading success factors in fostering TT (Carvalho et al., 2012).

The focal point in NIS literature tends to be focused on the conditions, elements, and interactions within the system functioning itself. This is even more evident in the case of developing economies, despite the exponential rise of a global vision and the unbridled emergence of international competition. Even so, existing interactions between NIS and global innovation networks are also highlighted in the literature for their importance in maintaining a thriving environment for the continuous development of innovation (Freeman, 1995). The expected output of a properly structured and effective NIS is essentially the development of the economy's innovation capabilities. Consequently, so it is market competitiveness, meaning an overall increase in economic productivity and the development of the well-being of society (Lundvall, 2007).

### **Evolution of National Innovation Systems (NIS)**

As far as the concept of NIS is concerned, it earned its place in literature, being currently used as a replacement, or complement to traditional linear models of innovation. NIS does not consider innovation as being carried out in a chained way in a direct process with unidirectional interactions.

With the evolution in the understanding of how innovation is carried out, the systemic approach, namely the concept of NIS, has been demonstrating the importance of feedback between stages, agents, and activities of the process. It is from this back-and-forth loop that it is possible to achieve the creation and acceleration of technological knowledge throughout the entire innovation lifecycle, and not just in the early stages of R&D (Edquist, 2014). The complexity of the innovation dynamics is now widely recognized. Thus, from a systems perspective, the generation of technological knowledge and innovation itself is to be triggered by a combination of dynamic contact networks of agents and players from different backgrounds (Dezhina & Saltykov, 2004).

As innovation theory and TT have become more systematically approached, the focus has shifted towards understanding the complex dynamics of innovation. Currently, greater emphasis is placed on the interactions between agents involved in the innovation process, rather than solely on the agents or the

object being transferred. Additionally, regulatory effectiveness has become more prominent than the output of the innovation process.

These changes are evident when comparing two ideal NIS typologies: the “planned economy” and the “market economy” approaches (Dezhina & Saltykov, 2004, 2005; Edquist, 2014).

The “planned economy”, which is mostly observed in communist countries where the government plays a predominant role, subjugates the NIS and its innovation processes to a nationalist principle that dominates the spectrum of labour outputs, including intellectual knowledge. In this paradigm, the system turns inward, closes itself off, and eliminates any transfer of knowledge, either outward or from the outside (see Figure 5). In such a system, various innovation activities, including research, are indoctrinated by the government, which biases scientific and technological development. This type of NIS is also characterized by low interaction between players and industries, as well as negligent allocation of resources, favouring sectors and scientific fields that correspond to the ideology and objectives of the state (Etzkowitz & Leydesdorff, 2000; Leydesdorff & Etzkowitz, 2001).

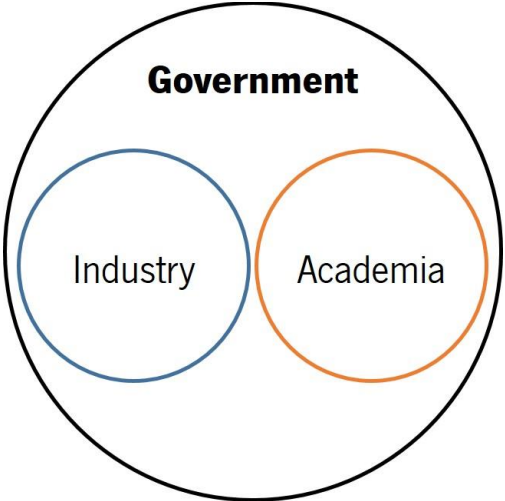


Figure 5 - Planned Economy NIS

Source: Etzkowitz and Leydesdorff (2000)

In short, in economies with a planned approach, the NIS and all its entities (i.e., academia, research, companies, etc.) have fewer motives or incentives to innovate when subjugated solely by the state. Even so, the planned economy model shown in Figure 5 also presents advantages, namely the possibility of mobilizing a large set of resources in a focused response to a problem or objective. Also, this planned economy NIS tend to present excellent social and economic conditions for the development of fundamental research (Dezhina & Saltykov, 2004).

A second perspective, commonly found in capitalist societies such as those in most western countries, is based on the “market economy” approach. In this approach, the government, although an essential part of the NIS, is of equal importance to other elements (Figure 6). Therefore, government inputs, like any other, must undergo multidirectional interaction with other agents, operating according to the “*laissez-faire*” principle<sup>1</sup>. In this paradigm, all elements are free to interact with one another, and regular feedback is present among all stakeholders, highlighting a model with greater openness for the local economy. This model is open to interaction and integration with other economies, supported by a set of regulations focused on protecting private property, including intellectual rights, as some R&D results may require. Thus, in a win-win perspective, agents can satisfy their interests, aligned with market opportunities and consumer needs that enhance the innovation process.

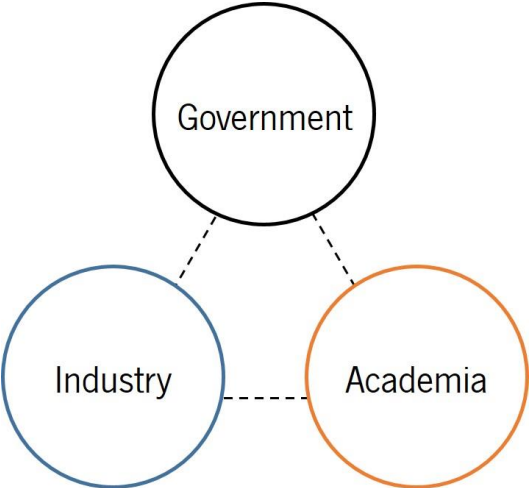


Figure 6 - Market economy NIS

Source: Etzkowitz and Leydesdorff (2000)

Within this typology of NIS, the freedom granted to agents also entails greater responsibility, as they assume the inherent risks of their research activities. Despite these risks, in the market economy model, the potential benefits resulting from innovation activities provide sufficient incentives for individuals and organizations to pursue them. Market-based NIS typically comprise a mix of large corporations and numerous small and Medium-Sized Enterprises (SME). SME are often characterized by their smaller and

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<sup>1</sup> Laissez-faire (from the French: “leave alone”) is policy principle stated that the less the government is involved in the economy, the better off business will be, and by extension, society as a whole. “Laissez-faire economics” is a key part of free-market capitalism.



more flexible structures, which enable them to take risks and pursue innovation in earlier stages of the technology lifecycle (Dezhina & Saltykov, 2005).

More recently, NIS literature has shown a new evolutive perspective, derived from the transformation of increasingly global economic systems, fuelled by an acceleration in technological and scientific advances. It was during these transformations that systems functioning, explicitly the relations between university, government, and industry, underwent a set of evolutionary changes, leading to a new perspective of the innovation model (Binz & Truffer, 2017; Freeman, 2002).

In planned economy approaches to NIS, the spheres operate dependently, with companies and academia fully controlled by the government and no room for partnership relationships. In contrast, in market-based NIS, interactions are typically bidirectional, with free feedback between agents forming double helices. However, as global economies have transformed and competitiveness in technology and industry has advanced, such interactions have become insufficient to support strategic decision-making. Consequently, theoretical models of innovation and NIS have evolved to respond to the need for triple interactions, which involves combining all three agents of the system in a networking format to create a modern innovation model known as the “Triple-Helix” (Etzkowitz & Leydesdorff, 2000).

#### *2.2.2.3. The Triple-Helix framework*

The conceptualization of a triple-helix framework as a new perspective of NIS focuses on, and studies, interactions between the three helixes of academia, industry, and state (see Figure 7). This new model seeks to understand and describe the interactions between helixes and learn from the results (Etzkowitz & Leydesdorff, 2000). Literature on innovation economics has shown that technology and knowledge are increasingly being valued as key resources in the performance of any economy, as it benefits all three helixes accordingly (Leydesdorff & Etzkowitz, 2001).

An unbridled race in search for innovative products and new technologies has led the innovation process from being an internal process within companies to a more complex process involving companies, academic research entities (Etzkowitz, 2003) and the government (Santoro & Bierly, 2006). Some still point out the academic sphere as being the primary source of innovation within a NIS (Leydesdorff, 2012). Yet, in this new economic paradigm, the production of innovation and knowledge becomes the third dynamic of economic development, apart from the market equilibrium and normative control mechanisms (Etzkowitz, 2003).

The triple-helix model proposed by Etzkowitz & Leydesdorff (1995, 2000), is supported by three key components (Papagiannidis et al., 2009):

- The protuberant position of the academia alongside business and the state;
- The relationship between academia, business and the state as the main contributor to innovation;
- The distinct roles of the three helices.

In the original NIS concept, the main role of creating innovation was the responsibility of the industry (Meyer et al., 2003), having the remaining helices of academia and state a more supportive role (Etzkowitz, 2003). In the triple-helix model, the most prominent helix for its importance in the innovation process might be academia (Etzkowitz & Leydesdorff, 2000) that dynamically, and in interaction with the other helices, is the primary source of knowledge and technological innovation.

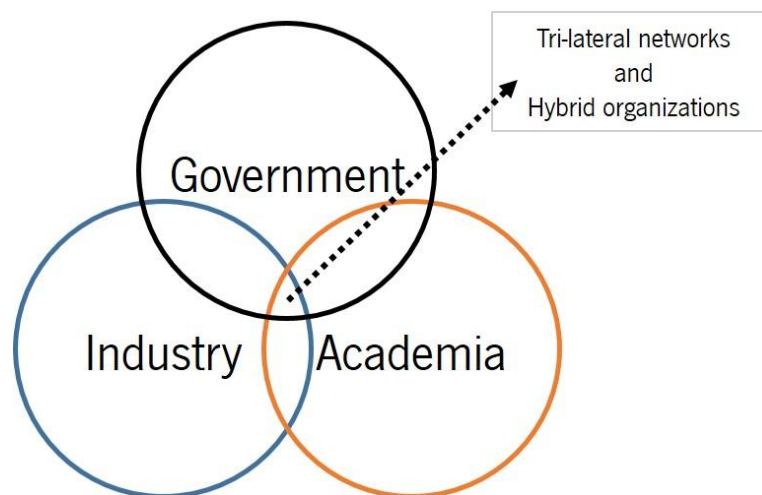


Figure 7 - Triple-Helix model

Source: Etzkowitz and Leydesdorff (2000)

Nowadays, in developed economies, as they tend to become more knowledge-based economies, the key role in fostering innovation shifts from the agents to the interactions within the triple-helix (Etzkowitz, 2003). Following this perspective, the design and policy-making activities are no longer fully state-centric, being these policies a result of multiple collaborative interactions between agents of the three helices (Etzkowitz, 2003). In addition to the evolutionary increase in interactions and relationships between helices, the triple-helix model also suggests an internal transformation within each of them (Leydesdorff & Etzkowitz, 2001). This transformation enhances their traditional roles by overlapping them

with functions from other circles, reducing competition, and improving performance through reciprocal relationships (Etzkowitz, 2003).

Previous innovation and NIS models characterized each institution (i.e., each helix) based on its unique attributes and functions (Etzkowitz, 2003). However, the abundance of innovation roles extending beyond the internal boundaries of each of the three helixes results in overlapping between them (Sherwood & Covin, 2008). Therefore, the new vision is that, in addition to each agent continuing to be characterized by its traditional/core roles, it also plays new roles, typically related to collaboration and relationships with other helixes. Figure 7 aims for a visual representation of this idea (see above).

### **University, Industry and Government**

In short, the Triple-Helix framework is fundamentally different from the traditional theoretical model of public-private partnerships from the industrial ages. This is due not only because of the nature and type of relationships between the three helixes but also due to the challenges arising from their overlap functioning (Leydesdorff & Meyer, 2006). The major transformation occurred at the policy-making level with the state losing its core functions but still playing a decisive role in regulating the triple-helix as an IS.

From a NIS perspective, government policies' focus should be on creating economic support programs (Santoro & Bierly, 2006) and financial incentives to foster collaboration between business and academia (Leydesdorff & Etzkowitz, 2001; Papagiannidis et al., 2009). Academia and industry helixes have also undergone transformations, mostly derived from their relationship with each other (Santoro & Bierly, 2006).

Academia has evolved its focus and mission, as it now better understands the economic value of the scientific knowledge produced and its commercialization potential (Santoro & Bierly, 2006). From this mindset shift, a more entrepreneurial culture of TT is emerging from academia, promoting, and participating in spin-offs, start-ups, and companies, following a strategy of knowledge capitalization (Etzkowitz, 1998).

Nevertheless, this overlap of the three helixes is a reflection not only of the evolution of institutional boundaries within the NIS but also a result of the strategic opening of the national market boundaries themselves (Leydesdorff & Etzkowitz, 2001). With national and international sectors and markets increasingly interacting, organizations and institutions are beginning to take a more global and open stance, both in terms of innovation and economic development (Etzkowitz & Leydesdorff, 2000; Leydesdorff & Meyer, 2006). This resulted in the emergence of new players, and hybrid organizations

playing within the overlapping of helixes as positioning strategy. For instance, the last two decades have seen an emergence of hybrid organisations between academia and industry, such as technology interface centres (TIC) looking to foster the intermediation performance of NIS (Meyer et al., 2003; Rocha et al., 2021).

2.2.2.4. *The Open Innovation model (OI)*

The scope of the innovation concept is extensive and increasingly complex. As a process, innovation can follow two different dimensions and corresponding management strategies. An organization can either generate innovation on its own, or search for and adopt innovations developed and disseminated by other organizations. In a traditional closed innovation model (see Figure 8), organizations typically work within their boundaries, progressing linearly from idea to product launch.

However, a current perspective on innovation, adopted by many organizations worldwide, emphasizes an open approach in which organizations combine internal and external resources and capabilities to create more efficient and effective projects to meet their innovation needs and strategic objectives (Chesbrough, 2015; Chesbrough et al., 2006).

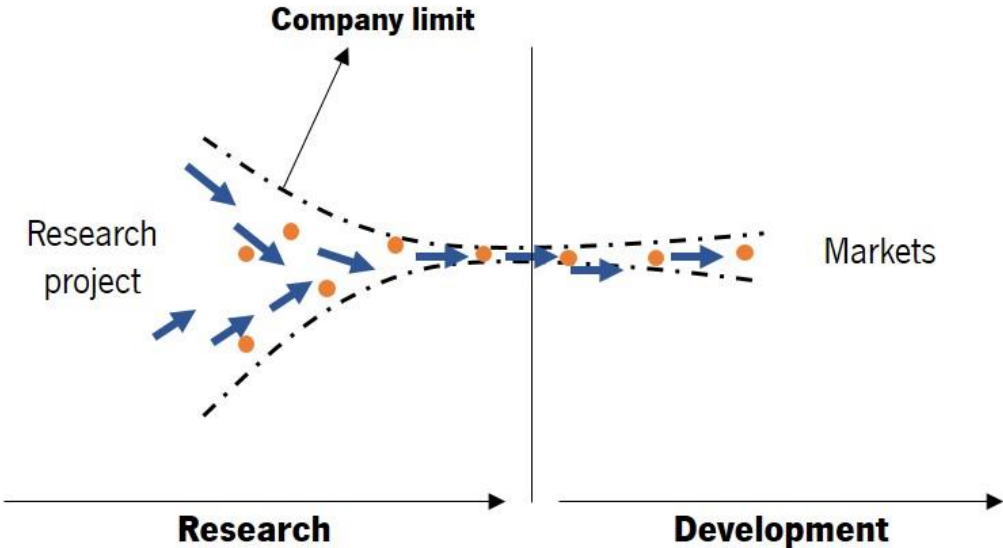


Figure 8 - Closed Innovation paradigm

Source: Adapted from Chesbrough (2003)

The open perspective on innovation creates a flow of highly complex and valuable interactions among various actors within the IS. Due to the rapid development of technology and markets, it has

become increasingly more common for organisations to search for knowledge, resources, and technologies beyond borders. This has led to a need for additional competencies to manage knowledge inflows and outflows in response to the global needs of companies (Chesbrough et al., 2006). Knowledge and its diffusion among IS's players can predict which companies will be better positioned to respond to market opportunities as they gain better intel and market knowledge (Clausen et al., 2013). Thus, strategic cooperation between players is a privileged way to access technological capabilities and project resources.

Improved cooperation is crucial for boosting innovation development, funding, and market access, as well as achieving economies of scale and scope, cost-sharing, and risk spreading (Faria et al., 2010). In the open innovation model, an innovative organization uses knowledge from both internal and external sources (see Figure 9). By doing so, the organization can achieve better performance in its internal innovation processes and subsequently enter and expand in the external market (Chesbrough, 2004). The focus is on opening the innovation process beyond the borders of the organization, promoting greater interaction with knowledge sources and external players (Chesbrough, 2003; Mortara & Minshall, 2011).

However, this opening to external inputs presents new challenges to the formal and informal ownership of technical knowledge and technology. There are new needs for innovation protection, such as intellectual and property rights, in this global and open innovation market (Zobel et al., 2017). Protection mechanisms, such as patents, trademarks, copyrights, and designs, as well as other forms such as confidentiality agreements, become particularly relevant in this perspective of Open Innovation (OI). These mechanisms and strategies have gained renewed significance as instruments that not only protect innovation outcomes but also facilitate the transformation of such results into competitive advantages (Milesi et al., 2013).

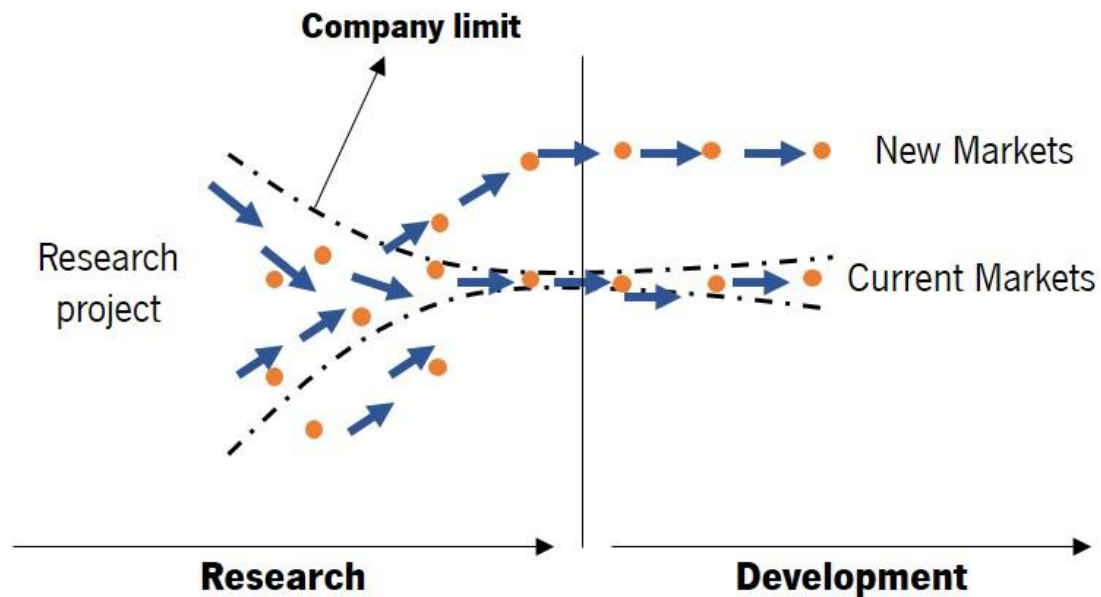


Figure 9 - Open Innovation paradigm  
 Source: Adapted from Chesbrough (2003)

Even so, there are still companies with difficulties to adopt an Open Innovation (OI) model. According to Drechsler and Natter (2012), some difficulties stand out, such as the lack of knowledge about the technology market; a deficient use of intellectual property protection instruments; and a fear of competition, especially regarding the entry of new players in the market or copying and imitation. Alternatively, to encourage the adoption of an open approach to innovation, some factors can also be emphasized, such as financial incentives for the practice of innovation; improvement in the regulation; and supporting mechanisms to foster the use and effectiveness of property protection instruments (Drechsler & Natter, 2012).

In this way, innovation and R&D processes are no longer something internal to organizations. Companies are now encouraged to interact with other agents from the system as a way to exchange knowledge and skills. Thus, organisations and companies can better identify and generate opportunities to create and launch new products, services, and ideas in response to true market and society needs (Chiang & Hung, 2010; Garriga et al., 2013; Laursen & Salter, 2006; Valdez-Juárez & Castillo-Vergara, 2021; Van de Vrande et al., 2009; Yun et al., 2020). Through interactions, companies have the opportunity to explore both the best and worst practices within the market, enabling them to continuously refine their value proposition and maintain global competitiveness.

Van Der Meer (2007) stressed that, initially, the open innovation approach was strongly adopted by companies with a high culture of innovation, particularly those in technology-intensive sectors.

However, other sectors and less innovative organizations have also gradually adopted OI models. As a result, companies that were previously inward-oriented are now taking greater advantage of knowledge inputs from outside their organizations. The adoption of open innovation by SME is also associated with their increasing receptivity to interactions and collaborations with a variety of external players within the NIS (Bogers et al., 2019; Hsu & Ziedonis, 2013; Mortara & Minshall, 2011).

In this way, the approach to open innovation went from being depicted as a model especially recognized in TT literature, to being generally accepted and implemented in innovation processes. According to Ozkan (2015), this modern systematic process of innovation is divided into three structural stages:

1. **Conceptual stage** – Identification and selection of strategies to establish an organizational structure supporting an open innovation philosophy, with incentives for the organization's employees and the conducting of R&D activities. This stage offers a preliminary study and subsequent planning of an OI support infrastructure, dividing the necessary flows of knowledge and information (i.e., inputs and outputs).
2. **Development stage** – Adoption mechanisms are built, competencies are identified, and projects are carried out. At this stage, the instruments and mechanisms-built focus on the infrastructure and organizational culture, previously conceptualized.
3. **Implementation stage** – The system begins, properly aligned with previously defined planning and structure, focusing on the acceleration and management of information interactions and exchanges between elements within the company and external stakeholders.

With an analysis of Open Innovation (OI) literature (Aquilani et al., 2017; Chesbrough, 2015; Diener & Piller, 2010; Kani & Motohashi, 2012; Van de Vrande et al., 2009; Zobel et al., 2017), it is possible to identify two central lines of research:

- The research of factors at an internal level within the organization, specific to each type of agent in question (i.e., university, company or state);
- The research of external factors, namely systematic interactions and relationships established between agents within the IS that foster open innovation, technology transfer processes, exchanges of technical knowledge, and training of stakeholders involved.

It is important to note that innovation can take different forms, with varying degrees of novelty resulting from modern approaches like OI or traditional closed approaches. Radical innovations typically result in new products and/or technologies entering the market. On the other hand, incremental innovations tend to result in improvements and adaptations to products that are already available in the market (Hall et al., 2014).

Although the OI approach has gained popularity, there are still organizations that rely on traditional, closed, and linear innovation models that focus on inventing, producing, and directly commercializing their products (see Figure 8). Typically, these organizations have their R&D departments and depend solely on their internal structures, which is feasible only for large corporations (Chesbrough et al., 2006). While this closed innovation model offers advantages to shareholders, such as high control and protection over innovation processes and results, it requires significantly more financial, human, technical, and time resources (Chesbrough, 2003, 2004; Chesbrough et al., 2006; Chesbrough & Rosenbloom, 2002).

As the innovation paradigm shifts towards openness (Figure 9), the number of players involved in the system increases, resulting in dynamic growth and acceleration of processes that benefits all stakeholders. The systematization of the OI model enhances organizations' ability to transform ideas quickly and cost-effectively into reality. This ideal ecosystem for industrial and business development strengthens competitiveness, expands market reach, and yields greater financial returns for organizations, ultimately improving the quality of life for society (Chesbrough, 2004; Chesbrough et al., 2006; Ozkan, 2015).

### **Technology Transfer (TT) in an Open Innovation (OI) context**

Technologic innovations can quickly and severely transform the normal functioning of companies and organisations. With global economies currently undergoing a fourth industrial revolution, digital transformation has become a high priority on the agenda of many companies and governments (Hess et al., 2016). It is possible to find several examples of organizations that have succumbed to not being able to adapt to the disruptive evolution of technology (Hess et al., 2016). To highlight the importance of this transformation, experts tend to bring up "*Moore's Law*", which states that with the current unbridled scientific and technological development, the capacity and performance of digital technologies will double every two years (Deloitte, 2015).

Challenges related to the adoption of new technologies go far beyond the technology itself, including issues associated with users, infrastructure, and the symbolic meaning of the change itself



(Geels, 2002). As a result, many organizations are currently experiencing a development cycle gap, between the technologies they have knowledge about and the ones they will adopt. It is, therefore, of vital importance to study this process of dissemination of technological innovation.

Although the adoption of innovation can provide companies with numerous competitive advantages, the innovation process requires significant organizational resources and involves a high-risk, high-reward strategy that can lead to failure (Tatikonda & Rosenthal, 2000). The process of innovating is complicated by various barriers, which can hinder the adoption of technological innovations. Therefore, regardless of its typology, innovation requires careful planning and resource allocation to mitigate the risks associated with the process.

As mentioned in the “Oslo Manual” (OECD & Eurostat, 2018), several conditions can hamper innovation and impair its results, of which the following stand out:

- High risks;
- Shortage of funding;
- ROI is too long;
- Lack of capacity for innovation;
- Lack of specialized human resources;
- Ignorance of technology;
- Ignorance of market conditions;
- Difficulties in external cooperation;
- The complexity of intellectual property.

Still, regarding the involvement of companies in technological R&D, the main limiting factors identified by Matheson and Matheson (1998) tend to be the:

- Temporal distance between R&D activities and the achievement of their benefits;
- Uncertainty and risk;
- Lack of knowledge of the market;
- Difficulty of companies in adapting their business model to technological domains they do not master.

In addition, other authors have been more recently emphasizing the importance of aligning R&D project scopes with companies' strategy, implying a need for greater cooperation between internal and external agents of the company (Mazurkiewicz & Poteralska, 2017).

#### *2.2.2.5. Innovation Policymaking*

Innovation policy can be defined as the public actions influencing an innovation process, i.e., the development and diffusion of innovation, both in terms of products and processes (Chaminade & Edquist, 2006). These actions include also public actions that may influence demand-side innovations (Edquist, 2001). According to these definitions, public action is crucial to stimulate innovation, although nothing is said about the form or the extent to which these actions should take place.

Some answers can be found in the innovation economics literature, where “market failures” (neoclassical approach), “systemic failures” (evolutionary approach) and “voluntarist motives” are pointed out as justifications for the government intervention in the economy, especially when policymaking (Bonaccorsi, 2014; Schröter, 2009; Swann, 2009).

The traditional approach (i.e., neoclassical) to innovation considers technology development as being an exogenous variable of the economy, adding that technological progress is just a result of R&D activities (Bach & Matt, 2005). This approach claims that there are “market failures” (Gråsjö et al., 2018; Klein Woolthuis et al., 2005) making it impossible for the market to function in equilibrium. A market failure occurs when there is no efficient allocation of resources due to a breakdown of the price mechanisms, which can be caused by a market phenomenon preventing a socially optimal equilibrium (Swann, 2009). The neoclassical approach associates market failures with knowledge creation, with knowledge being synonymous with information that can be codified, generic, accessible, or adaptable to the companies' characteristics (Chaminade & Edquist, 2010).

However, tacit knowledge is also essential to any innovation process. While the fundamental idea that “knowledge” is equal to “information” implies that knowledge can be considered a public good, there are three major market failures associated with the production, dissemination, and accumulation of knowledge (Chaminade & Edquist, 2010; Nelson, 2009; Swann, 2009):

- **Externalities** – which can be positive or negative, and which can provoke an inadequate appropriation of results by those who produce knowledge.
- **Uncertainty** – results from the asymmetry of information access among the agents, meaning that results and risks of a research process may not be fully known.

- **Indivisibilities** — difficulty in managing economies of scale, resulting from the need for a minimal investment in knowledge to produce new knowledge.

In summary, in the neoclassical approach, market failures justify the need for public innovation policies supporting R&D activities and the production of technological knowledge. However, one of the main criticisms of the “market failures argument” justifying state intervention in innovation concerns the primacy given to the market about other forms of organization of economic activity (Nelson, 2006, 2009).

By the late 1990s, and especially in the early 2000s, there was a gradual shift from a vision based on science and technology policy, to a more holistic view based on innovation policy (Soete, 2007). This new trend was characterized by a greater emphasis on the relationship between R&D, innovation, economic and social development, from a systemic perspective (Steinmueller, 2009). Contributing to this new vision, public innovation policies started being designed as strategic contributions to:

- The importance of interaction and cooperation between companies and their external environment (Breschi & Malerba, 2005; Chesbrough et al., 2006; Porter, 1998);
- Formal and informal networks (Laursen & Salter, 2006);
- Institutions and learning processes or users (von Hippel, 2005, 2009).

In the last two decades, there was also a stagnation of public efforts for R&D in OECD and EU countries. Although total expenditure on R&D increased in the 2000s, the relative efforts of states in R&D stagnated or even decreased. In contrast, the relative effort put forth by higher education institutions and companies increased during this period (Santos, 2016).

### **The systematic approach to innovation Policy**

The evolution of current innovation policies in response to the fourth industrial revolution, characterized by digital transformations within industries, has been greatly influenced by the development of the field of Information and Communication Technologies (ICT). These technologies have contributed to a change in the perception of the nature of innovation processes and have been instrumental in the adoption of a systemic perspective in the policy formulation process (Delanghe et al., 2009; Soete et al., 2009). ICT enabled quick access to new technologies, namely digital technologies, stimulating the development of knowledge services specialized to support the innovation process itself (Perez, 2009). In other words, while access to knowledge and innovations did not necessarily lead to the immediate

development of Research & Development (R&D) activities, it did encourage the recombination of existing ideas and technologies, with a focus on the commercial exploitation of R&D outcomes (Soete et al., 2009).

In addition to the impact of these digital technologies on the innovation process, there was a growing demand for competitiveness at sectoral/industrial levels in international markets, which was complemented by improving interactions and intermediation between industries' needs and national policies. This demand contributed to the creation of a favourable framework for adopting a systemic view of the innovation process by the policymakers, with a greater focus on expanding markets and changes in the political, technological, and institutional context on a global scale. As result, policymakers have been increasingly proclaiming the adoption of an IS approach as a framework and guide for designing future innovation policies (Edquist & Hommen, 2008).

This perspective considers that innovation policy should be comprehensive, including elements of R&D policy, technology policy, infrastructure policy, and regional and education policy, and thus showing its complexity, from an evolutionary (i.e., systemic) perspective (Edquist, 2014). The comprehensive view offered by the systematic approach to the innovation process means that it is currently used by international organizations with political influence, such as the OECD (OCDE, 1997, 2009).

The IS's approach is also being increasingly used within the policy-making context by regional organizations, national governments, public agencies, and international organizations such as the OECD and EU. In recent years, innovation policy has also been increasingly discussed in terms of “broad-based innovation policies” and in a more “demand-pull approach” (Edquist, 2014). The adoption of a systemic approach by policymakers and international entities makes the performance of public policies more transparent on the supply side, on the market, on the system functioning, and on the strategic action taken (Edquist, 2014; Santos, 2016).

### **2.2.3 The Portuguese innovation system**

#### *2.2.3.1 Characterization of the Portuguese NIS*

The development of the Portuguese NIS has followed a trajectory similar to that of other European Union countries, beginning with a traditional and linear approach focused on science as the primary driver of innovation and economic growth, and then transitioning towards a more open and systemic perspective (Henriques & Larédo, 2013).

Over the past few decades, the Portuguese NIS has increasingly adopted an IS approach. Significant investments were made in the development of scientific infrastructure and technology, as well

as in the training and qualification of researchers, which have greatly benefitted the Portuguese NIS (Rodrigues et al., 2003). From a historical perspective, Portugal has never presented a linear evolution concerning its NIS. Still, key development clusters can be identified, representing different stages of Portuguese NIS evolution (Ferreira, 2005; Santos, 2016):

- **The 1960s** – Strong investment in HR training and the development of national R&D infrastructures.
- **The 1970s** – Promotion of R&D capacity in strategic sectors of the national economy, directing them to the absorption and application of technical and technological knowledge.
- **The 1980s** – Focused heavily on an industrial policy to encourage the collaboration of industries with universities, encouraging the emergence of hybrid interface institutions (e.g., TIC) in support of technological development between agents.
- **The 1990s** - Oriented to training, competencies and professionalization of R&D activities carried out in academia.
- **The 2000s** - Focused on opening the system itself, mostly aiming for an internationalization of the NIS, with policies to incentivise collaborative ITT projects between companies and academic and R&D entities, both within the NIS and with foreign partners (Godinho, 2013).

In Portugal, the NIS approach adopted between the 1980s and 1990s focused on a traditional and linear perspective of technology-push, with the government directly promoting and funding science, technology, and innovation. During these decades the Portuguese government regarded the academia as the primary source of innovation (Godinho & Simões, 2005; Laranja, 2007), as result most of its investment focused on national R&D technology infrastructures (Duarte & Carvalho, 2020; Laranja, 2007).

However, by the late 1990s, the Portuguese economy gradually shifted towards a more modern and systemic approach, aiming to meet the state-of-the-art models of the NIS at that time. To support innovation during this period, there was an increasing demand for the integration of different political sectors, as well as greater integration of operational management, financial, and fiscal incentive programs (Duarte & Carvalho, 2020; Laranja, 2007). The adoption of this new and systemic perspective was a milestone foundation for the current NIS. Over the last few decades, policies and innovation programs have been designed in a more modern and open innovation perspective following the directives of the EU (Santos, 2016).

Following this, Simões (2003) categorised the five main agents constituting the Portuguese NIS:

- Companies;
- Academia and research institutions;
- Technology interface entities (as key intermediaries);
- Financial system;
- Governmental (public) entities.

However, the interactions and relationships between agents in the Portuguese NIS, whether formal or informal, remained limited and inconsistent. This was largely due to the specific characteristics of the organizations involved and their inadequate capacity for collaborative networking (Ferreira, 2005). The functioning, structure, and characteristics of the Portuguese NIS have been extensively analysed by several authors (Assis, 1999; Costa et al., 2022; Ferreira, 2005; Godinho, 2013; Henriques & Larédo, 2013; Santos & Mendonça, 2017; Simões, 2003; Teixeira & Lopes, 2012) who have identified common strengths and weaknesses of the system.

While the strengths are primarily related to the level of infrastructure and the qualifications of the system, the weaknesses are linked to institutional factors and the characteristics of the Portuguese economy's productive structure (Costa et al., 2022; Duarte & Carvalho, 2020).

### **Weaknesses as opportunities for the Portuguese NIS**

Many of the innovation models see system gaps, weaknesses, and failures as opportunities for continuous improvement. Regarding the Portuguese NIS, its greatest's weaknesses are essentially systematic, centred on the structure of the economy and society itself, in addition to institutional factors that have been thoroughly highlighted by several authors in recent years (Duarte & Carvalho, 2020; Laranja, 2009). For instance, Simões (2003) identified as main weaknesses of Portuguese NIS:

- The systemic deficiencies in the articulation, coordination and strategic guidance on the part of innovation policymakers, who continue to be unable to overcome the dichotomy between sciences and economics;
- The biased vision and management of public institutions, such as the lack of a culture of risk and entrepreneurship, as well as reducing the number of cooperative interactions between players, leading to a reduced level of self-confidence;

- Lack of skilled resources supporting innovation activities within key public and governmental entities of the NIS, especially interface entities, policymakers, financial system and even inside most companies.

The latter, the lack of qualification and competencies for innovation was also mentioned by Mamede et al., (2014), who associated it with the low weight of knowledge and technology-intensive sectors within the Portuguese economy. This is reflected in the low specialization and internationalization of Portuguese companies, mostly SME.

### *2.2.3.2 Financial innovation incentives*

Following its accession to the European Economic Community (EEC) in 1986 and the adoption of the Schengen Area and the single currency, Portugal began receiving support from the European regional policy to align its development patterns with the European average. Over the past 35 years, the structural and cohesion funds have played a crucial role in the country's progress, serving as a significant factor in its economic development and modernization. The impact of these funds can be measured both directly and indirectly, as they have contributed to the improvement of the economy and society in Portugal, both in terms of previously registered advancements and expected future benefits (Alexandre, 2021).

The structural and cohesion funds are essential in promoting innovation capabilities and enhancing the performance of public and academic infrastructures, as well as industries' approach to innovation. In Portugal, these funds have played a significant role in shaping the NIS by providing financial incentives for innovation. Over the years, Portugal has submitted six strategic intervention proposals to obtain support for its development through the European Regional Policy's programming cycles. These funds have been widely adopted due to their crucial role in funding and incentivizing national innovation programs, particularly those aimed at companies. Additionally, they have a proven ability to mobilize public and private funding for innovation since national funds are required to complement community funds in approved projects (Laranja, 2009; Santos, 2016; Simões, 2003).

### **QCA III - Community Support Framework (2000-2006)**

After the initial Community Support Frameworks - QCA I (1989-1993) and QCA II (1994-1999) – Portugal began the new millennium with a third QCA (III). Between 2000-2006 the primary public financing instrument for the modernization of the Portuguese economy and territorial development was

the third Community Support Framework (QCA III). The QCA III consisted of sectoral operational programs, divided into four key aims:

1. Qualification, employment and social cohesion (included support for education, employment and training, science and innovation, knowledge society, health and culture);
2. The changing of the productive profile of the Portuguese economy (support for agriculture, fisheries, industry, commerce and services);
3. Territorial development (support for accessibility, transport, and the environment);
4. Sustainable development of regions and national cohesion (support for regional development).

### **QREN - National Strategic Reference Framework (2007-2013)**

In the period 2007-2013, the reference instrument for competitiveness policies was the National Strategic Reference Framework (QREN). The QREN took on a major strategic aim of responding to the main weaknesses of the Portuguese economy and society, namely the lack of qualification of the Portuguese population; the valorisation of knowledge, science, technology, and innovation; as well as an increase in efficiency and quality of public institutions (Alexandre, 2021). To this end, the implementation of the QREN was ensured by three thematic operational programs, which had the following objectives:

1. Operational Program for Human Potential (OPHP), which aimed to overcome the qualification deficit of the Portuguese population, support qualification in scientific and technological institutions, as well as support job creation, entrepreneurship, the transition to active life, and equality of opportunity.
2. Operational Program for Competitiveness Factors (OPCF), which focused on improving the competitiveness of the Portuguese economy, in a global market context, by stimulating innovation, S&T, internationalization and modernization of public administration.
3. Operational Program for Territorial Enhancement (OPTE), which was intended to strengthen the country's international connectivity, the national infrastructure network and overall territorial cohesion.

### **PT2020 – Portugal 2020 (2014 – 2020)**

The most recent innovation incentive program in the Portuguese economy was called Portugal 2020 (PT2020). This program focused on the appropriate application of European structural funds in Portuguese NIS between 2014 and 2020, with its complete closure coming to be extended to 2023 due



to the 2020-2022 pandemic crisis (Alexandre, 2021). The design of this incentive program was aligned with the benchmarks of Europe 2020 strategy, oriented towards intelligent and sustainable growth, focused on the application of more than 25 billion euros in four distinct operational domains (Carvalho et al., 2012; Santos, 2016):

1. **Competitiveness and Internationalization Program (POCI/COMPETE 2020)** – meant to increase national economic competitiveness as well as internationalise Portuguese SMEs. The main areas supported by the program were R&D, Innovation, SME competitiveness, job creation and the modernization of government institutions.
2. **Social Inclusion and Employment Program (POISE)** – aiming to improve the quality of employment, labour mobility, inclusion and also the promotion of social innovation initiatives.
3. **Human Capital Program (POCH)** – focused on educational development, training, and learning, including adult training and absorption of highly qualified human resources (MSc and PhD) by companies.
4. **Program for Sustainability and Efficiency in the Use of Resources (POSEUR)** – designed to mitigate carbon emissions, promoting efficient and sustainable use of natural resources.

Among the four main operational lines, POCI/COMPETE 2020 stood out as the most significant, representing 75.5% of the total budget. This line comprised five intervention axes, with a focus on enhancing the competitiveness of companies, public institutions, innovation, and technology through funded R&D and TT projects (Cabral, 2018; Carvalho et al., 2012).

One of the priority axes aimed to incentivize companies and technological institutions to collaborate on R&D projects and disseminate their results, promoting effective knowledge and TT between different agents. These funded projects included various typologies such as R&D, technology pilots and demonstrations, dissemination of results, IP patenting and licensing, marketing innovations, and the establishment and maintenance of sectoral and regional innovation networks supported by recognized Portuguese clusters (Alexandre, 2021; Santos, 2016).

## **2.3 Technology Transfer (TT)**

### **2.3.1 Transferring technology and innovation**

This growing emphasis on issues related to TT and its impact has gained the attention of researchers and governmental entities worldwide (Bengoa et al., 2020; Choudhry & Ponzio, 2020; Gerli et al., 2021; Rocha et al., 2021). The literature has seen a proliferation of proposals for taxonomies, models, perspectives, and definitions concerning this issue. However, despite these efforts, a full understanding of the concept remains elusive due to its dynamism and multidisciplinary nature, which keeps evolving (Belitski et al., 2019; Bengoa et al., 2020; Choudhry & Ponzio, 2020; Soete & Weel, 1999).

It is recognised widely as challenging to understand the concept of TT due to the complexity of the parallel processes that operate simultaneously among different players during the process (Roessner in Bozeman, 2000). This complexity is corroborated by other authors (Belitski et al., 2019; Bengoa et al., 2020; Mauricio Sanchez & López Mendoza, 2018; O’Kane, 2018), who say that transferring technology within a company is a challenging procedure for those involved, as it goes through an additional set of complex dynamics and interactions between academic, R&D and of other companies involved. It is, therefore, understandable why some authors (Bozeman, 2000; Choudhry & Ponzio, 2020; Rocha et al., 2021) emphasize the need to evaluate and measure the performance and impact of the various agents involved in this complex process. TT has a multidisciplinary character since it is not limited to any particular field of research and transcends science or technology (Reisman, 2005).

There are several fields of research that have contributed to the understanding of the concept of TT. While each scientific domain presents its vision, definition, and taxonomies, a multiplicity of scientific biases inevitably leads to an increase in the complexity of the process itself (Bengoa et al., 2020; Johnson & Lybecker, 2009). This complexity was also identified by other authors in the literature. Bozeman (2000) emphasized that prior to the 2000s, the literature on Knowledge and Technology Transfer (KTT) tended to overlook the political, commercial, and operational dimensions of the process, as well as the interdependent vertical and horizontal perspectives of the concept.

TT occurs across several scientific, technological, and sectoral economic fields (Glass & Saggi, 1999; Rogers, 2016). While it may be challenging to generalize the concept, it can be described as a process in which a company acquires an innovative technology from an external source, typically an organization focused on knowledge and R&D affiliated with academia (Bessant & Rush, 1995; Cummings & Teng, 2003; Good et al., 2018). In addition to this superficial view, it is also essential to analyse the role of other variables, such as the ability to transfer, the maturity of the receptor’s absorptive capacity,

or the economic and technical utility of the technology (Cunningham & Mohamadi, 2011; Mazurkiewicz & Poteralska, 2017).

From the point of view of innovation dissemination, Rogers (2003) suggested that the concept of TT could be defined as the application of knowledge and that it could be often considered a process where participants have dissimilar characteristics, that is, technology receivers (i.e., companies) tend to speak a different “language” than of the technology providers (i.e., academia, R&D). It may seem that the interrelationships between the concepts of “innovation dissemination” and “technology transfer” may be confusing, in the sense that they operate within the same domain. However, literature allows to clarify these two areas of interest.

Rogers (2003) postulates that TT is an essential communication process through which scientific research results are transformed into marketable innovations. Thus, TT represents a unique and challenging form of scientific communication for all parties involved. While some technology experts argue that TT activities are not essential, citing instances where ideas and technologies have spread spontaneously and organically, this notion is not supported by the available literature. In reality, TT activities play a critical role in bridging the gap between scientific research and marketable products.

Within the TT literature, brokers and intermediary agents emerged as a crucial agents in facilitating the diffusion of knowledge and supporting the TT process. In the 1950s and 1960s, the concept of “change agents” (Hägerstrand, 1952; Rogers, 1962) became significant in their ability to diffuse and absorb technology, contributing to the creation and marketing of new products and services across various industries and organizations.

Intermediaries also played other roles in the field of information systems and TT, primarily focused on promoting technology and knowledge adoption by firms. These roles involved activities such as standard setting, defining specifications and requirements, and even evaluating technology (Mantel & Rosegge, 1987). Other authors have taken a broader perspective on the role of intermediaries in various phases of TT, rather than just the transfer of market-ready technology to industries.

Watkins and Horley (1986) found a significant involvement of intermediaries in less expected stages of TT processes. The authors found intermediaries taking roles such as:

- Seeking and identifying partners and/or suppliers for projects;
- Supporting the development of technology value proposition to be transferred between two entities;
- Supporting due diligence related to the deal-making process.

Other authors have taken more forthcoming research on what activities intermediaries might become increasingly involved in through different phases of TT (Howells, 2006; Pollard, 2015; Vidmar, 2021), namely by developing new roles more focused on providing negotiation and contractual competencies to the TT process.

The integration of the three helices created tri-lateral networks and hybrid organizations such as technological interface centres (TIC), brokering academia R&D results directly with companies (Etzkowitz & Leydesdorff, 2000). In this context, Leydesdorff & Etzkowitz (2001) also highlighted the emergence of technology and knowledge brokers, acting as network coordinators and organizers with the task of intermediating people from different spheres.

These newly emerged and empowered intermediary professionals could better move in the complex system of overlaid networks using their inter-organizational and interpersonal skills (Colombo et al., 2015; Knockaert & Spithoven, 2014). The skills brokerage business model of Papagiannidis & Li (2005) also highlights the emergence of new hybrid intermediary organizations that act as interfaces at the intersection of academia and industry. These semi-public entities, such as TIC, were created to move more seamlessly between the helices of academia and industry, facilitating collaboration and knowledge transfer between the two spheres.

The new intermediaries primarily function within a skills brokerage business model, facilitating exchanges between entrepreneurs or established companies of skills, resources, and access to networks. They can also offer other forms of human and social capital in exchange for skills provision, with the provider receiving equity, direct access to venture returns, or a combination of both (Papagiannidis et al., 2009). Technological knowledge brokers can act as facilitators between market actors forming a link between them to encompass the lack of skills and costs, identified as the two main challenges in marketing new products, technologies, and innovations (Kidwell, 2013; Winch & Courtney, 2007).

### **2.3.2 Challenges to Technology Transfer**

The crucial role of innovation and technology in the competitiveness of organizations, as well as its significance for economic growth, has been widely studied across various scientific fields, including innovation economics, politics, sociology, and engineering. Numerous concepts and models of technology creation and diffusion exist in the literature, with TT being the most prominent. It refers to the process of converting knowledge and technology arising from fundamental research into marketable product applications (Johnson & Lybecker, 2009; Rogers, 2003).

Literature on TT is still largely focused on academic and political perspectives, that is, mostly focused on identifying the best strategies, financing instruments and public involvement necessary to ensure the intellectual and economic effort invested is not lost through the “*valley of death*” (Baglieri et al., 2018; Gulbrandsen, 2009; Hudson & Khazragui, 2013; Lindström & Silver, 2017). This valley of death is mainly associated with public entities, representing a gap between R&D and the market, where many projects, technologies and knowledge are lost due to the difficulty in successfully reaching the market (Gulbrandsen, 2009; Lindström & Silver, 2017).

TT literature is still dominated by a linear perspective of pushing technological knowledge to the market, even despite authors such as Jun and Ji (2016) having properly demonstrated that articulation between technological development and market needs poses a positive influence to the success of TT processes. Also, Pollard (2006) had previously highlighted the importance of studying the process of TT on a deeper level of interpersonal relationships, examining how systemic influences can shape TT through the individuals involved in the process.

According to Hidalgo and Albors (2008), the traditional notion that innovation is primarily driven by research (i.e., the technology-push model) and its transfer between entities has been superseded by a contemporary perspective that emphasizes innovation in a social network. Moreover, Klerkx and Leeuwis (2009) drew attention to the emergence of a typology of systemic intermediaries focused on promoting and sustaining these networks and Innovation Systems (IS). However, existing literature often fails to adequately explore the specific role and relationship between intermediaries and the components of the innovation process itself (Motta et al., 2017).

In most TT processes, the key aim is to accelerate the process, ensuring a greater and faster Return On Investment (ROI) from R&D activities responsible for the creation of technological innovation (Jun & Ji, 2016). In all cases, the significant pursuit and effort invested in improving the speed and efficiency of TT are central to this type of research. Though, the problem is that technologies currently being developed often exceed the organization's maturity and ability to use them effectively (Deloitte, 2015; Mazurkiewicz & Poteralska, 2017).

A well-known challenge among researchers is the process of TT and knowledge diffusion. Successfully achieving TT requires overcoming several communication barriers, such as the use of distinct vocabularies, differing motivations, and varying organizational cultures among the agents involved (Carter et al., 2001; Coppola, 2007). The fundamental difficulty in the TT process lies in the dissimilarity of the participants (Liyanage et al., 2009).

Markets are dynamic and constantly evolving, which forces its participant agents, particularly companies, to innovate to maintain their competitiveness. By forming partnerships and collaborative relationships with economic agents (i.e., both public and private), it becomes possible to access knowledge and technological resources that may otherwise be unavailable (Barros et al., 2014; Vahlne & Johanson, 2017). This, in turn, fosters the development of the ability to create and launch innovation in the market, improve market access, increase productivity, and share risks and gains (Faria et al., 2010).

### 2.3.3 Key components of the TT concept

TT is a complex and multifaceted process involving the movement of knowledge, skills, or technologies from one entity to another, often from universities or research institutions to the companies within an industry. Although there are numerous studies on specific TT projects and case studies, few comprehensive studies on the process itself exist, which makes it difficult to identify the critical factors and strategies that should be considered when designing and implementing TT projects.

Even so, Battistella et al. (2016) shed light on this issue by comparing TT models and their characteristics from the perspectives of several authors (Abdul Wahab et al., 2011; Bengoa et al., 2020; Bozeman, 2000; Kumar & Ganesh, 2009; Liyanage et al., 2009; Malik, 2002; Mauricio Sanchez & López Mendoza, 2018). From this comparative and complementary analysis, three main elements were identified as key composing parts of any generic TT model:

- **The Source and the Receiver of the technology:** The source of the technology is the organization or individual that possesses the technology or knowledge, while the receiver is the organization or individual that seeks to acquire it. Both parties play a critical role in the TT process, and it is essential to understand their needs, expectations, and constraints to ensure a successful transfer.
- **The object (or technology) to be transferred:** The object of the TT can be any product, process, or knowledge that has commercial or societal value. The object can be tangible, such as a prototype or software, or intangible, such as a patent or know-how. It is essential to assess the technical feasibility, market potential, and intellectual property rights of the object before initiating the TT process.
- **Intermediaries (or mediators) facilitating the process:** Intermediaries are individuals or organizations that help facilitate the TT process between the source and receiver. Intermediaries can include technology transfer offices, venture capitalists, patent lawyers, and consultants. Their role is to provide expertise, guidance, and resources to ensure a smooth and efficient transfer.

Understanding these key elements of a generic TT model is essential for designing and implementing successful TT and innovation policies and incentives. By considering the source and receiver of the technology, the object to be transferred, and the intermediaries facilitating the process, governmental organizations and policymakers can define strategies and actions aiming to increase the likelihood of a successful transfer and maximize the economic and societal impact of the technology innovation transferred.

#### *2.3.3.1 Sources and Receivers of the technology*

The basic components in all TT systems/models are the entities involved at each end of the transfer process: the source who sends the technologies and the recipient who receives and/or uses such technology. Malik (2002) compares this relationship to the “message transmission model” commonly used in communication studies. The author employs traditional communication terminology such as sender, recipient, and message to describe the TT process. The author also emphasizes that TT is a reciprocal process where both sender and recipient engage in a “feedback process” to gain additional knowledge about the technology being transferred.

In contrast, other authors describe the TT process as involving a source and receiver, with the former possessing the technology to be transferred, and the latter having a need to acquire such technology (Allen et al., 2017; Cunningham & Mohamadi, 2011). The main objective of any TT project is to effectively transfer and implement the knowledge in the receiving organization. Liyanage et al. (2009) refer to the source and receiver as the primary actors in the TT process, with the former being responsible for sharing knowledge, and the latter for acquiring and applying it in the market and society. These entities possess unique characteristics, such as innovation capabilities and specific needs, enabling them to receive and utilize created knowledge effectively.

#### *2.3.3.2 Object (or Technology)*

A TT process involves the exchange of a particular object, which represents a dimension identified by Kumar and Ganesh (2009). This object encompasses the properties and characteristics of the technology and/or knowledge being transferred. However, the term “technology” itself is too complex to be described adequately (Bozeman, 2000; Sanchez & Mendoza, 2018; Mazurkiewicz & Poteralska, 2017; Prud’homme et al., 2018). To fully understand it, various market dimensions and stakeholders’ perspectives must be considered (Bozeman, 2000; Duan et al., 2010; Zhao & Reisman, 1992). As such, the technology term itself can be subject to further research and comprehension.

Until the late 1990s, technology as a concept was primarily described as a “tool” (Bozeman, 2000). Other authors such as Sahal (1981, 1982) had previously thought that the concept of technology could be itself considered as a “configuration”. The author stressed that the transfer of such technology cannot be simply perceived as the physical movement of such technology as a product might make, from a source to a recipient. The focus should be on its application and effective use by the receiver, which corroborates the idea of innovation thought by Schumpeter (McCraw, 2010; Soete & ter Weel, 1999).

Combining perspectives, others such as Liyanage et al. (2009), support the view that the object being exchanged typically represents a concrete technology but could also be considered as technological knowledge. For instance, Keller (2001) presented three defining attributes of the concept of technology:

- It is a created good thought to be shared until its marginal cost per added user becomes insignificant;
- The ROI of innovative technology can be private (as companies own it), but also public (as institutions may also benefit from its knowledge);
- Technological development results from the work of private players creating innovation, whether through new products or new processes.

Corroborating the perspective of Madeuf (1984), several other authors (Choudhry & Ponzio, 2020; Lane, 1999; Morrissey & Almonacid, 2005; Rogers, 2016) have a contribution to the perception of the concept of technology as a combination of techniques and more or less formalized information resulting from conducting R&D activities. Still, others see technology as something that should not exist by itself or be transferred without any control, fearing that a monopolized use of it as a competitive advantage by some companies, would corrupt its meaning as a “public good” (Bozeman, 2000; Santos, 2016).

The transfer process entails the involvement of two distinct entities, the sender, and the receiver, who exchange technology or knowledge as a valuable "object" with unique significance for each party. Merely transferring people, knowledge, or technology in isolation is insufficient. As noted by Malik (2002), it is also important to transfer the know-how necessary for the proper interpretation and use of the received technology and knowledge.



### *2.3.3.3 Intermediaries (or mediators)*

Davenport and Prusak (1998) have described the transfer of knowledge and technology products as a non-free exchange between parties. In this exchange, the supplier develops and transfers units of knowledge in exchange for remuneration, creating a knowledge and innovation market of high importance for both R&D developers and companies looking to acquire it. The agents involved in this process, in most cases, are also the intermediaries who are responsible for finding, managing, relating, and contracting buyers and suppliers. When there is a specialized intermediary agent involved in the process (a.k.a. mediator or broker), they may or may not be directly involved in the entire TT process. In many cases, intermediaries are contracted to assist with specific tasks that other players (i.e., source and recipient) have no competencies, resources, or interest in performing (Colombo et al., 2015). The intermediary agent is a specific emerging body of literature where its role in the transfer process is being analysed. Innovation intermediaries are generally depicted as agents facilitating the process of KTT between organizations and industries (Silva et al., 2018).

Intermediaries are considered part of the innovation system, and their role focuses mostly on assisting in the TT process between people and organizations, dealing with facilitating or restrictive factors. They play a crucial role in the process, particularly in the context of transfers between organizations. They intervene in the process by acting as mediators between parties, facilitating the relational context and supporting the process to ensure desired results for all parties involved (Kivimaa et al., 2019; Stezano, 2018; Watkins et al., 2015).

The evolving comprehension of the inherent complexity in the innovation process and its stakeholders has prompted entire governments, economies, and their NIS to embrace more contemporary and inclusive perspectives. The potential outcomes stemming from open collaboration between organizations have served as a catalyst for recognizing the significance of intermediary agents in the literature on innovation (Howells, 1999; Kivimaa et al., 2019).

From an Open Innovation (OI) perspective, the specialized role of such intermediaries has acquired substantial significance by connecting and aligning source and recipient organizations, as well as facilitating the dissemination of information and market requirements among key stakeholders. In essence, intermediaries contribute to the conceptualization and oversight of high-risk/high-impact TT projects and the market introduction of resulting novel products and solutions (Colombo et al., 2015; Howells, 2006; Jenson et al., 2020; Randhawa et al., 2018; Tran et al., 2011).

## **2.4 Intermediation and Intermediaries**

### **2.4.1 Technology Transfer intermediation**

As previously mentioned, Silva et al. (2018) have described TT intermediaries as mediating agents in innovation processes and systems, highlighting their role as facilitators to organizations in TT. However, Dalziel (2010) has proposed an alternative definition, focusing on intermediaries' purpose as organizations or groups working to enable and foster innovation in technology and market. Innovation intermediaries can take many forms, such as technology brokers, university interface departments, R&D centres, regional technology centres, innovation agencies, and transnational networks (Watkins et al., 2015).

Some companies, especially certain KIBS, may also be included in this group, given their extensive service offerings and flexibility in operations and interactions (Shearmur & Doloreux, 2019). Private consultancy firms that specialize in innovation and technology fields may also be considered intermediaries in an OI paradigm, as they serve as a source of ideas and knowledge for entire industries and market sectors (Tether & Tajar, 2008). Innovation intermediaries can both expand and strengthen the innovation capacity of recipient companies, industries, regions and even nations. They reduce the gap between internal and external knowledge, reduce the time of access to know-how and marketing, increasing the efficiency and efficacy of innovation in recipient companies (Dalziel, 2010; Villani et al., 2017).

The concept of innovation intermediaries can be traced back in the literature to the “brokers” in the agricultural and textile industries of the sixteenth to eighteenth centuries. These brokers had mostly commercial functions but also actively disseminated technical knowledge (Howells, 2006). Since then, intermediaries have gained new importance (Hakkarainen & Hyysalo, 2016), and their functions have become more extensive and varied depending on the agent.

With the widespread adoption of OI by NIS worldwide, innovation intermediaries have proliferated and have been playing a broader, more dynamic, and recognized role. Intermediaries work directly with their clients on an individual basis, seeking collaborations of interest, but are increasingly involved in more complex relationships, especially in the context of national innovation networks and systems (Barlatier et al., 2017; Howells, 2006; Zajko, 2017).

Fields such as KTT, Innovation and Technology Management, IS, and even Business Strategy or Product Marketing have identified various roles and specializations for entities acting as technology intermediaries (Howells, 2006; Lichtenthaler & Ernst, 2008). However, this was not always the case. In the early 1990s, most publications, especially in the TT-related literature, typically summarized the

functions of intermediary agents into just two roles: “brokering”, as the main function during the innovation and/or TT process; and “networking”, a typical role for an intermediary within an IS, providing and maintaining the right connections and network conditions in a defined sector or industry and among its stakeholders (Agogu  et al., 2013; Barrie et al., 2019).

Other authors (Wolpert, 2002; Lynn et al., 1996) added two other major activities that were found to be increasingly demanded from intermediaries: “communication” and “scanning and gathering of information”. These activities posed a milestone in understanding that there is a broader potential in their intermediary role of boosting, supporting, and sustaining IS and TT processes (Battistella et al., 2016).

In most cases, authors tend to agree that the intermediary's role in innovation and TT is far more complex than just mediating and brokering - the most highlighted intermediation roles in TT literature. For instance, Bessant and Rush (1995) showed that private management consultants had a particular role in acting as “innovation bridges” by providing a set of specialized activities sold as Knowledge Intensive Business Services (KIBS). These specialized “bridging activities” observed by Bessant and Rush (1995) overlapped and went beyond their previous notion of intermediation activities, among which are:

- The articulation of needs and selection of options;
- The identification of needs and training selection;
- The creation of business cases;
- Communications and development;
- Education and links to external info;
- Project management activities, like managing external resources and organisational development.

Despite the development of the innovation intermediary literature, the roles, and activities of intermediaries in innovation and TT literature are still relatively ambiguous and scattered (Soares et al., 2020). In general, the literature continued to describe the intermediary's focus within specific TT case studies rather than their actual roles and specialized activities.

Thus, the term “intermediary role” is being used to describe a portfolio of activities, tasks, responsibilities, focus, or even goals within a TT process. Examples of this are (Diener et al., 2020; Howells, 2006; Pollard, 2015; Vidmar, 2021):

- Building linkages with external knowledge providers;
- Providing specific knowledge of technology and industries;

- Articulating communications;
- Diagnosing and evaluating technologies to be transferred;
- Establishing relationships between TT agents to facilitate transactions;
- Providing guidance and implementing innovation policy.

Howells (2006) made a significant contribution to the innovation intermediary literature by presenting a comprehensive study in which he compiled, systematized, and shed new light on the activities that innovation intermediaries can undertake and why they are becoming key agents in IS. This contribution has been further corroborated by more recent publications (Dalziel & Parjanen, 2012; Laranja, 2009; Todeva, 2013; Vidmar, 2021).

Howells (2006) showed that innovation and technology intermediaries can act across a wide spectrum of domains, ranging from technical knowledge diffusion and TT process support to innovation management and marketing. In addition, intermediaries were found to provide KIBS in several steps of TT projects, expanding their role into domains of idea conception, technical problem-solving, matchmaking, intellectual property, technology brokering, and even commercialization. In what concerns innovation intermediaries' roles, the contribution of Howells (2006) is still widely accepted and used (Pinto, 2018). Howells (2006) proposed ten key intermediary functions, namely:

1. Foresight and diagnostics;
2. Scanning and information processing;
3. Knowledge processing and combination/recombination;
4. Gatekeeping and brokering;
5. Testing and validation;
6. Accreditation;
7. Validation and regulation;
8. Protecting the results;
9. Commercialisation;
10. Evaluation of outcomes.

Several authors have adopted Howells' framework proposal on the activities that intermediaries undertake in both innovation and TT (Kanda et al., 2018). These authors seek to complement and add new roles and activities to the existing framework such as:

- Forecasting and road mapping (Agogu  et al., 2013; Kivimaa, 2014);
- Information gathering and dissemination (Bessant & Rush, 1995; Geels & Deuten, 2006);
- Fostering networking and partnerships (Kivimaa, 2014; Klerkx & Leeuwis, 2009);
- Prototyping and piloting (Matschoss & Heiskanen, 2017);
- Technical consulting (Pinto et al., 2015);
- Resource mobilisation (Polzin et al., 2016; Van Lente et al., 2003);
- Commercialisation (Bessant & Rush, 1995; Van Lente et al., 2003);
- Branding and legitimation (Kivimaa, 2014);
- Investment appraisal analysis (Pinto et al., 2015);
- Definition of innovation needs (Agogu  et al., 2013; Pinto et al., 2015).

Current literature indicates that intermediaries do much more than simply mediating and brokering, as was traditionally believed. Intermediaries have taken on the role of innovation architects in the collective exploration and creation of knowledge at the often-diffuse front of innovation (Agogu  et al., 2013). From Howells' (2006) widely recognized perspective, innovation intermediaries support the development of new technologies by acting as specialized intermediary agents between two or more participants (Dalziel, 2010). Pinto et al. (2015), who studied KIBS's involvement in innovation marketing, proposed an updated and extended version of Howells' proposal (2006) to shed light on the typical functions and service offerings of KIBS as innovation intermediaries:

1. Analysis and definition of innovation needs;
2. Identification of user requirements and main trends;
3. Signalling of technological options;
4. Design of new services;
5. Design of new organizational methods;
6. Definition of new marketing strategies;
7. Identification of potential partners;
8. Testing and dimensioning;
9. Selection and training of specialized resources;
10. Protection of innovation assets;
11. Accreditation and certification;
12. Investment evaluation.

This framework, based on Howells' (2006) initial proposal, foresees a broader role for innovation intermediaries, suggesting some new and improved functions that result from a broader understanding of the innovation concept (Pinto et al., 2015; Pinto, 2018). Other studies have also highlighted the contribution of these "third parties" in the process of innovation and TT (Kirkels & Duysters, 2010). Despite this, there are still few publications exploring the concrete roles, functions, and specialization of these intermediary agents (Barlatier et al., 2017; Shearmur & Doloreux, 2019; Soares et al., 2020; Tether & Tajar, 2008).

Despite the proven contribution of intermediaries in fostering innovation and accelerating new products to the market (Colombo et al., 2015) they continue to be a particular type of NIS agent that is neglected in the scientific literature (Dias et al., 2017). Dias et al. (2017) draw attention to the lack of literature focused on understanding the multiplicity of distinct agent organizations playing the role of intermediaries in NIS. Their research conclusions also underline the need to empirically study a new reality in which private organizations are increasingly playing a direct role as innovation intermediaries operating in NIS.

#### **2.4.2 Understanding intermediaries and their role**

The significance of intermediaries has been increasingly recognized in the literature, as evidenced by the growing number of publications that delve into the subject with varying levels of depth. Over the last few decades, the concept has evolved, and scholars have come to realize that intermediaries play a more complex and dynamic role than previously thought (Howells, 2006; Soares et al., 2020; Zajko, 2017). Any agent that provides support or performs tasks between a technology source and a recipient can be considered an intermediary.

This new understanding of intermediation goes beyond the traditional notion that intermediaries merely facilitate technology brokering between academia and industry by developing networks for opportunities (Zajko, 2017). While some scholars have proposed frameworks to simplify the overall understanding of intermediaries, literature on intermediation roles, activities, and responsibilities is still largely fragmented across various publications, research fields, and designations (Intarakumnerd & Chaoroenporn, 2013; Randhawa et al., 2018; Soares et al., 2020; Zajko, 2017).

Some scholars have acknowledged this fragmentation and have proposed modular frameworks to categorize, structure, and connect intermediation roles using different conceptual logics. Todeva (2013) viewed intermediaries as innovation "coordinators" responsible for coordination activities and proposed a framework with three main coordination categories: "network", "cooperation", and "political".

Other scholars have differentiated intermediaries by using specialized cluster domains such as “problem-solving”, “technology transfer”, or “coordination of networks in innovation systems” (Agogu  et al., 2017; Sieg et al., 2010).

The role of technology transfer intermediation encompasses various essential activities, which Howells (2006) categorized into four key areas:

- Providing information about potential collaborators;
- Brokering a transaction between two or more parties;
- Acting as a mediator or go-between organizations already collaborating;
- Helping to find advice, funding, and support for the innovation outcomes of such collaborations.

Although the role of innovation intermediation has evolved, the traditional focus on disseminating and diffusing knowledge and technical information within a given sector or industry remains prominent in the literature (Stezano, 2018). Howells (2006) supports this view, highlighting intermediaries' emphasis on addressing the specific needs of TT projects. In addition, Tether (2005) identifies a particular interest in studying intermediaries' performance, particularly in the manufacturing sector, regarding the implementation of innovative technologies in new products and manufacturing processes.

### **2.4.3 Intermediary organizations**

As discussed, innovation intermediaries are a type of organization tackling the in-between tasks of TT. Their starting role tends to be finding a match between two or more parties (Howells, 2006), however, they can then evolve to provide and develop other technology opportunities alongside the project needs. Intermediaries can act as superstructures in the IS (Betz et al., 2016; Kivimaa, 2014; Lynn et al., 1996; Nilsson & Sia-Ljungstr m, 2013), not only by being a bonding agent between new partnerships and projects but also by posing as a catalyst agent helping to disseminate key knowledge and information. Acting from within the systems, some intermediaries are strategically positioned to identify and better respond to market needs and innovation opportunities (Canato & Giangreco, 2011; Martinez et al., 2016). Numerous authors have been noticing the rapid growth in the number and typology of entities performing some kind of intermediation role within the IS (Diener et al., 2020; Howells, 2006; Mignon, 2017; Pollard, 2015; Todeva, 2013; Vidmar, 2021). However, despite this multiplicity of agents with distinct intermediation roles in TT, proper categorization of these entities is lacking, as they are often depicted under the generalized concept of “intermediary”.

Both in the innovation intermediation and the TT literature, intermediary organisations can be found depicted under a set of different, yet synonymous, terms, such as “intermediaries”, “brokers”, “mediators”, “consultants”, “third parties” or “bridge organisations” (Klerkx & Leeuwis, 2009). By itself, the concept of “intermediary” as an actor playing within the IS, may not significantly imply that it is directly involved in the TT (Battistella et al., 2016).

Both the importance and the complexity of its role and impact within the NIS earned innovation intermediaries their own body of literature (Battistella et al., 2016; Hargadon & Sutton, 1997; Howells, 2006; Lichtenthaler & Ernst, 2007; Roth, 2003). Several authors have been further exploring their understanding regarding these emerging and highly dynamic organizations and their role, both within the NIS and in supporting TT processes (Betz et al., 2016; Janssen et al., 2019; Nilsson & Sia-Ljungström, 2013).

A review of the literature on innovation intermediaries has revealed a connection between the adoption of the open innovation model by NIS and the emergence of new players strategically responding to system gaps and market opportunities, as noted by (Howells, 2006). Pollard (2006) further suggested that this increase in the number of organizations serving as innovation intermediaries is also driving the evolution of roles available to address unmet system gaps and market needs. Consequently, this trend has piqued the interest of scholars, particularly in the fields of innovation management and related areas (Chesbrough et al., 2006; Diener et al., 2020; Howells, 2006; Shearmur & Doloreux, 2019; Todeva, 2013). The development of this new research field is contributing to the understanding of systems' intermediaries from perspectives previously underexplored, namely the variety of intermediary organization typologies, their roles, and their importance to NIS (Agogué et al., 2013; Gasco-Hernandez et al., 2017; Li-Ying, 2012; Pinto, 2018; Stewart & Hyysalo, 2008).

The concept of intermediary is no longer considered a generalized theoretical concept, as its role has evolved beyond its traditional functions of supporting networking and technology mediation between senders and receivers. As a result, the term “intermediary” has taken on a wider range of meanings, encompassing different types of intermediary agents and organizations, and a larger portfolio of roles played by them.

As the multiplicity behind the concept of intermediary gained recognition, scholars began to observe and hypothesize the existence of a correlation between types of intermediary agents and the roles they played in the NIS (Katz et al., 2013; Pollard, 2015; Silva et al., 2018). While several roles have already been scrutinized from different points of view, there is still a need for further research to



understand how specific types of intermediaries may be associated with particular intermediary roles (Li-Ying, 2012; Pinto, 2018).

From the first mentions of intermediaries as a concept, which mainly focused on mediating and brokering technology negotiations, the literature now identifies several new kinds of intermediation entities, such as “innovation consultants” (Basu & Taylor, 2010; Bessant & Rush, 1995; Costa et al., 2021; Howells, 2006), “knowledge-intensive business services” (KIBS) (Klerkx & Leeuwis, 2008, 2009; Shearmur & Doloreux, 2019), “knowledge brokers” (Hargadon, 1998; A. Hargadon & Sutton, 1997), “innovation marketplaces” (Lichtenthaler & Ernst, 2008) and idea scouts or technology scouts (Nambisan & Sawhney, 2007).

While many intermediaries can be identified and distinguished, most of them still fall under the umbrella term of “brokers”, which refers to their traditional intermediary role of brokering. However, categorizing all intermediary agents as “brokers” insinuates that they are all direct competitors with each other, which would suggest that they compete under the same conditions and value proposition. In the last few decades, scholars have become increasingly aware that the involvement of these distinct organizations within the NIS can be much more complex, as many organizations may present distinct roles and value propositions (Agogu e et al., 2017; Bessant & Rush, 1995).

Additionally, just as there are technology demands and technology supplies, there is also an emerging group of intermediary actors who perceive the NIS as an innovation market. With this free-market perspective in mind, modern intermediaries have increasingly been observed building up their capabilities and value propositions in response to systemic failures and gap-filling opportunities (Agogu e et al., 2017; Howells, 2006; Klerkx & Leeuwis, 2008).

From a review of the literature over the last thirty years, sixteen major types of organizations with intermediary roles can be highlighted. These types are described below, starting with ten key players categorized as “traditional”, mostly known for being public coordinated entities operating either from academia or from government helixes:

1. **Regional counties** – are local councils focused on applying innovation policies locally, encouraging the rapid diffusion of knowledge, skills, and best practices within a region, following a perspective of Regional Innovation System (RIS) (Inkinen & Suorsa, 2010; Pino & Ortega, 2018).
2. **Governmental innovation agencies** – are government agencies strategically created to develop actions aiming to support technological and business innovation within a country, market, or sectors (Etzkowitz, 2003; Tamtik, 2018).

3. **Innovation hubs and centres** - are the focal point for the innovation communities' activity within key areas of focus. They bring together researchers, creators, and innovators to nurture ideas into industry-changing products and services. They may serve as clusters for a particular region, discipline, or university (Stezano, 2018; Von Hippel, 2009).
4. **Science Policy Centres** – are mostly a hub for stakeholders of science, technology, and innovation policy within a country and aim to strengthen science infrastructures, strategy, and policies (Spithovenm & Knockaert, 2012; Stezano, 2018).
5. **Collective research centres** – are typically organised at the sectoral level (i.e., clusters) or regional levels, to promote and coordinate technological development and technical improvement aligned with sectoral or regional needs, respectively (Knockaert & Spithoven, 2014; Spithovenm & Knockaert, 2012; Stezano, 2018).
6. **University Research Units** – consist of small teams of researchers within universities tasked with funded project work usually in conjunction with external partners (Mauricio Sanchez & López Mendoza, 2018; Yu & Yan, 2018).
7. **Science and Technology Offices** - advise the government and other public agencies on the needs and effects of science and technology on national and international development, mostly to foster innovation policymaking (Lundvall & Borrás, 2006; Mirowski & Sent, 2002; Tether & Tajar, 2008).
8. **Technology Transfer Offices (TTO)** - are the key responsible for supporting and intermediating technology transfer and other aspects of the commercialization of the research that takes place in the university (Baglieri et al., 2018; Rocha & Romero, 2012).
9. **Research Laboratories** - are facilities providing controlled conditions in which scientific or technological research, experiments, and measurement may be performed (Chesbrough et al., 2006; Etzkowitz & Leydesdorff, 1995; Liang et al., 2015).
10. **Technology Interface Centres (TIC)** - are hybrid institutes that serve as an intermediary link between higher education institutions and companies. They are dedicated to valuing R&D results in the form of new products and services, mostly through technology transfer (Meyer et al., 2003; Prud'homme et al., 2018; Rocha & Romero, 2012).

The literature also mentions six types of private and semi-private players who have some degree of intermediary role in the NIS:

1. **Incubators and Accelerators** – These organisations can exist as public, semi-private or even private institutions. All of them aim to provide mentorship support to entrepreneurship ideas, many times resulting from KTT. Incubators ‘incubate’ disruptive ideas with the hope of building out a business model and company, while accelerators ‘accelerate’ the growth of an existing company and the launch of a new product/technology into the market (Becker & Gassmann, 2006; Etzkowitz, 2002).
2. **Industrial Associations** – Can be sectoral or regional. These associations can be composed of private and public members and aim to regularly share information, discuss issues, develop standards, and establish rules for best practices within their industry or region (Watkins et al., 2015).
3. **Venture Capitals** – Focusing on investing in early and risky start-ups and ideas, they have a key role in financing innovative companies and products to reach the market (Papagiannidis & Li, 2005; Sung et al., 2003).
4. **Consulting firms** – Highly dynamic firms selling knowledge-intensive services related to management and innovation to SMEs and/or large corporations, to foster their competitiveness and results (Cesário et al., 2015; Dias et al., 2017).
5. **Patent Attorneys** – Mostly are typical attorney firms focused on providing important impulses at the interface between technology and the law mostly with an advising role on protecting intellectual property and rights of scientific and technological innovations (Li et al., 2015).
6. **Knowledge Intensive Business Services (KIBS)** - These include other companies offering key specialized services to cater to TT stakeholders alongside project demands. They are specialized in niche domains, sectors or even technologies. They can be found in the form of companies such as scientific or technology consultancies, marketing, or design agencies or even engineering/development firm entities (Muller & Zenker, 2001; Shearmur & Doloreux, 2019).

Agogué et al. (2017), in line with previous studies, found indications in the literature that the diversity of organizations playing intermediary roles might be directly associated with the multiplicity of those roles. However, most literature still focuses on case studies involving traditional intermediary organizations, typically those belonging to, or managed by, the public system. Other authors (Intarakumnerd & Chaoroenporn, 2013; Tamtik, 2018) have argued that remaining intermediary

organizations not related to the public system may be considered non-official intermediaries, as the NIS is essentially composed of institutions supported and recognized by the government. Nevertheless, the NIS concept, particularly when claiming to follow open innovation, should include not only publicly funded organizations but also private entities, such as innovation businesses and associative organizations that actively foster innovation within the system (Binz & Truffer, 2017; Gråsjö et al., 2018; Lundvall, 2007).

To properly distinguish intermediaries, this thesis uses the terms “traditional” or “public” when referring to more officially recognized intermediary organizations operating on the academia or government helixes (Bellgardt et al., 2014; Intarakumnerd & Chaoroenporn, 2013). Similarly, the mention of “private” intermediaries will describe for-profit businesses or organizations that contribute to intermediary roles within the NIS by providing specialized knowledge-intensive services in innovation or TT processes (Intarakumnerd & Chaoroenporn, 2013).

#### *2.4.3.1 Private Intermediaries*

A review of literature spanning 30 years and focused on ITT intermediaries was conducted. The latter half of this period witnessed a marked increase in the number and relevance of studies aimed at identifying and delineating the roles played by such intermediaries (Howells, 2006; Intarakumnerd & Chaoroenporn, 2013; Jenson et al., 2020; Soares et al., 2020).

This evolution of the literature has brought to the fore new challenges, such as a lack of understanding of the specific types of intermediary organizations and their roles, particularly those of private intermediaries. These lesser known “private” intermediaries are innovation intermediaries that typically operate from within the industry's helix.

Although not well documented in the literature, many of these private intermediaries operate as consulting firms or generalized KIBS, as they have increasingly become involved in NIS, particularly in TT' related matters. They offer specialized services that match those provided by more widely known intermediaries, and they view many systematic gaps as business opportunities. Therefore, key publications were referenced that mention or are centred on these particular types of private intermediaries:

- **Consulting firms** (Basilioa et al., 2019; Bessant & Rush, 1995; Betz et al., 2016; Cesário et al., 2015; Costa et al., 2021; Howells, 2006; Jacobson et al., 2005; Johanna & G, 2012; Klerkx & Leeuwis, 2008, 2009; Pinto et al., 2015);

- **Other Knowledge Intensive Business Services (KIBS)** (Basilioa et al., 2019; Betz et al., 2016; Bocquet et al., 2016; Howells, 2006; Lee & Miozzo, 2019; Muller & Zenker, 2001; Pinto et al., 2015; Winch & Courtney, 2007; Zajko, 2017).

Others, less mentioned, but still participating in some publications found in the literature review were private, or predominantly private, organizations, like Industrial Associations (Clayton et al., 2018; Watkins et al., 2015); Patent Attorneys (Li et al., 2015); or Venture Capitals (Clayton et al., 2018; Pollard, 2015). Despite the range of entities with intermediation-related roles, they tend to be commonly portrayed similarly, based typically on the fact of being privately-held businesses, which provide specialized services to NIS key players for a profit (Zylberberg, 2017). Private intermediaries have professionalized their roles by adapting their specializations to system gaps and market needs, capitalizing on these needs by providing clients with a portfolio of services that facilitate and boost TT tasks and phases (Lichtenthaler & Ernst, 2008; Li-Ying, 2012; Yusuf, 2008).

Private intermediaries have become increasingly significant to the NIS by fulfilling TT with highly demanded knowledge-intensive “soft innovation” services (Pinto et al., 2015). The specialization and professionalization of innovation intermediation roles by private businesses are a natural market response to the dynamic needs of TT projects and the organizations involved.

A new market is emerging, focusing on the demand and supply of support services to innovation, monetizing knowledge, networks, and experience within sectors (Dias et al., 2017; Shearmur & Doloreux, 2019). This idea aligns with Howells (2006), who previously emphasized the emerging innovation service industry fuelled by the professionalization of private innovation firms offering their experience in a particular field or project domain through KIBS.

KIBS are outstanding contributors to the worldwide economies, tackling both the “softer” and “harder” sides of technological innovation lifecycles and serving as catalysts to accelerate change in entire industries, particularly consultancy firms. To the market, KIBS represent a new and professionalized gateway to access privileged knowledge, experience, networks, and opportunities not available freely. They bring to the NIS a new dynamism and agility, especially when considering more traditional and less innovative industrial sectors (Intarakumnerd & Chaoroenporn, 2013; Tether, 2005; Tether & Tajar, 2008).

In this context, studying the innovation roles played by private intermediaries, such as innovation management consulting firms (Dias et al., 2017), can provide new insights to improve NIS dynamics. Traditional perspectives in the literature must evolve, shifting from an almost exclusive focus on

traditional/public intermediaries to a more open NIS that recognizes the potential role that private entities are playing as innovation intermediaries (Dias et al., 2017; Drejer, 2004).

#### *2.4.3.2 Consulting firms as innovation intermediaries*

As emphasized by Howells (2006), innovation intermediaries that operate within systems have high systemic value. The number and types of such intermediaries have also increased, with private consultants specializing in innovation and management offering services to support their clients' competitiveness through strategy and innovation (Back et al., 2014; Wright et al., 2012). While the consulting industry's impact on economic sectors is being studied mostly from marketing and economic perspectives (Back et al., 2014; Basu & Taylor, 2010; Butler, 2009; Dias et al., 2017; Drucker, 1981), Dalziel (2010) noted that certain intermediaries stand out due to their size or impact on NIS. For instance, various innovation consultants have had a significant impact on NIS worldwide (Back et al., 2014; Cesário et al., 2015; Dalziel, 2010; Intarakumnerd & Chaoroenporn, 2013).

Private intermediaries, in particular, private consulting firms (KIBS included), have gained greater relevance in literature (Intarakumnerd & Chaoroenporn, 2013). These firms have developed an industry that is globally recognized for professionalizing knowledge into services that support and foster innovation and strategic competitiveness in companies. By realizing that markets and companies seeking innovation and TT represent an underexploited market opportunity, these intermediaries have taken on an unofficial role in NIS by offering specialized services to those who can pay (Dias et al., 2017).

Dias et al. (2017), noted a trend towards the specialization of consultancies in providing transversal services that support and foster innovation and marketing in the Portuguese innovation market. These services are also known as soft innovation services as they do not directly deal with core innovation tasks such as R&D. Instead, they tend to focus on more managerial, creative, and strategic support roles, such as market diagnostics and innovation project execution management. A study by the same author focused on marketing innovation consultants' value proposition and found that the traditional role of "brokering" is no longer considered critical in most project support services. For projects involving new technologies and greater levels of technical uncertainty (i.e., lower TRL<sup>2</sup>), consultants' response is divided. The distinction is found in those KIBS that can directly fulfil tech needs (e.g., engineering, design, etc.) and soft innovation consultants who use their networks and specialization in management and

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<sup>2</sup> Technology Readiness Levels (TRL) are a method originally developed by NASA in the 1970s for understanding the technical maturity of a technology during its acquisition phase.

strategy, which can be applied across sectors and technologies (Muller & Zenker, 2001; Shearmur & Doloreux, 2019).

Although consultants in Portugal have been proven to have a significant impact on organizational strategy and innovation marketing within their clients' organizations, they continue to operate in the background of the NIS in a way as a parallel innovation market. Despite their value proposition, which is not yet formally recognized within the NIS as innovation co-producers but as merely innovation facilitators (Pinto, 2018), most innovation consultants in Portugal strategically specialize in more transversal soft innovation services, focusing less on technology knowledge-intensive domains (Costa et al., 2021). As a result, they embody the role of intermediaries supporting innovation processes and TT-financed projects while leaving the hard innovation to the key stakeholders (Cesário et al., 2015; Costa, 2012).

The role of innovation intermediaries in a TT context has become as comprehensive as the typology of organizations that are part of it (Howells, 2006). Consequently, the role of private consultants in TT cannot be purely summarized by the traditional roles of “mediation” and “brokering”, as described in the literature (Back et al., 2014; Basu & Taylor, 2010; Dias et al., 2017). The comprehension of private consultants' role as innovation intermediaries within NIS might go beyond the activities they perform and also include the way they are positioning themselves to perform such roles. They have been found to act proactively alongside their clients and stakeholders, fostering symbiotic relationships to design, fund, and market innovations (Dias et al., 2017).

## **2.5 Private Consulting firms**

### **2.5.1 Innovation and management consulting**

Consulting has emerged as a new business model with high intangibility, focused on knowledge as its main asset and highly dependent on the people performing it (Canato & Giangreco, 2011). However, there is no widely accepted definition of consultancy due to a lack of consensus in delimiting its performance in the market, especially in terms of its roles (Sousa, 2018). Nonetheless, the literature provides several contributions and perspectives related to consultancy and consultants' roles.

Greiner and Metzger (1983) described consulting as an advisory role played by highly skilled and trained teams who diagnose and analyse issues in clients' organizations, to define solution proposals that may or may not be implemented by consultants. Butler (2009) corroborated this view, adding that consultants are dedicated to supporting organizations in achieving their strategic objectives by identifying opportunities to implement changes and improve learning and innovation capabilities.

Costa and António (2014) defined consultants' role as external functional support for organizations' strategy and operations, whether proposing solutions in response to identified problems and opportunities or supporting their implementation. The same authors recognized that consultants have a key role in distributing knowledge and triggering new and innovative practices, both within and between organizations.

The consultancy has its origins in the management and strategy literature, where the concept of consultant first appeared. Drucker (1981) argued that management is neither a science nor an art, but a practice learned through exposure to and experience with a wide variety of companies in various industries. According to Drucker, consultants are those who can transcend organizations and gain this much-valued exposure. He is recognized as one of the main thinkers of consultancy as an activity and has even been labelled by several scholars as “the father of modern management” (Cohen, 2009). For Drucker (1981), the consultant has an expertise-application role, similar to any other executive position within a company. The difference between the two, however, lies in the fact that consultants have a greater range of exposure to the market through their experience with various organizations and perspectives on the same or different business issues, and thus gain a special capacity for diagnosis (Costa et al., 2021).

Still, their role is closely associated with their defining characteristics. The consultants pose an external perspective to clients' organizations, and this allows them to provide an unbiased, impartial, and rational perspective (Costa et al., 2021; Drucker, 1981). For Drucker (1981), and more recently corroborated by other authors (Canato & Giangreco, 2011; Cesário et al., 2015; Costa et al., 2020), the consultant's value proposition still resides essentially in these two characteristics:

- Being a specialist with high exposure to a given subject;
- His professional perspective is detached from the client's organisational involvement.

Following these previous contributions of Peter Drucker, other authors felt a need to characterize consultants as well as their role as agents of change in organizations. Bower (1982) presented six factors contributing to the understanding of the consultants' value proposition. Other authors (Butler, 2009; Costa et al., 2021; Wright et al., 2012) found six underlying factors/motivations behind the decision of organizations to hire management and innovation consultants:

1. Being able to provide competencies that are not available inside the organization;
2. Have varied experience in the world outside the client's organization;



3. Having time and resources to study problems;
4. Having a professional attitude;
5. Being independent of the client's organization;
6. Have the ability to create action based on their recommendations.

Some methods and good practices provided by consultants are linked to organizations buying access to management knowledge, bypassing the learning curve (Basu & Taylor, 2010; Butler, 2009). Additionally, Wright et al., (2012) emphasized the consultant's key role and responsibility in promoting standard setting in industries, generating isomorphism based on good practices and knowledge. This view is further supported by other authors' versions (Costa et al., 2021; Jacobson et al., 2005), who highlight consultants' roles as intermediaries and disseminators of knowledge within specific sectors or industries. Canato and Giangreco (2011) classified the consultant's role into four main perspectives:

1. **Consultants as standards setters** - Consultancies build up state-of-the-art debates explicitly to supply industries with a set of methods and solutions, for which they then can offer full assistance.
2. **Consultants as information suppliers** - Consultants have superior knowledge, experience, and expertise in specific industries. They have been exposed to general trends in the industry, contacting different environments, situations, and problems, rather than focusing on a single firm's specific scenario.
3. **Consultants as knowledge brokers** - The experience gained by assisting their clients with different solutions developed in different industries gives management consultants the capacity to use and transfer useful knowledge from one project into another.
4. **Consultants as knowledge integrators** - Consultants act as knowledge integrators as they not only advise and instruct but also help customers to implement recommendations and support knowledge transfer processes.

Consulting presents a unique environment, providing consultants with a privileged positioning to diligently track emerging trends in technology markets (Dias et al., 2017). Management and innovation consulting firms tend to have a catalyst role in the markets they operate through their understanding of market and technology dynamics (Alexandre, 2021; Basu & Taylor, 2010; Cesário et al., 2015; Gråsjö et al., 2018). As catalyst agents within NIS, private consulting firms provide specialized intelligence and

services to support the project's scope and strategic goals. They are also vital in fuelling innovation and TT projects by supporting project stakeholders in accessing financing and funding (Chesbrough et al., 2006).

### **2.5.2 Consulting Industry in Portugal**

In Portugal, the first consulting firms emerged between the 1940s and 1950s, primarily founded by academics or as a spin-off from support departments within corporate organizations (Sismet, 1993). By the 1960s, the consulting industry experienced its first peak, driven by government efforts to modernize the Portuguese economy and promote industrial development (Amorim and Kipping, 1999). Despite this, the Portuguese consulting sector remained underdeveloped, creating an opportunity for foreign consulting groups to enter the national market.

By the 1970s, the evolution of the consulting industry was marked by the April 25<sup>th</sup> revolution and the beginning of Portuguese democracy. This was the first key political event to impact the consulting industry and could be considered a milestone for the creation of the second generation of consultants (Sismet, 1993). The mass nationalization of the financial sector and some industrial organizations shifted the focus from the most powerful organizations. Consulting firms operating at that time in Portugal could no longer keep up fulfilling the market's needs, of which were back then in line with supporting key processes of nationalization and were involved in the population's concern regarding labour relations and industrial organization (Cunha & Marques, 1995). Once again, the underdeveloped national consultancy industry was overtaken by foreign consulting companies entering the national market allured by market gaps and unfulfilled opportunities to offer their services designed to foster industrial organization and labour performance.

The second political event that changed the course of the consulting market in Portugal occurred in 1986 when Portugal joined the European Economic Community (EEC). Since then, the Portuguese market has undergone significant changes in its productive structure, leading to high economic growth (Freire, 2008). Many previously nationalized corporations were privatized once more, benefiting from the growth and evolution of European markets, leading to considerable growth and diversification of activities (Cunha & Marques, 1995). Portugal also experienced high levels of Foreign Direct Investment (FDI) and financial incentives from EU funding programs (Freire, 2008). Amidst this favourable context of business development and emerging opportunities, the consulting industry in Portugal underwent an accelerated growth, driven by the emergence and expansion of national SME and the entry of some multinational companies (e.g., McKinsey in 1989; Boston Consulting Group in 1995) (Costa & António, 2014).

With the beginning of the new millennium, the consultancy in Portugal had evolved and can currently be divided into two key segments/clusters of activity (Basilioa et al., 2019; Costa & António, 2014; Freire, 2008):

1. **Big Consulting** – Large consulting firms, all of them multinationals with a foreign origin have established themselves close to the main national economic, financial, and political arteries.
2. **SME Consulting** – Thousands of small and medium-sized consulting companies, most of them of Portuguese origin, spread throughout the territory and compose most of the consulting scene.

The first, larger established consulting firms dominate the market for large national and multinational corporations and groups. They are also known for providing specialized services to public and governmental organizations, focusing on strategy, corporate finance, and IT services.

On the other hand, the thousands of SME consulting firms tend to compete with each other, as well as with public and semi-public agencies and organizations. SME consulting firms are the most common type in the Portuguese market as the Portuguese economy is also primarily populated by SME. They drive and are driven by the growth and acceleration of small and medium-sized businesses and their innovations, whether in the form of products or services. These firms focus on supplying general management services and niche-specific services based on key knowledge or experience that SME may not possess. They also provide economic and market studies, access to finance and fiscal incentives, accreditation, and generalized training (Costa, 2012; Freire, 2008).

The economic development dynamics and opening of markets create opportunities for companies, but they also face constant pressure from market dynamics such as competition, customers, suppliers, financial institutions, and even government agencies. As a result, companies of all sizes are increasingly turning to external consultants to remain competitive and innovative (Freire, 2008; Lapiedra et al., 2011; Pinto, 2018).

Despite lagging behind other developed global markets, the consulting industry in Portugal has experienced rapid growth over the years, similar to what has been seen in other countries (Costa & António, 2014; Sousa, 2018). According to the publication “Companies in Portugal – 2020” (*Instituto Nacional de Estatística*, 2022), Portuguese KIBS providing “consulting, scientific, technical, and similar activities” have sold services worthing 370 million euros in 2020, a 47% increase since 2015. Additionally, by the end of 2020, almost 41 thousand companies (+19% compared to 2015) provide these services, employing 191,338 people (+29% compared to 2015). As one of the fastest-growing sectors in the Portuguese economy, the role of private consulting firms in promoting competitiveness and

innovation in the NIS is of great importance for governments and regulators to understand further (Alexandre, 2021).

**2.5.3 Consultants’ role in Technology Transfer**

The literature on IS has emphasized that the success of TT projects depends on the overall system and the quality of its interconnections (Basu & Taylor, 2010; Villani et al., 2017). In particular, Bigliardi & Dormio, (2017) have highlighted the impact of various types of intermediaries on the success of TT. These intermediaries, increasingly present in the literature, mainly focus on public and academic entities, those recognised as traditional intermediaries.

Consulting services involved in TT intermediation often provide a broad range of interactions throughout the process (Cesário et al., 2015). They can provide essential information and knowledge and offer administrative support services to bridge the “valley of death” - the gap between technological opportunity and poorly defined market needs (Bessant & Rush, 1995; Dias et al., 2017).

Table 2 below presents six types of activity domains performed by private consultants in TT project, identified by Bessant & Rush (1995). According to the authors, consultants involved in these processes can either replace/outsourcing TT processes or complement the capabilities (or the lack of them) of project stakeholders.

Table 2 - Activities of consultants in technology transfer  
 Source: Adapted from Bessant and Rush (1995)

| <b>Domain</b>                           | <b>Activity</b>  | <b>Supply side</b>  |
|---|--|---|
| <b>Technology</b>                       | - Articulation of specific needs<br>- Selection of appropriate options | - Sources of technology   |
| <b>Skills and human resources</b>       | - Identification of needs<br>- Selection<br>- Training and development | - Labour market<br>- Training resources                         |
| <b>Financial support</b>                | - Investment appraisal<br>- Making a business case                     | - Sources of finance – venture capital, banks, government, etc. |
| <b>Business and innovation strategy</b> | - Identification and development<br>- Communication and Implementation | - Environmental signals – threats, opportunities, etc.          |

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|                                       |  |                             |
|---------------------------------------|--|-----------------------------|
|                                       | - Education, information and communication             |                             |
| <b>Knowledge about new technology</b> | - Locating key sources of new knowledge                | - Examples of best practice |
|                                       | - Building linkages with the external knowledge system | - Emerging knowledge base   |
| <hr/>                                 |  |                             |
|                                       | - Project management                                   |                             |
| <b>Implementation</b>                 | - Managing external resources                          | - Specialist resources      |
|                                       | - Training and skill development                       |                             |
|                                       | - Organisational development                           |                             |

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In line with the core concepts of TT and innovation, consulting was traditionally viewed as a linear function, in which the consultant's role was primarily focused on the final stage of KTT, serving as a market champion who implements R&D/TT outcomes in the market (Bianchi et al., 2016). However, the role of consultants as TT intermediaries has evolved to become more complex. As consultants have gained exposure to their clients' TT challenges, they have developed their services to provide TT stakeholders with improved innovation and TT expertise and capabilities, thus offering a more complete response to process phases (Basilioa et al., 2019; Bessant & Rush, 1995).

Even in the early days of the consulting industry, Schein (1969) depicted the role of consultants as a form of "process consulting", a catalytic, non-directive approach that emphasizes teaching and convenience over-prescription. As time passed, more consultants began to reshape their roles into softer innovation intermediation services (Costa et al., 2021; Lapiedra et al., 2011; Pinto, 2018), following the perspective and opportunities of open innovation to offer businesses and institutions innovation and TT-related expertise. The role of consultants has become increasingly focused on creating value and shared problem-solving, rather than attempting to sell one-off products or projects. This has led to a shift in their commercial interests, with consultants now seeking to create and maintain long-term networks and high-value partnerships (Bessant & Rush, 1995; Costa et al., 2021; Freire, 2008).

## 2.6 Literature Review conclusions

The literature review has reinforced and supported the research objectives by contextualizing the need to understand the roles of private consultants as intermediaries in TT. In addition, it has provided a comprehensive understanding of the field of study, identifying the main ideas and frameworks used by various authors in recent decades. Several key findings relevant to the study have been identified:

- Despite the linear description of technology transfer (TT) as part of the innovation process, it is recognized in the literature as a highly dynamic process in light of current innovation perspectives. It has gained importance both as a mechanism and for its outcomes in promoting competitiveness and innovation in economies.
- The intermediation of innovation and TT has become a new field of research. Its complexity and significance go far beyond the traditional roles presented by classical authors - brokering and mediating. Intermediation now includes a multitude of agents and activities that can catalyse, accelerate, or support flows of communication, information, and knowledge between two or more entities.
- It is still challenging to comprehend the multitude of organizations with an intermediary role, as well as the different roles, functions, activities, or responsibilities they may be played in the system by such intermediaries. The literature on the intermediary concept and its role has proven to be insufficient and scattered among different authors, perspectives, levels of depth, and even research fields. Several authors have highlighted the need for further structuring and synthesizing information. However, many have also contributed ideas, frameworks, and compilations in response to this need.
- The “role” of a TT intermediary is a theoretical concept still not fully delimited. It is composed of various responsibilities, functions, activities, and specializations that are performed in response to the complex emerging needs of TT processes and market failures (i.e., gaps). However, it is possible to compile several contributions from different authors and define a portfolio of key roles/specializations that could come close to defining this “role” of the intermediary (see Table 3).
- The literature on innovation intermediation and TT intermediaries still primarily focuses on the traditional view of public intermediaries, those mostly linked to the state or academia. Nevertheless, publications mentioning the intervention of private intermediaries in TT processes can be found. Private intermediaries sell their professional services and are emerging in the literature as an unofficial player acting and contributing to the NIS.

- One of the main types of private intermediaries are consulting firms (i.e., management and innovation) that develop and sell a wide range of KIBS on the market. These consultants have had their role and importance recognized by some of the key authors in the TT and IS field as they bring a new perspective of “innovation-as-a-service” to the NIS.
- The “servitization” of the role of intermediation by consultants has become more relevant in recent decades. The growth of private consultancy markets working within the triple-helix (i.e., companies, academia, and the state) has led to an increasingly discussed need to study their role as innovation intermediaries in TT within the NIS.

**CHAPTER 3**  
**THE ROLES OF AN INNOVATION**  
**INTERMEDIARY**



## CHAPTER 3 - THE ROLES OF AN INNOVATION INTERMEDIARY

Innovation Intermediaries are now recognized as a fundamental component for the well-being of an innovation system, at all levels, sectors, and fields. The basic understanding of the intermediation role is still rooted in a linear perspective of innovation, which views this role as simply supporting the connection between technology sources and users of such knowledge (Howells, 2006; Vidmar, 2021). However, the innovation intermediary concept now encompasses a broader, heterogeneous, and growing set of entities, whose importance and functions are both varied and critical for proper functioning within current models of open NIS (Diener et al., 2020; Katzy et al., 2013). Therefore, a good understanding of their roles may be a way to uncover the structure behind the link between roles and types of intermediaries.

The increasing emergence of new roles and designations describing activities and functions performed by innovation intermediaries may be associated with new interpretations of data that were not duly explored and/or understood in previous decades (Vidmar, 2021). The heterogeneity of organizations that can be classified as innovation intermediaries, the roles they play in TT, as well as their increasing specialization, all contribute to the complexity of the intermediation phenomenon and a recognized difficulty in properly interpreting the concept (Jenson et al., 2020).

Based on the literature, it is possible to identify different terms referring to the same role and activity, in addition to several activities that can be categorized under the same umbrella. Even after combining and merging several similar roles' designations, the range of the intermediary's responsibilities and activities is still too wide and fragmented to be properly analysed.

To provide a comprehensive yet concise analysis that responds to the research goals of this thesis, a framework is proposed following a synthesized approach to the review findings. This framework uses key roles and specializations as categorization criteria, which act as umbrella clusters for the activities, functions, and focuses that intermediaries perform alongside TT. The widely accepted contributions of Howells (2006) were used as a baseline, being also considered the extensive and more recent set of contributions and additional roles and designations proposed and highlighted by several authors reviewed.

The outcome of this study is the proposal of a framework that synthesizes the review findings into thirteen key roles (Table 3). Each role describes a specific specialization that an intermediary agent can perform, along with the associated duties, responsibilities, and activities found in the literature review. By integrating the various specializations of intermediaries, this framework provides a deeper understanding of the diverse activities that make up the "intermediation role".

The framework serves as a basic structure and is intended to be expanded with new additions or condensed into fewer specialization clusters based on the contributor's perspective. Furthermore, the process of developing this framework revealed that the level of intermediaries' involvement can vary based on the technology transfer approach, organizational needs, and stakeholders' proximity. Intermediaries can provide services that are more or less proactive, closer, or more distant to stakeholders, and more or less knowledge intensive.

Table 3 presents the framework with thirteen intermediary's role specializations, each of them properly described afterwards.

Table 3 – The thirteen intermediary's role specializations

| # | Role specializations                                     | Description   | References   |
|---|--|---|--|
| 1 | <b>Policy &amp; Strategy (PS)</b>                        | Support and lobby policymakers in the development and implementation of regional, sectorial, or national-wide innovation policy strategies, providing a connection to government and public entities in matters of innovation.  | (Kanda et al., 2018; Smits & Kuhlmann, 2004; Tamtik, 2018; Van Der Meulen & Rip, 1998)                               |
| 2 | <b>Mediation &amp; Mobilization (MM)</b>                 | Create and coordinate networks and other strategic intermediation platforms, providing neutral grounds to foster collaboration between the innovation system's stakeholders and potentiate the mobilization of its key resources.   | (Agogu e et al., 2017; Berg ek et al., 2008; Bessant & Rush, 1995; Howells, 2006; Lin & Wei, 2018; Tamtik, 2018).    |
| 3 | <b>Knowledge Diffusion &amp; Support (KDS)</b>           | Act as a two-way communication channel between university and industry, providing a centralized point of contact to both knowledge diffusion and knowledge support.   | (Howells, 2006; Lin & Wei, 2018; MSilva et al., 2018; Tamtik, 2018)  |
| 4 | <b>Funding &amp; Finance (FF)</b>                        | The focus is to identify and bid to funding opportunities aligned with project needs, or in the due diligence and activities related to the strategic selection and sourcing of public or private financing schemes.  | (Agogu e et al., 2017; Bessant & Rush, 1995; Clayton et al., 2018; Dias et al., 2017; W. Janssen et al., 2014)       |
| 5 | <b>Technology Scouting &amp; Market Foresight (TSMF)</b> | Constantly monitor the technology state of the art evolution, scan and gather information to support innovation decisions and technology procurement. Playing as an input source of market opportunities through strategic foresight activities, such as identifying and diagnosing market trends, industry' needs and innovation challenges. | (Back et al., 2014; Bessant & Rush, 1995; Hossain, 2012; Howells, 2006; W. Janssen et al., 2014; Pinto et al., 2015) |

|    |  |   |  |
|----|--|---|--|
| 6  | <b>Design &amp; Idealization (DI)</b>                | Support the conceptualization and generation of new project ideas, by assisting in the idealization process contributing with knowledge and creative support.   | (Agogu  et al., 2013; Ces rio et al., 2015; Howells, 2006; Muller & Zenker, 2001; Pinto et al., 2015; Silva et al., 2018)                |
| 7  | <b>Brokering &amp; Gatekeeping (BG)</b>              | Brokering & Gatekeeping technology, R&D results, and intellectual property, arranging and negotiate technology deals between sources and interested recipients.   | (Battistella et al., 2016; Howells, 2006; Lin & Wei, 2018; Pollard, 2015)  |
| 8  | <b>Project Management &amp; Assessment (PMA)</b>     | Assisting with the design, set-up and management of projects properly aligned with defined goals and needs, interacting regularly with key stakeholders from project administration and execution control tasks. Also, since acting as neutral third parties, intermediaries can independently assess and evaluate technology transfer projects performance and its impacts.  | (Howells, 2006; Janssen et al., 2014; Tamtik, 2018), (Bessant & Rush, 1995; Hidalgo & Albers, 2008; Silva et al., 2018)                  |
| 9  | <b>Financial &amp; Technical Feasibility (FTF)</b>   | Assisting with concept proofing, supplying qualified feasibility analysis, and testing, diagnosing, and evaluating ideas, models, and technologies' prototypes in order to validate and evaluate its potential.   | (Bendis et al., 2008; Bessant & Rush, 1995; Howells, 2006; Matschoss & Heiskanen, 2017; Winch & Courtney, 2007)                          |
| 10 | <b>Accreditation &amp; Quality (AQ)</b>              | Support in accreditation and standards, providing assistance in technology regulation and arbitration due diligences and through quality processes.   | (Bessant & Rush, 1995; Howells, 2006; Pinto et al., 2015)  |
| 11 | <b>Intellectual Property &amp; Rights (IPR)</b>      | Support R&D and technology needs through legal strategies, representing and supporting bureaucratic processes to protect and value intellectual property, rights, and other innovation assets.  | (Howells, 2006; W. Janssen et al., 2014; Kivimaa, 2014; Li et al., 2015)   |
| 12 | <b>Implementation &amp; Knowledge Transfer (IKT)</b> | Be part of the technology transfer and implementation processes fostering the recipient absorptive capacity through knowledge transfer strategies such as the selection and training of specialised workforces.   | (Battistella et al., 2016; Bessant & Rush, 1995; Pinto et al., 2015; Tamtik, 2018)   |
| 13 | <b>Marketing &amp; Business Development (MBD)</b>    | Bridge and help to sell ready-to-market technology innovations, by assisting in key business activities like marketing research and strategy and after by assisting in the commercialization process. Also, in the case of entrepreneurial technology transfer strategies, being in the form of spin-offs and/or start-ups, it adds up the need for business development support to create, accelerate and grow the ventures. | (Battistella et al., 2016; Cant  et al., 2015; Ces rio et al., 2015; Howells, 2006; Klerkx & Leeuwis, 2008; Pollard, 2015; Tamtik, 2018) |

### **3.1 Policy & Strategy (PS)**

Intermediaries can often play key roles in innovation policy, namely by getting closer to policymakers and through their policy-making process, giving support to the implementation of innovation policies and strategies at national and regional system levels. The interaction between intermediaries and public entities is not only about establishing and maintaining relationships with government entities (Tamtik, 2018) but also about giving orientation and support to the implementation of innovation policies and strategies into the system (Howells, 2006; Van Der Meulen & Rip, 1998).

Some intermediaries have an active role in policy-making processes (Kanda et al., 2018; Tamtik, 2018), assisting in the development and coordination of innovation strategies and policies (Tamtik, 2018), and in some cases even proactively lobbying government entities to fulfil previously identified system needs of innovation, science, and technology (Tamtik, 2018). The literature also contains mentions about intermediaries playing some public support activities that can be related to this Policy & Strategy role, such as the management support to public interfaces and strategic structure development in the contexts of NIS (Smits & Kuhlmann, 2004).

### **3.2 Mediation & Mobilization (MM)**

This is the role of innovation and TT intermediaries with greater presence in the literature and it is related to the intermediary's designation – “inter-mediation”. Focusing on developing the understanding of mediation specialization it is possible to realise that this role goes beyond the creation of a neutral ground for connection, also aiming to achieve a conciliation of several stakeholders' interests (Tamtik, 2018). Howells (2006) sees this mediation role as the responsibility to build linkages with external knowledge providers.

This idea that an intermediary can become a single point of contact in some parts of the system, such as in a particular industry field, is corroborated by several authors (Agogu e et al., 2013; Bessant & Rush, 1995). However, Agogu e et al. (2013) suggest that a mediator can also take on this responsibility by providing an “innovation arena”, something like a neutral ground where collaboration can be fostered.

Two main components are interconnected and combined under this role Mediation & Mobilization: mediation of networks and the mobilization of resources. The management of networks stands out as the main component of the mediation role, being the component that groups activities and responsibilities such as the creation of networks (Lin & Wei, 2018); the coordination of networks and the expansion of networks (Agogu e et al., 2017; Tamtik, 2018); the design and management of network support structures like infrastructures (Tamtik, 2018) and intermediation platforms (Lin & Wei, 2018).

Second, once networks have been up and running it is the intermediary responsibility to make the most of it by mobilising its key resources (Tamtik, 2018). Authors like Bergek et al. (2008) and Howells (2006) highlight that the resources to be mobilised can be both human, financial, technical, and complementary assets.

### **3.3 Knowledge Diffusion & Support (KDS)**

In conceptual terms, innovation intermediaries are, by definition, natural knowledge diffusers. Many intermediary entities highlight as their core value proposition their contact networks and their ability to navigate and communicate within them. Knowledge diffusion as a role is highly bound to TT.

Universities and research centres are the main sources of knowledge and technology. Thus, it is critical to foster a fluid diffusion of new knowledge throughout the system levels (Lin & Wei, 2018; Silva et al., 2018). This happens not only by making science and technology innovation popular (Tamtik, 2018) but also by promoting it directly to target industries (Intarakumnerd & Chaoroenporn, 2013).

One way of doing this, as previously highlighted in the role of mediation, is by becoming a single point of contact. This goes both ways. Firstly, from the university to the industry, as intermediaries act as a channel to diffuse knowledge and search for potential technology recipients; and secondly, from industry to universities by providing specific industries with centralized support on finding reliable knowledge and technology sources (Howells, 2006; Silva et al., 2018).

### **3.4 Funding & Finance (FF)**

Funding plays a major role in fuelling scientific and technological innovation. For many innovation opportunities, the lack of funding or financing strategies is a make-or-break situation restraining the possibility of such ideas ever even seeing the market (Bessant & Rush, 1995). Some intermediary entities, such as management consulting firms (Dias et al., 2017), play a critical role in providing this key fuel resource in NIS. Funding and financing innovation opportunities serve as important factors in TT's success (Tamtik, 2018).

Intermediaries' role in financing innovation focuses mainly on providing a strategic and capable bridge with financing institutions (Clayton et al., 2018); supporting due diligence related to the investment appraisal of project opportunities (Pinto et al., 2015); and seeking financial sources (Bessant & Rush, 1995) that could be public (Janssen et al., 2014), or private (Agogu e et al., 2017).

### **3.5 Technology Scouting & Market Foresight (TSMF)**

As with every innovation challenge, TT processes start either with a problem or with an opportunity. The literature recognises the increasing involvement of intermediaries in TT, actively, even from the idea origin (Janssen et al., 2014). Howells (2006) defined and presented a role focused on foresight and diagnostics.

Other authors have been also highlighting the involvement of intermediaries in finding and presenting innovation challenges (Back et al., 2014). Mostly through the analysis and definition of innovation needs and opportunities (Pinto et al., 2015); the development of market research activities (Hossain, 2012); the diagnosis of user needs and the identification key market trends (Pinto et al., 2015); and through the help provided to project stakeholders in identifying innovation needs (Bessant & Rush, 1995), both within the TT process and inside stakeholders' organisations.

After analysing the market and identifying specific opportunities and problems, it is up to the intermediary to transform the market foresight diagnosis into technical and technological requirements. These will allow a search for technological solutions and knowledge within R&D sources, evaluating those with the capabilities to respond to the identified requirements.

Several authors designate the role of collecting and analysing information in pretty similar ways, such as scanning and gathering information (Lynn et al., 1996); scanning and exchanging information (Howells, 2006); or scan and transferring information (Agogu e et al., 2017). Complementarily, Agogu e et al. (2017) and Bessant & Rush (1995) have similar points of view, in which the key focus is on information processing and use, as some intermediaries must be able to deal with the articulation, combination and handling of scientific and technological knowledge.

This role specialization, related to information scanning and processing, can be found as a backbone of technology surveillance and scouting, being a specialization that includes also activities related to technology procurement (Hossain, 2012). Following this role more proactive intermediaries can also assist in the signalisation and selection of technological options (Pinto et al., 2015), or through the exploration of new technology uses and the transfer of knowledge (Becker & Gassmann, 2006).

### **3.6 Design & Idealization (DI)**

Intermediaries have been using their knowledge advantage to develop and present new creative capabilities within the system. By being closer to the system agents, especially to the key stakeholders of each project, in more recent literature intermediaries were found to be proactively involved in highly critical and creative phases of the innovation process.

In most of these creative phases, intermediaries were found to play a key role in both the problem-solving phase (Agogu  et al., 2013) and idea origination (Janssen et al., 2014). Other more specialised intermediary entities, like KIBS (Ces rio et al., 2015; Howells, 2006; Pinto et al., 2015), have also been emerging with new capabilities to respond to systemic needs for supporting more creative phases of idealization and conceptualization (Pinto et al., 2015).

Other authors mention this participation of third-party entities as a specialized knowledge and creative support to several idealization and conception domains, namely in knowledge processing (Howells, 2006); projects design and creation (Silva et al., 2018); and in idea generation and combination (Howells, 2006; Muller & Zenker, 2001).

### **3.7 Brokering & Gatekeeping (BG)**

After mediation, “brokering” is the most present role designation found in the literature referred to as one of the key roles of an innovation and TT intermediary. Howells (2006) highlighted in his compilation the role of technology gatekeeping and brokering as being one of the most relevant roles for an innovation and TT intermediary. It is a key function of an intermediary to help business and industrial recipients to fulfil technology needs or strategic interests through the identification and selection of a technology provider (Lin & Wei, 2018).

Within this Brokering & Gatekeeping role, it can also be found activities related to strategic management of technologies, as intermediaries can also act as industrial property hosts and brokers (Pollard, 2015). Therefore, bridging the university and industry by being a gatekeeper who supports both sides of the process on the identification of opportunities for TT and acquisition (Battistella et al., 2016), is as well recognised as a vital intermediation role for TT performance.

Likewise, it is a key role of an intermediary to broker/connect and effectively manage parts of the project, monitoring the individual interests of stakeholders and aiming for a win-win scenario with positive results and satisfaction of all parties involved. It is therefore essential for the intermediary to be positioned in this relationship as a neutral third-party, properly capable of supporting the process of creating last-long working groups, as well as coordinating the parts.

This Brokering & Gatekeeping role is supported by intermediation activities such as the identification of potential partners (Pinto et al., 2015; Silva et al., 2018) and by consortium building (Janssen et al., 2014). Janssen et al. (2014) highlighted the importance of governance functions for managing the good connection and collaboration of the parties, but other authors do not specify with

such detail, giving the intermediary a broader and generalized role of coordinator (Tamtik, 2018; Todeva, 2013).

Facing TT projects with different organizations and different interests, Silva et al. (2018) argued that for both parties to work effectively together, intermediaries must have a critical focus on monitoring and actively reducing potential opportunistic behaviours of the parts, that may put at risk the project trust relationships, which could negatively impact the project performance and its results.

### **3.8 Project Management & Assessment (PMA)**

The complexity and heterogeneity of TT projects led to a set of different characteristics and different management needs to ensure the achievement of projects' aimed goals. Some intermediaries specialized in key functions of project development (Bessant & Rush, 1995), as well as in project management, and monitoring (Hidalgo & Albors, 2008). It is an intermediary's responsibility to assist project stakeholders, freeing them from peripheral tasks so they can dedicate themselves to project core activities related to technology and innovation. Hossain (2012) distinguishes project management-related activities as being a soft-innovation role, supportive and administrative activities present in any TT process. The intermediary becomes responsible for supporting and developing project management functions such as organizational set-up and budgetary support (Intarakumnerd & Chaoroenporn, 2013); also, the intermediary may be committed to more bureaucratic activities like reporting and drafting of contracts (Silva et al., 2018).

The results of innovation and TT projects have different stakeholders and therefore different points of view, needs and interests. It is safe to assume a suitable role of project assessment from an intermediary, as being a neutral third-party operating in the project. Thus, an intermediary could be responsible for evaluating the project's performance, its results, and the overall impact of it, having in mind the project's initial goals, and the expectations of each involved part, as well as the market and society standards. Howells (2006) defined assessment and evaluation as a key role specialization, also corroborated by other authors, as they highlight the importance of measuring innovation and evaluating its results and impacts (Janssen et al., 2014; Tamtik, 2018).

### **3.9 Financial & Technical Feasibility (FTF)**

Emerging intermediary organizations have been focusing on improving and expanding their value propositions to satisfy different needs alongside TT and innovation projects. As an example, Howells



(2006) mentions knowledge-intensive business services (KIBS) as being a new kind of innovation intermediary. Characterized by their high technical skills, KIBS can provide IS with services of technical and technological intensity, such as consultancy to assist companies in their innovation and TT processes.

Regarding a technical and economic feasibility focus, several authors have been highlighting these technical and specific functions as being increasingly performed by intermediary entities, specifically in supporting independent analysis and validation of the viability of technologies and ideas (Winch & Courtney, 2007). Considering their focus on feasibility, the intermediary's activities can also be as eclectic as the development of feasibility studies (Bendis et al., 2008; Bessant & Rush, 1995); making prototypes and pilot series (Matschoss & Heiskanen, 2017); or even as generalized as testing, diagnosing, and evaluating technologies to be transferred (Howells, 2006).

### **3.10 Accreditation & Quality (AQ)**

Specialized third-party organisations are increasingly being demanded by TT projects as quality controllers and standard experts. Handling supporting activities related to quality and accreditation has been also recognised in the literature, due to intermediaries' importance in the quality and certification phases of technological innovations to be transferred (Howells, 1999; Lee et al., 2002). Howells (2006) gathers under the same umbrella the intermediary roles and activities related to accreditation and standards, regulation, and arbitration. This role was also corroborated by Pinto et al. (2015), namely the assistance in due diligence activities related to accreditation and certification. In addition, Bessant & Rush (1995) included in the role of some innovation consultants the responsibilities of auditing and quality control which are very important for new technologies and innovations with no market track.

### **3.11 Intellectual Property & Rights (IPR)**

Patents, rights, and other forms of intellectual property are the most tangible form of technology and knowledge transfer between academia and industry. It is therefore not surprising that intellectual property (IP) management is a major role emphasized by the literature (Howells, 2006). This role appears particularly in the later stages of TT projects and also involves specific types of intermediary agents, such as consultants and attorneys. This highly specialized agent must be packed with market & legal knowledge to be able to effectively respond to strategies for valuing R&D results and making them available to the interested recipients, and at the same time, protected from "copy-cats" (Li et al., 2015).

In the literature, there are several forms and functions indicative of this role. From more generalist functions such as the management of IP (Howells, 2006; Janssen et al., 2014); legal and IP support (Agogué et al., 2017; Hossain, 2012); to more specific activities such as the creation and valorisation of patents (Li et al., 2015); protection of innovation assets (Pinto et al., 2015) and brand management (Kivimaa, 2014).

### **3.12 Implementation & Knowledge Transfer (IKT)**

As the TT project progresses, it will come a time for the concrete application of the technology object at the receiving entity. Intermediaries have been evolving to provide recipient organizations with adequate absorptive capabilities to successfully implement and use the received technology as part of their business model. This market needs demands more specialized intermediaries, such as KIBS (Howells, 2006), and senior researchers specialized in the technology to be transferred, and who can temporarily act as consultants to the recipient company (Tether & Tajar, 2008).

Intermediaries are increasingly being expected to perform a range of implementation support-related activities (Bessant & Rush, 1995), many involving direct knowledge transfer such as training (Battistella et al., 2016), or technology-related workshops (Tamtik, 2018). Another author also put a great emphasis on the intermediaries' responsibility to improve the absorptive capacity of the recipient companies, through support in the selection and training of specialised workforces (Bessant & Rush, 1995; Pinto et al., 2015).

### **3.13 Marketing & Business Development (MBD)**

This role is especially related to more mature and ready-to-market technologies that need support to be converted into ready-to-launch products (Agogué et al., 2013), particularly in the first phases of the commercialization process (Howells, 2006). The commercialization aspect of innovation (Tamtik, 2018) is a function that can and should be developed by innovation intermediaries within TT. They tend to have more market intelligence and product marketing management expertise to assist the technology is gaining traction in the market. As so, within this role, two sides coexist - Marketing and Business Development (commercialization). Both have a residual presence in the literature on IS and TT (Cesário et al., 2015) but a high presence in marketing and innovation management literature (Jenson et al., 2020; Pinto et al., 2015).

A generalist marketing and commercial support was highlighted by Klerkx & Leeuwis (2008) as a necessary role to be performed by intermediaries as market facilitators of technologies leaving the academia. Then again, Pinto et al. (2015) described a specific need in the innovation process to support stakeholders in the definition of new marketing strategies.

These marketing strategies may even include, according to Thursby et al. (2001), the development of activities to attract potential investors. The intermediary role in business development and commercialization has been recognized as needing assistance with business strategy (Battistella et al., 2016; Howells, 2006), as well as complementary activities like research commercialization (Pollard, 2015).

TT processes can also proceed in a very different way when there is no technology-receiving entity involved and instead, there is a strategy to spin off the R&D project. In this scenario, those responsible for the R&D results tend to have full ownership of the innovation process, through the creation of their own company as a strategy to place their innovation in the market. Yet in this scenario, researchers as highly skilled in hard innovation tasks are mostly inexperienced with product marketing strategy and operations and thus might compromise the entire project.

When it comes to entrepreneurship and business development support, the main innovation intermediaries mentioned in the literature are incubators and accelerators (Clayton et al., 2018), innovation hubs (Cantù et al., 2015) and business consultants (Clayton et al., 2018; Slaughter & Leslie, 1997). Regardless of the intermediary selected, they must possess the necessary skills to assist teams lacking in business acumen. This involves providing support in activities like business planning and development (Albors et al., 2005; Dias et al., 2017), as well as business scaling (Pinto et al., 2015). Additionally, Tamtik (2018) mentions the intermediary's role in linking new entrepreneurs with the required expertise or investors to effectively bring their technological innovations to market.

# **CHAPTER 4**

## **METHODOLOGY**

## CHAPTER 4 – METHODOLOGY

This thesis utilizes a mixed research methodology, which combines quantitative and qualitative techniques. To collect qualitative and quantitative data, structured interviews and document analysis from a case study were respectively employed. Content analysis and statistical analysis were the procedures utilized to process the data collected. The upcoming chapter will discuss the research strategy exploration and definition, where the methodological instruments designed for collecting and analysing data will be elaborated.

This chapter explores the assumptions and key characteristics of the methodological perspectives, i.e., qualitative, and quantitative methods, in the fields of Innovation and Engineering. The focus will be on identifying opportunities for the simultaneous and complementary use of both techniques.

### 4.1 Qualitative research methods

Qualitative methods in research form a distinct field of study that is interdisciplinary and applicable to diverse topics and fields. Over the past century, qualitative research has undergone continuous epistemological and methodological transformations. The term “qualitative” implies a focus on the domain of quality, highlighting the socially constructed nature of reality beyond process and meaning (Baxter & Jack, 2015). This method emphasizes how the researcher and the object of study relate to each other, which can be influenced by situational factors and biases (Debout, 2016; Denzin & Lincoln, 2000).

Aspers and Corte, (2019) characterized qualitative methodologies as an approach in which the researcher becomes the research instrument, following the development of a narrative that incorporates the perspectives and experiences of the study's participants. Serapioni (2000) summarized the qualitative method:

- Its fundamental characteristics of having a behavioural analysis centred on the actor's point of view;
- The focus on naturalistic observation of the situation, without any control;
- The subjective “insider perspective” of the interviewees;
- The importance of the process and discovery;
- The exploratory, descriptive, and inductive approaches;
- Its particular and not generalizable nature.

It is possible to identify six main pillars that govern qualitative methodology as a research phenomenon (Baxter & Jack, 2015; DiCicco-Bloom & Crabtree, 2006):

1. **Complexity** - Qualitative research processes involve social components that result in behavioural and cultural manifestations of high complexity. They cannot be reduced to a mere set of variables.
2. **Subjectivity** - Since the researcher is an instrument of observation in the process, their reality and values result in an inevitably subjective perspective that cannot be suppressed. Therefore, the researcher must accept and acknowledge that the results cannot be entirely objective.
3. **Contextualization** - To understand a phenomenon or object of study, the researcher must consider the influence of contextual factors, as reality itself is a combination of numerous multidimensional factors.
4. **Free interpretation** - Qualitative research results in multiple interpretations and meanings that can be radically different from different perspectives and realities. Interpretive and meaning analysis are essential components of qualitative research methodology.
5. **Study objective** - Since non-subjective explanations of causality, control, or precision are impossible, the primary objective of qualitative studies is to understand and interpret phenomena. The researcher plays a role in creating empathy and recreating the experience of others in themselves (Bresler, 2000);
6. **Application objectives** - Although understanding a given phenomenon and its contexts may serve as a basis for understanding others, it is crucial to note that the knowledge resulting from qualitative methods is not generalizable but rather transferable (Seabra et al., 2009).

A qualitative research methodology distances itself from purposefully neutral and aseptic language to reach an empathetic understanding of the experience shared by participants. Beyond its characteristic abstraction, it should be a record of the empirical phenomenon as it was observed, leaving space for interpretations and debates, and thus increasing the range of questions that can be used to further the study (Aspers & Corte, 2019). Therefore, according to Turner (2010), there are limitations to the qualitative methodology, mostly regarding the limited precision of the data. This poses as a natural imprecision from an inexact science and thus must be complemented by constant referencing of discourses in an original and raw form.

Following a path of qualitative research presupposes conducting an in-depth analysis of the meanings, experiences, and quality of the phenomenon under study, with a whole focus on the importance of the process rather than on the acquisition of tangible results. Fidalgo (2003) highlights the

fact that following this methodology, the information ends up being framed and interpreted according to the general context of the situation, reality, past experiences, and other factors with special significance for the participants involved.

It is the role of the qualitative researcher to study each phenomenon in its natural context, focusing on the interpretation of that phenomenon and the meaning attributed by the people involved. Thus, it is a process requiring the collection of data that describe specific aspects by the individuals involved, and whose interpretation constitutes an attempt to develop knowledge about the study object (Morgan, 2022; Roberts, 2020). The choice of a qualitative study method involves an interest in what is complex, seeking to describe and understand the process more than its results. A qualitative study provides access to a diverse and complex reality of study. This reality is enriched by contextual factors and by the meaning that others give to it (Marques, 2005), and gives internal validity since it focuses on the specific characteristics involved in the study (Aspers & Corte, 2019; Park & Park, 2016). Hence, it is possible to identify key strengths and weaknesses of qualitative research, as summarized in Table 4.

Table 4 - Qualitative Research - Pros and Cons  
Adapted from Rutberg and Bouikidis (2018)

| <b>Advantages</b>   | <b>Disadvantages</b>  |
|---|---|
| <ul style="list-style-type: none"> <li>• Accessibility to what is complex;</li> <li>• Spectrum of interpretations and meanings;</li> <li>• Notion of context;</li> <li>• Internal validation of the process itself;</li> <li>• Access to the participants' point of view;</li> <li>• Investigator poses as a research tool;</li> <li>• Transportability of analysis to different contexts;</li> </ul> | <ul style="list-style-type: none"> <li>• Data inaccuracy and variability;</li> <li>• Might not be accepted by adepts of the exact sciences;</li> <li>• Limitations to data generalization;</li> <li>• Deals with small and non-statistically significant samples;</li> <li>• Subjectivity of the analysis;</li> </ul> |

Qualitative research methods allow for the exploration and understanding of complex and subjective phenomena and experiences by collecting rich and descriptive data focused on quality, rather than quantity (Rutberg & Bouikidis, 2018). However, it is important to acknowledge that qualitative research also has some inherent weaknesses. Firstly, the limitation to generalizing its results hinders the direct transfer of data between different contexts. Nevertheless, the principle of transportability can be employed to draw analogies, patterns, and commonalities between different (Park & Park, 2016). Nonetheless, researchers must refrain from claiming that the results of their sample represent the entire

population. Other scholars suggest also that it is only appropriate to aim for conceptual and analytical generalization, which seeks to theorize about the process and phenomenon studied without measuring the frequency of the same in the society or reality envisaged (Azevedo et al., 2017).

Another weakness of qualitative research is the imprecision, variability, and subjectivity of its data. Researchers are therefore required to continuously refer back to the raw data and maintain fidelity to the perspective of the individual studied, to avoid biases towards their interests or opinions. In addition, qualitative research tends to focus on the complexity and depth of a topic at the expense of sample size, unlike quantitative methods which prioritize larger and statistically significant samples (Turner, 2010). Despite this, qualitative research remains an ideal option for small samples and isolated case studies, where in-depth analysis is necessary for contextualizing reality and gaining depth through the techniques and instruments used in the collection and analysis of information (Azevedo et al., 2017; Rubin & Rubin, 2005; Serapioni, 2000).

## **4.2 Quantitative research methods**

A quantitative research methodology focuses on explaining, predicting, and controlling the phenomena studied. It seeks to identify rules and laws through objective, quantifiable, and measurable processes, and techniques (Herciu, 2017; Park & Park, 2016). The foundations of quantitative research methodologies include a focus on the quantification of phenomena and cause related to the object of study, the use of controlled techniques, objectivity, the hypothetical-deductive nature of the process, the possibility of generalizing and replicating results, and the notion that the object of study and surrounding reality is somehow static (Rutberg & Bouikidis, 2018; Serapioni, 2000).

Through these highly objective procedures, the aim is to create knowledge that can be generalized (Rutberg & Bouikidis, 2018), meaning that it depends heavily on external validity (Moreira, 2006; Serapioni, 2000). By allowing a generalization of the study's outputs, the quantitative method tends to move away from the singularity of the phenomenon. However, this distance leads to highly useful results due to its replication value in different realities (Moreira, 2006). The same author also highlights that this type of analysis has two main focuses: the description of the distribution of entities by the different values of the variables; and the description of the relationship between the variables. By opting for a quantitative and correlational methodology, the researcher seeks to understand and, in a certain way, predict the phenomena under study, either by testing and analysing internal or external constructs relating to the context variables (Maula & Stam, 2020).



The use of mathematical language by quantitative research methodologies allows the systematization of the phenomena observed, developing it concretely and analytically to generate new knowledge, which can be generalized (Maula & Stam, 2020). Mathematics then brings to the quantitative research objectivity and tangibility in the research process, by quantifying what would otherwise be seen as subjective. However, Minayo and Sanches (1993) preferred to emphasize the importance of deciding which techniques and quantification tools are relevant to certain problems, as well as what disadvantages can arise from their use. The authors base this question on the limitations of mathematical language, which, according to them, can lead to idealized conceptual models, based on an abstract construction that, in practice, only partially describes reality (Minayo & Sanches, 1993). One of the main weaknesses of quantitative techniques, particularly in the face of a positivist position, refers to the lack of consideration of the researcher's social role in the process (Rutberg & Bouikidis, 2018). This does not consider its ideological impact on the research bias, which is disregarded by the presence of objectivity of the methods in use, as well as by the logic of mathematical thought and language (Cardoso, 2007).

Furthermore, the objectivity of a quantitative methodology does not take into account the individual's perspective, traditionally associated with qualitative techniques. This could lead to insufficient internal validation and consequent ambiguity of the measured variables (Rutberg & Bouikidis, 2018; Serapioni, 2000). Table 5 summarizes the main strengths and weaknesses of quantitative research.

Table 5 - Quantitative research - Pros and Cons  
Adapted from Rutberg and Bouikidis (2018)

| <b>Advantages</b>   | <b>Disadvantages</b>  |
|---|---|
| <ul style="list-style-type: none"> <li>• External validation of the process</li> <li>• Possibility of replicating results</li> <li>• Generalization of results</li> <li>• Methods and tools accepted by the scientific community</li> <li>• Capability of coverage in larger samples</li> </ul> | <ul style="list-style-type: none"> <li>• Insufficient internal validation</li> <li>• Does not consider the individual's point of view</li> <li>• Fails not consider the existence of the researcher's subjectivity as part of the process;</li> </ul> |

### **4.3 Combination of research methods**

The discussion and conflict between quantitative and qualitative research paradigms have been observed since the foundation of social sciences. This question exists from both perspectives, leading to a set of theoretical works dedicated to criticism and problematization of the concurrent methodology (Minayo & Sanches, 1993; Serapioni, 2000). Although there is a natural understanding of a complete separation between quantitative and qualitative perspectives, with the former focusing on the physical sciences and the latter on the human sciences, there are even authors such as Poeschl (2006) who see an opportunity to use them both to complement each other through a symbiotic relationship.

However, an analysis of the polarities of both methods emphasized that they do not contradict each other, but rather have different natures, despite focusing on answers to the same questions (Serapioni, 2000). Minayo and Sanches (1993) highlighted that neither of the two methods is good enough on its own to provide a complete understanding of the research object. According to these authors, a good method should ensure a proper structure of the data supporting the global understanding of the theory and be properly adjusted to the research objectives, having all the instruments and techniques necessary for the analysis, and remaining operationally feasible (Hanson & Grimmer, 2007).

Following these ideas, it is noticeable that, without epistemological favouritism, both methodologies show positive results in their practice of research, especially when used combined and complementarily. Given the strengths and factors of each methodology, opting for a combination of them allows the researcher to reach a greater scope in terms of internal and external validation (Hanson & Grimmer, 2007). This approach provides the researcher with a set of tools and techniques to implement to achieve a concrete answer to both polarities that a research challenge may present. However, this validation of the method in use cannot be taken abstractly, as it is dependent on the specific needs resulting from the relationship between the problem and research objectives (Park & Park, 2016; Rutberg & Bouikidis, 2018). To compare and dispute the main characteristics of quantitative and qualitative research methods, the framework proposed by Cardoso (2007) was taken as a basis (Table 6).

Table 6 - Research Methodologies - Comparative analysis  
 Source: Adapted from Cardoso (2007)

| <b>Quantitative Research</b>  | <b>Qualitative Research</b>   |
|---|---|
| It is based on positivist, behaviourist and empiricist philosophies.                                    | It is based on phenomenological-naturalistic, ethnomethodological and symbolic interactionism.  |
| Establishes relationships and explains changes.   | Understands social phenomena from the perspectives of the participants.   |
| The methods and processes are specific and predetermined and the research strategy decisions are rigid. | The methods and processes are flexible, the research design is emergent, decisions can be modified throughout the research.                       |
| It is based on correlational or experimental designs, to reduce biases and external variables.          | It admits the existence of subjectivity both in data collection and in the interpretation of these data.  |
| The investigator's role should be, as far as possible, one of detachment.                               | The researcher lives in the immensity of the situation and in the social phenomenon, past and future.   |
| The research's aim, mostly, to allow generalizations.   | Actions are strongly influenced by the contexts in which they occur; they are conceptual generalizations.   |
| Data are analysed deductively.  | Data are analysed inductively.  |
| Data are collected to confirm previously constructed hypotheses.  | They do not collect data or evidence to confirm or disprove previously constructed hypotheses.  |
| Emphasis on the results or products of the research.  | Greater emphasis on the research process.   |
| The samples are, in the majority, large, stratified, with a control group, of random selection.         | The samples of the research are small, numerically not representative.  |
| The most used methods and techniques are experimental, questionnaire, and structured interview.         | The most used methods are participant observation, document analysis and open interview (semi-structured, informal conversation, non-structured). |

It is possible to gain an understanding of the different perspectives between the quantitative and qualitative methodological paradigms. Both have undeniable virtues, but they also have limitations. Therefore, a complementary approach of both paradigms is a valuable strategy to follow.

As such, this research aims to adopt a symbiotic methodological design that can lead to optimal results and the creation of better knowledge. The following research plan outlines the combination and interspersing of methods to better address the research needs. By selecting the most suitable instruments and practices from each paradigm, the research's plan aims to effectively systematize and comprehend the phenomena under study.

#### **4.4 Research Plan**

Starting from the strengths and weaknesses of each methodological perspective, this research has chosen to follow a combination of methods and carry out a mixed study that guarantees the best results. As Minayo and Sanches (1993) noted, no methodology can be considered good or bad by itself. The choice of a methodological perspective should be a strategic formulation of a plan designed to understand and assess the object/phenomenon of study and reach the proposed objectives, rather than a mere presupposition at the start of the research design.

The analysis and understanding of the role of private innovation consultants in TT projects, as well as the factors that may influence their role, present a possibility of conceptual generalization due to a large amount of documentary data available from case studies. This could immediately lead to the use of quantitative methodologies, as they might facilitate the analysis of large numbers and offer a holistic view of the reality under study (Maula & Stam, 2020). However, the perception and knowledge regarding private innovation consultants by different agents within IS, might be subjective, as it is intrinsically conditioned by the particularity of the experiences of each of these agents, whether as organizations or individuals. Therefore, a qualitative perspective could be the best research approach to understand the complexity of the reality under study before moving to a more quantitative approach.

The combined use of different methods and sources becomes a triangulation strategy that encourages an increase in the complexity, richness, and rigour of the objects under study (Denzin & Lincoln, 2000; Park & Park, 2016). This provides the researcher with concrete internal and external validation of the research. To achieve this, two different sources of research data - NIS agents linked to TT and a pool of innovation projects' dossiers - and qualitative and quantitative methodologies were adopted to consecutively move from subjectivity to objectivity. The phenomenon studied was explored through the experiences and opinions of the different interlocutors involved in the process, using semi-

structured interviews. The results were complemented with a case study of a private consulting firm, where document collection and statistical analysis were conducted, following quantitative methodologies.

Thus, the aim of the research was achieved through a combination of complementary research methods, which allowed for the extraction of new knowledge and provided answers to the research questions. The research was initially centred on an exploratory focus on the economic, political, and systematic nature of private consultants acting as an innovation intermediary in TT projects within the Portuguese NIS. Therefore, two key research questions were defined:

- **Research question 1:** What is the role of the private consultant in technology transfer projects?
- **Research question 2:** How are private consultants' roles positioned when compared to traditional intermediaries on NIS?

The intangible nature of the research object and the characteristics of the data to be analysed led to the development of a research strategy divided into two phases. The first phase had a more exploratory and qualitative nature, where a semi-structured interview was designed in line with the research objectives. The aim was to interview key players (stakeholders) within the Portuguese NIS possessing distinct perspectives and experiences in interacting with private consultants in TT projects.

Theoretical perspectives resulting from the literature review were combined with the results obtained from the content analysis of the interviews. This combination enabled the definition of the second phase of the research with a greater focus, on a more tangible and quantitative nature. To support the design of the second phase of research, research hypotheses were proposed in line with each of the research objectives and supported by the results from the first research phase. Subsequently, a statistical analysis was carried out through a document analysis of hundreds of TT projects performed by a case study firm, which is a private consultancy firm operating in Portugal.

To achieve methodological complementarity and synergy, the two different and complementary ways of collecting information were followed, namely the semi-structured interviews and the document analysis (i.e., within the case study). The use of different techniques in the same research for the sake of methodological complementarity and synergy was regarded as necessary and thus, followed (Hanson & Grimmer, 2007; Lessard-Hébert et al., 1990). As a result, the combined use of the two research methodologies following two different methods of data collection and analysis was extremely useful.

#### **4.4.1 Semi-structured Interview**

The use of interviews as a research method allows for close interaction with the interviewees, resulting in richer communication and better results (Turner, 2010). Direct interaction with the interviewee enables the researcher to adjust open-ended questions to facilitate the interviewee's understanding of the question and prevent deviation from the intended answer topic. Semi-direct interviews, also known as semi-structured interviews, involve the researcher preparing a set of guiding questions to support and guide the conversation (Johnson et al., 2021). The order of the questions can be reformulated or alternated to facilitate a more natural conversation flow with little need for intervention from the interviewer. The researcher's involvement in the interviewee's discourse should not be objective, nor should it be seen as a bias to the results. Some interviewees may deflect from the subject of the interview, and the resulting interaction with the researcher constitutes a process of elaborating on thought rather than just collecting data (Roberts, 2020). The option for an interview as a methodological instrument is especially suitable for analysing the different meanings interviewees may express regarding to their past experiences and preconceived opinions (Roberts, 2020).

One of the main advantages of this method is the possibility of a deeper analysis of collected data with greater flexibility and straightforwardness, enabling the researcher to respect the frameworks, language, and mental categories used by the interviewees (DiCicco-Bloom & Crabtree, 2006; Turner, 2010). The responsive model of the interview involves collecting qualitative data through individual interviews with relevant individuals, using a script to guide the interviewee in an in-depth discussion of previously defined topics in response to research objectives. Each interview becomes unique since questions can be adapted to what each interviewee shares (Roberts, 2020; Rubin & Rubin, 2005). The interview has advantages over a questionnaire since it allows for flexibility in contextualizing, adjusting, and deepening script topics appropriately to better suit the interviewee's profile (DiCicco-Bloom & Crabtree, 2006; Turner, 2010).

Interview results also tend to include extended verbalized content from each participant, allowing for data extraction beyond straight answers, making the method applicable to a group of individuals with different profiles and backgrounds (Johnson et al., 2021). However, the interview as a research tool has weaknesses such as the limited number of people to which it can be feasibly applied and an increase in the margin of error resulting from lower standardization.

Various factors can make the method more prone to error, including the interviewer, the script, the coding, and the sample (Johnson et al., 2021; Turner, 2010). Compared to a questionnaire, for example, the interview has limited reliability (DiCicco-Bloom & Crabtree, 2006; Tuckman, 2000). Nevertheless, the

interview allows for a closer approximation to each individual, fewer limitations in the answers, the possibility of identifying and discovering relevant parallel data, and a better understanding of the reality experienced by the interviewees (Roberts, 2020).

4.4.1.1 Interview script design

To complement the data collected and analysed in the bibliographic review, semi-structured interviews were conducted with a sample of relevant players and stakeholders in the NIS, particularly those actively involved in TT and the marketing of innovation and R&D results.

This methodology aims to explore, collect, and analyse relevant data in line with the research objectives previously presented and described in the introduction of this document:

- **Objective 1** - Identify the key roles played by private consultants in TT projects;
- **Objective 2** - Identify what key motivations may constitute a value proposition leading the involvement of consultants in TT projects;
- **Objective 3** - Understand whether there is a complementary or overlapping interaction between the roles of traditional intermediaries and private consultants in TT projects.

The research objectives were deconstructed, focusing on identifying key domains to support the design of the interview structure, resulting in a set of specific aims presented in Table 7.

Table 7 - Interview script design

| <b>Objective</b> | <b>Interview Aims</b>   | <b>Interview Script</b>  |
|------------------|---|--|
| 1 and 2          | - Get to know the participant background knowledge and experience with both public and private intermediaries<br>- Identify perceptions and preconceptions about intermediaries | - What is your perception and experience with public intermediaries?<br>- What is your perception and experience with private intermediaries (namely consultants)? |

|            |   |  |
|------------|---|--|
| 1 and 2    | <ul style="list-style-type: none"> <li>- Identify the main offer of private intermediaries</li> <li>- Identify your outstanding key roles</li> <li>- Understand your attractiveness in the system</li> </ul>  | <ul style="list-style-type: none"> <li>- What are the key characteristics, skills and roles sought in consultants (value proposition)?</li> <li>- Are there other factors (external to the private consultants) contributing for their involvement in TT projects?</li> </ul>                |
| 3          | <ul style="list-style-type: none"> <li>- Understand the level of threat/competition that private consultants represent to the public</li> <li>- To identify complementarities of the performance of the private ones for traditional performance</li> </ul> | <ul style="list-style-type: none"> <li>- Are private consultants' competition (threat) or complementary (opportunity) to public intermediaries?</li> </ul>   |
| 2 and 3    | <ul style="list-style-type: none"> <li>- Understand the perceived positioning of consultants in the NIS</li> <li>- Understand whether innovation policies take into consideration the role of private intermediaries</li> </ul>                             | <ul style="list-style-type: none"> <li>- (In your opinion,) does the NIS decision making level recognizes the private consultant's role?</li> <li>- (In your opinion,) do innovation and TT support programs and policies recognize/take account the role of private consultants?</li> </ul> |
| 1, 2 and 3 | <ul style="list-style-type: none"> <li>- Identification of key role specializations performed by consultants as intermediaries</li> </ul>   | <ul style="list-style-type: none"> <li>- Which roles/specializations do you identify as being performed by private consultants as intermediaries?</li> </ul> <p>(Assisted with the thirteen role specialization framework developed in Table 3)</p>  |

Based on the interview aims, an interview script was developed with key questions to support the researcher during the collection process. The script, which included direct, semi-direct, and even assisted questions, was designed to allow the researcher to adjust the scope of the response of each interviewee in case they deviated from the central aims of each question. Additionally, the questions were sufficiently open to allow the interviewee the freedom to contextualize and justify their answer, thus providing a greater quantity and quality of data to be analysed later. The interview script can be found in Annex I.



#### *4.4.1.2 Sample definition*

Samples can be the groups of subjects to whom the interview was conducted or the sets of recorded occurrences or behaviours to be analysed (Almeida & Feire, 2000; Turner, 2010). Sampling has a significant impact on the quality of the results, as it should be as representative of the population as possible. The inferences that may be made depend entirely on the relevance and quality of the samples from which the data was collected. The significance of a sample refers to the number of elements that constitute it, while its representativeness refers to its quality (Turner, 2010).

Regarding data collection instruments, a sampling procedure appropriate to the method in question was developed. The Portuguese NIS has a high and incredibly diverse number of players with a distinct variability of positions and roles. Therefore, a too-small sample of interviews could condition and bias the research results. However, one of the main limitations of this method is the limitation of the number of interviews realistically possible to carry out while maintaining the quality of the sample and its results. Moreover, the characteristics of relevant individuals with the greater potential to be subject to an interview make it difficult to reach participants in high numbers, as they are in positions hard to reach, being most of them academic directors, company executives, and representatives of public bodies.

To boost feasibility and sample significance, the sampling process was carried out with some degree of convenience. A varied set of profiles was strategically selected from different NIS backgrounds, both public and private, from academia to businesses. The variety of the sample focuses not only on the helix of their provenance but also on the type of organization and the position of the person interviewed. However, it is possible to identify some sample bias characteristics resulting from convenience picking, such as the majority of stakeholders being from the ICT field and having a higher provenance from the northern region of Portugal. This bias resulted from the researcher's network of contacts and proximity within the ICT sector in the north of Portugal.

To protect their anonymity, the names of the interviewees were replaced with identification codes, and any information that could jeopardize their anonymity was omitted (e.g., the name of the organization they represent or work with). For this purpose, a sample characterization matrix was created, in which a tracking identification code (from #A01 to #A19) was assigned to each of the participants (refers to Table 8).

#### *4.4.1.3 Interview process*

The interviews were conducted over a period of eight months, between 2021 and 2022, subject to the availability of the respondents. Due to the covid-19 pandemic, the interview process was made

more flexible and was carried out either in person, by video call, or by phone call. To minimize the influence of the interviewer, in all interviews, the pivotal interviewer was the same person – the researcher (Johnson et al., 2021; Tuckman, 2000).

It is worth noting that all the interviews were conducted in Portuguese, the native language of the participants, which facilitated their understanding of the questions and interactions with the researcher. As the interviews were exploratory in nature, their duration varied according to the profile of the interviewee, with the shortest interview lasting 32 minutes and the longest interview lasting more than 160 minutes.

Table 8 – Interview sample characterization matrix

| <b>Organization type</b>                     | <b>Sectors</b>   | <b>Subject role</b>       | <b>Code (#)</b> |
|--|--|---------------------------|-----------------|
| Innovation and Financing Consulting          | ICT, Electronics, Manufacturing Industry,                    | Senior Director           | A01             |
| Innovation and Financing Consulting          | Manufacturing Industry, Food Industry, Textile and Materials | Co-founder & CEO          | A02             |
| Innovation and Financing Consulting          | ICT, Electronics, Urban Mobility, Energy, Systems            | Founder & CEO             | A03             |
| University                                   | Innovation and TT, Teaching and Research                     | Professor & Researcher    | A04             |
| University Technology Transfer Office (TTO)  | Mechanical and Material Engineering, industrial and robotics | Vice-President & TTO      | A05             |
| University Technology Transfer Office (TTO)  | ICT, Electronics, Materials, Construction                    | Project Manager           | A06             |
| University Research Centre                   | ICT  | Research Coordinator      | A07             |
| Research Centre & University interface (TIC) | ICT  | Senior Business Developer | A08             |
| Research Centre & University interface (TIC) | Materials, Energy, Environment                               | Senior Researcher         | A09             |
| Research Centre                              | Nanotechnology, Health, Food tech                            | R&D Group Leader          | A10             |
| Collaborative Laboratory                     | ICT  | Executive Director        | A11             |
| Collaborative Laboratory                     | Food Tech, Biotech   | Principal Researcher      | A12             |
| Incubator and accelerator                    | ICT, FinTech, Health tech                                    | Executive Director        | A13             |
| University Technology Transfer Office (TTO)  | ICT, Manufacturing Industry, Textiles and Materials          | Executive Director        | A14             |

|                                |  |                                    |     |
|--------------------------------|--|------------------------------------|-----|
| Innovation Association         | Innovation, tech transfer intermediation, business qualification | Project Manager                    | A15 |
| Governmental Innovation Agency | Innovation, tech transfer intermediation, Funds management       | Board Member                       | A16 |
| Company (Corporative Group)    | Industrial AI, Tech developer                                    | Co-founder & CEO                   | A17 |
| Company (Corporative Group)    | Product Engineering, Digital Manufacturing, Mould-making         | Board Member & Innovation Director | A18 |
| Company                        | Media AI and Software Dev  | Co-founder & CEO                   | A19 |

All the interviews were recorded with total or partial permission of the participants, to be used for research purposes only. Some interviewees did not authorize full disclosure of their audio recordings and their respective transcripts (Johnson et al., 2021). For these specific cases, the partial transcripts and notes taken were later filtered and validated by the interviewees themselves, who wished to remain anonymous, so that all the final elements contained in this thesis and its respective annexes could be fully disclosed. Therefore, following the guidelines proposed by Ghiglione & Matalon (2006).

#### 4.4.1.4 Content results analysis

After conducting the interviews, the process of transcribing the audio recordings and compiling the respective notes was carried out. Due to the considerable number of interviews conducted, whose duration greatly varied, selective transcription of the interviews was done using a non-naturalistic and tabular method of content analysis (Azevedo et al., 2017), prioritizing the use of key content excerpts that bring value to the research question presented. This was achieved by firstly omitting speech or conversation not related to the study, such as non-responses and indirect/parallel developments to the questions asked. Additionally, were also excluded parts where the interviewee requested not to be considered in the analysis, such as opinions of a more political and/or sensationalistic nature (Turner, 2010).

Despite this, for interviews with more sensitive discussions and/or interviewees more concerned with their anonymity, the transcripts and notes taken were later sent to the participants so they could further filter and validate the final content to be analysed. Thus, the resulting transcripts and notes are fully authorized for analysis and subsequent discussion disclosure (i.e., under anonymity) (Johnson et al., 2021; Turner, 2010). The analysis followed a non-naturalistic tabular transcription scheme (Azevedo et

al., 2017), where key relevant excerpts from the interviews and their respective previously validated and authorized notes were tabulated as answers to each question. False starts, repetitions of sentences, interruptions, and non-relevant inputs were also excluded. Additionally, slang and Portuguese vernacular sayings were translated during the transcription process to allow English readers a full understanding of the discussion as well as to ensure that the transcription and analysis process focused on the accuracy of the interview (DiCicco-Bloom & Crabtree, 2006; Roberts, 2020).

This was followed by an analysis conducted question by question, where content codification parameters were identified and defined, allowing key answers/ideas to be compiled in a structured way (see Table 9). The content analysis and discussion were conducted following the most exemplary and relevant excerpts, expressions, or words for each question, and the analysis was carefully structured by its key codes, thus enhancing a properly organized and reasoned discussion (DiCicco-Bloom & Crabtree, 2006; Turner, 2010).

Table 9 - Interview content codification

| <b>Interview Questions / Key Domains</b>        | <b>Codification analysis (codes)</b>             |
|---|--|
| <b>Traditional Intermediaries</b>               | Roles and value proposition                      |
|   | Resources and responsiveness                     |
|   | Market positioning                               |
| <b>Innovation Consultants</b>                   | Roles and Value Proposition                      |
|   | The emergence of private players                 |
| <b>Value Proposition</b>                        | Proactivity                                      |
|   | Responsibility                                   |
|   | Competencies                                     |
|   | Relationships (Network)                          |
|   | Financing  |
| <b>Comparison</b>                               | Strategic complementarity                        |
|   | Residual Overlapping                             |
| <b>External Factors</b>                         | Sector and geographical area                     |
|   | Business interests                               |
|   | Time as factors                                  |
|   | Occupation and limitations of stakeholders       |
|   | Financial capacity                               |
|   | Financial opportunities                          |
| <b>Recognition</b><br>(Positioning perceptions) | Peers' recognition                               |
|   | Not properly recognized by NIS                   |
|   | Distinguishing intermediation roles and services |

In the interview results chapter (Chapter 5), the key ideas/answers to each question are presented and discussed following the script order proposed in Table 7. The argumentation narrative of the discussion of the results follows a combination of interviewees' ideas thoroughly referenced by their participant codes (e.g., #01), defined in the sample shown in Table 8. Additionally, whenever possible, direct interview excerpts were highlighted as tangible examples citing the ideas discussed. Throughout the text, reference may be made to the identification code of interviewees (from A01 to A19) to indicate the source of a proposition.

#### **4.4.2 Case study through document analysis**

Due to criticism previously pointed out to self-report methods such as interviews and questionnaires, it is recommended that they should be complemented adequately with other non-interfering methods (i.e., other data obtained by processes that do not involve the direct collection of information from the investigated subjects) (Hanson & Grimmer, 2007; Park & Park, 2016). In this way, a documental analysis was conducted in a case study as a quantitative method to complement the qualitative research (Morgan, 2022). This method involves the use of a statistical tool to conduct a quantitative analysis of the data collected from hundreds of TT projects found in the file folder of a case study subject – a Portuguese private innovation consulting firm.

The method of document analysis implies a quantitative approach that starts with the use of content analysis to extract data variables that are feasible to be analysed by a statistical program (Lee et al., 2002; Soni & Singh Yadav, 2015). In the present case study, it is important to understand the reality of consultants' work from an insider perspective regarding the roles they play in the NIS. Most of the data was analysed following previously discussed ideas, both in the literature review and in the individual interviews. Despite the existence of congruence points between the interviewees' contents, some interviewees' opinions were revealed to be mixed with personal opinions and preconceived ideas. Thus, some of these were taken into consideration when formulating research hypothesis as guidelines for the quantitative research design of the case study through document statistical analysis.

##### *4.4.2.1 Hypotheses formulation*

Following a deductive research approach, as previously shown, the second phase of the research (i.e., the quantitative phase) was designed with the output results from both the interviews and the literature review. The goal of this deductive approach was to hypothesize key aspects in line with the research objectives previously proposed and thus to structure and further deepen the research process

to reach concrete findings to answer the initial research questions. In this sub-chapter, the major congruence points from the qualitative research results were synthesized and discussed to achieve the formulation of concrete research hypotheses as pivot guidelines for quantitative research.

Therefore, the following hypotheses were discussed and formulated based on the content analysis of the interviews' results in Chapter 5 and aimed to narrow the research aim from a subjective (i.e., qualitative) to an objective nature (i.e., quantitative) (Maula & Stam, 2020). These research hypotheses were formulated and supported by the key discussion points highlighted in the results of the qualitative research. Five research hypotheses will be carried out as guidelines for the quantitative research design to be conducted, tested, and discussed throughout Chapter 6.

Chapter 5 presented the results of the interviews conducted to explore the research subject, which led to a broad range of contributions and ideas discussed. To deepen the research discussion, a set of research hypotheses was formulated to guide further developments through more quantitative research methodologies (Ang et al., 2019). These hypotheses served as subject guidelines to validate or refute the key findings from the literature review and interviews, and thus generate the final findings and conclusions aimed at with this research.

Starting with the central research focus - the intermediary role of consultants - different specializations and roles were identified both in the literature (refers to Table 3) and by the interviewees' contributions. Two major disruption points were identified.

**There are different role specialization perspectives from different interviewees.** The interviews revealed the existence of two major perspectives when identifying the roles played by private consultants. Mostly, disagreements were found between public and private entities interviewed. Particularly, these could be observed in the results of the assisted table of intermediary's role specializations (see p. 166, Table 12).

**Consultants can adjust themselves to clients' needs.** The literature on management and innovation consulting showed that consulting firms focus on increasing the value of their services by aligning them with clients' and market needs (Basu & Taylor, 2010; Butler, 2009; Drucker, 1981). Thus, consultants can be the product of client-consultant relationships (Costa et al., 2021; Martinez et al., 2016). Some consulting firms may develop their value proposition on more transversal and managerial roles with greater potential to respond to a wider market need, while other more specialized consulting firms and KIBS might focus on delivering more niche roles in specific fields and sectors related to knowledge-intensive services (Basilioa et al., 2019; Bianchi et al., 2016; Shearmur & Doloreux, 2019).

In addition to answering the first research objective of identifying the roles performed by private consultants in TT projects, the need for understanding such roles was enhanced. Unlike traditional intermediaries, the roles and specializations of private consultants are not planned and designed by regulators, nor thoroughly described in the literature, so, additional variables must be considered. As both the interviews' results and the literature review highlighted this defining importance of client-consultant relationships in the role of private consultants, the first research hypothesis was underlined:

- **Hypothesis H1 - The roles played by private consultants are associated with the type of entity originating the project.**

The role of private consultants, like the concept of an intermediary described in the literature, mostly focuses on the concrete functions, activities, and specializations they perform to respond to gaps and needs in TT processes. However, some authors with more a more “open market” perspective consider consultants' value proposition to be more complex than the hard innovation services they can provide (Basu & Taylor, 2010; Dias et al., 2017). Soft innovation roles are emerging in the literature as a gluing factor that supports consultants' services value proposition. These soft services and skill are response mechanisms and characteristics which consultants develop in response to market gaps and clients' needs (Back et al., 2014; Basu & Taylor, 2010). Interviewees supported this line of thought by mentioning additional factors contributing to the consultant's role, which were depicted as valuable as their core roles.

**Proactivity is regarded as the key characteristic of a private consultant.** Described by the interviewees as the attitude with which the most consultants tackle the response to the needs identified in both companies and public institutions (A01). This proactivity was highly regarded by most of the interviewees as the primary factor within private consultants' value proposition. Consultancy firms were recognized by some interviewees as innovation catalysts (A19), and even as the responsible entities for originating some of the Innovation and TT project opportunities (A15, A17).

**This consultant's proactivity has different meanings according to different interviewee perspectives.** Despite the overall agreement regarding consultants' proactivity that interviewees demonstrated, distinct perspectives were found. Public and academic entities interviewed mainly stressed this consultant's proactivity as the consultants' responsibility in prospecting new companies and partnerships outside their current network in a never-ending expansion of their current network (A08, A10). In contrast, interviewed companies (i.e., recipients) reported consultants' proactivity as a continuous collaboration in which consultants' responsibility is to propose and maintain a pipeline

of TT projects and funding opportunities within their current network, in order to keep their clients innovative (A19).

**Consultants strive to create, nurture, and maintain their network of close contacts (clients and partners).** The literature on the consulting industry emphasizes the importance of client networks as the primary critical success factor of consultants' activity (Costa et al., 2021; Tether & Tajar, 2008). Consultants tend to act according to their strategic interests, which are mostly of economic nature. For that reason, they tend to maintain close relationships with their network to foster opportunities to create and deliver value and generate revenue (Canato & Giangreco, 2011; Costa et al., 2020). From some interviewees' perspectives, a consultant's network represents both its specialization market and its comfort zone (A18). Therefore, working beyond their current network may only happen strategically or in need.

Consequently, the proactivity attitude and capacity of consultants to work beyond their normal network may vary depending on their client organizations' needs and characteristics. Their proactivity approach can range from originating TT projects themselves to supporting a stream of TT opportunities to meet the needs of their current network. Reports recognizing such consultants' proactivity seem to be mostly linked to entities from their current network, with which they had previous interactions. However, some interviewees mentioned the consultant's prospection of new recipient companies' partnerships (A08). To guide research exploration in this matter, the following hypothesis was formulated:

- **Hypothesis H2 - The TT projects where the private consultant works beyond their current network are linked to the type of entity responsible for originating the project.**

As the concept of an intermediary role is further understood, identifying the activities, functions, and specializations performed by a private consultant becomes insufficient to fully comprehend their role as intermediaries. The reasons and motivations behind the consultant's increasingly active role in NIS go beyond the functions they can perform, as their value is perceived differently by various agents involved in TT processes.

**The reasons to involve a consultant in a TT project go beyond their role specializations.** Interview exploration on the role of consultants as innovation intermediaries revealed additional factors contributing to the consultant's perceived value proposition in TT. The characteristics and needs of the projects' stakeholders were highlighted as trigger reasons/motivations to resort to



consultants, such as the need for financing options, their ability to free stakeholders from project responsibilities, or even the lack of contacts of project stakeholders in NIS or the market.

**Different entities showed different motivations to involve consultants in their TT projects.** From interviewee contributions, many motivations foster the contact and involvement of private consultants as innovation intermediaries to the detriment of traditional ones. Despite some commonalities in the motivations, such as the existence of innovation incentives or the desire for project management support to free the key stakeholders, interviews revealed that different motivations in the origin of a TT project may be linked to the entity originating it. Academia and research centres/interfaces highlighted their interest in consultants' networks, while companies preferred to highlight previous experiences or good references as motivations for the option of the private consultant as a preferred intermediary.

Private consultants' value proposition as intermediaries in TT processes may vary depending on their clients' characteristics and external factors that continue to evolve, such as policies and incentives. Likewise, different entities responsible for originating TT projects may have varying motivations for involving private consultants in their affairs. In addition to the concrete functions, activities, and specializations that private consultants perform, their proactivity attitude and capacity to expand their network can also differ depending on the needs and characteristics of the client organization (Back et al., 2014; Sousa, 2018). Therefore, understanding these factors and motivations is crucial to comprehensively grasp the consultant's role as an intermediary in TT processes. To explore these ideas, a third research hypothesis has been formulated:

- **Hypothesis H3 - The motivations for the contact and involvement of the private consultant in a TT project vary according to the type of entity that originates the project.**

To gain a better understanding of the role that private consultants play as innovation intermediaries, it is also necessary to examine their position in relation to traditional structures and institutions within NIS. Accordingly, the second research question aims to explore how private consultants' roles compare to those of traditional intermediaries within NIS. Both literature and the results from interviews suggest that consultants are increasingly working within NIS, although they are not formally recognized as intermediary agents. Based on these findings, several key contributions were identified in the interviews' discussion that can help to further define research hypotheses.

**The role of consultants in the NIS is not yet fully understood or formally recognized.**

While interviewees from public and governmental institutions mentioned having knowledge of consultants

acting within the NIS, and some even had experience collaborating with such consultants (A08, A10, A12), most interviewees showed a lack of understanding of the broad role that consultants can play as innovation intermediaries. Additionally, there is a widespread perception that despite being widely known and relied on by many institutions (including public ones), consultants are yet to be formally recognized as innovation intermediaries (A15, A16).

**Consultants are now partnering with other traditional intermediaries to tackle TT projects.** Some interviewees still question whether consultants pose a threat to traditional innovation intermediaries and the functioning of NIS dynamics (A08). Nevertheless, others mentioned TT projects in which consultants and other traditional intermediaries (such as TTO and TIC) collaborate side by side to better tackle TT challenges and improve TT results (A04, A06, A08).

**Private companies (i.e., recipients) are leading the interest in resorting to private consultants.** In discussing innovation intermediaries and previous experiences with each interviewee, recipient companies (A17, A18, A19) have shown an unbalanced favouritism towards consulting firms as their chosen TT intermediary. This is not mutually exclusive, but rather with different perspectives regarding consultants' positioning related to traditional ones.

Despite their unofficial and unrecognised role within the NIS and the biased demand from industry (i.e., companies), consultants may already be working with other traditional intermediaries. However, different entities have different perspectives regarding the use of private intermediaries, which could be complementary or competitive alternatives and could be mutually exclusively chosen by project stakeholders. As a result, to identify and verify these partnerships that have not been sufficiently explored in the literature, a fourth research hypothesis was defined to be tested:

- **Hypothesis H4 - The partnership between consultants and traditional intermediaries in the same project is associated with the type of entity originating it.**

Moreover, interesting findings emerged from the interviews, which are relevant to the third research objective of exploring whether there is complementarity or overlap between the roles of traditional intermediaries and private consultants in TT projects where they collaborate.

**The formal recognition of consultants' role as NIS agents might depend on their perceived positioning within the system.** While there is informal recognition of consultants' work within the NIS, decision-makers and innovation policies do not perceive them as innovation intermediaries. The interviewees attributed this lack of recognition to the absence of knowledge and supportive regulation that could help distinguish consultants' roles from those of traditional intermediaries. Although consultants

may be partnering with traditional intermediaries and academic institutions and operate in a "grey zone" (A01), there is still a debate on whether their role is a threat or an opportunity to the system. Three main perspectives emerged regarding consultants' positioning:

- **Consultants may complement traditional agents in the NIS** - As discussed earlier, consultants work with traditional intermediaries as partners in the same TT projects. Some interviewees perceive consultants as an opportunity to complement traditional institutions with specialized roles and market reach that traditional intermediaries tend to lack (A01, A08).
- **Consultants may pose direct competition to the regulated NIS infrastructure** - The opposite perspective was also discussed. Consultants, as private firms, have a set of strategic and economic interests that may not align with TT and innovation goals, which could bias results for the sake of profits (A14). As such, some of the interviewees, mostly from academic and public spheres, express concern about the increasing competition that consultants may be posing to traditional intermediaries by professionalizing and monetizing role specializations meant to be provided for free by NIS-supported agents (A05).
- **The role of consultants is distinct from that of traditional intermediary entities** - Yet, a third perspective, mostly from a market perspective (i.e., companies), discusses their perception of a distinctive role and positioning between private consultants and traditional intermediaries (A18, A19). This perception sees traditional role specializations with a more academic positioning, in contrast to consultants who are perceived to have a positioning of an industry-championing intermediary (A17, A18, A19). As such, their roles could be fundamentally distinct and may not pose any threat to the current traditional intermediaries.

The discussion on the positioning of consultants within the NIS has given rise to a range of perspectives, which are in line with the research objectives. To provide a more focused direction for the research, a fifth hypothesis has been formulated, which seeks to determine whether the roles played by consultants differ fundamentally from those performed by traditional intermediaries, in projects where both entities are involved.

- **Hypothesis H5 - The roles of consultants fundamentally differ from those performed by traditional intermediaries in projects they both participate.**

#### *4.4.2.2 The case study*

The direct observation was developed by accessing file folders from the case study, an innovation consultancy firm with over 25 years in the Portuguese market. Documents and support elements developed and used by consultants in both preparation and management of TT projects were collected and analysed. All the files refer to project applications (a.k.a. “calls”) to national funds under the Portugal 2020 program, between 2015 and 2021. To obtain a relevant sample, only funded-approved projects executed, or still in execution were selected, specifically those in which there was a concrete transfer of the technology or knowledge. Thus, the projects were those involving academic research entities with companies interested to be receivers (i.e., incorporating or bringing to the market new technological solutions based on the technology previously developed).

The case study option followed in this research was selected for its characteristics relevant to the objectives of the study. Still, convenience reasons were also considered as most players within the consultancy industry demonstrated to be highly closed, without a mindset open for sharing internal processes or projects data. This fact is comprehensible, since the value proposition of a consulting firm is mostly based on their knowledge and experience acquired over time and which constitutes a set of highly sensitive intellectual properties. Nonetheless, a highly relevant firm in the sector was selected and used to be the case under study. The management and innovation consulting firm considered in the study has more than 25 years of experience and brand recognition in the national market, being a key player within the segment of SME consulting. The firm's offer is mostly focused on the design, management, and especially in the financing of innovation projects, R&D and TT through funded programs such as PT2020 (Alexandre, 2021).

It is also relevant to add that the firm itself emerged as a spin-off from a previous consulting firm with more than a decade in the national market (in the 1980s) and which was already an active player in the access support to public and private funds for innovation projects. Also, a key focus of the initial consulting firm was to be closer to technology innovation, always looking for opportunities to boost TT between industrial and technological companies and sources of knowledge such as universities and R&D centres.

In this sense, the consulting firm targeted by the case study combines more than 35 years in the Portuguese market of financing and managing technological innovation activities, having a portfolio of projects and contacts throughout the country, and some beyond borders. Even so, the company's operations and its concentration of contacts had two major nodes, one in the country's capital, in the central region and another in the northern region of the country. Despite having experienced various

sectors of activity, from agriculture to aeronautics, it is in the transversal fields of information technologies (i.e., ICT, electronics, AI, Industry 4.0, etc.) that the firm became specialized, building a network of solid contacts and partnerships with business, academy, and government agencies.

The consulting firm being studied had over 30 employees (consultants) as of 2022, with more than 60% of them directly involved in R&D, TT, and innovation projects. This multidisciplinary team has a particular focus on engineering and economics backgrounds, while the remainder of the company's services revolves around support services for business management, strategy, international expansion projects, and access to tax benefits. With over 400 active clients, primarily small and medium-sized enterprises (SME), and a history of numerous dynamic projects, this case study firm was deemed highly relevant for being a significant national player in the ICT and related technological SME fields.

The quantitative research phase focused on a set of projects that were executed within the scope of the innovation projects applied to PT2020 funds, which were the primary source of innovation financing incentives available for SME from 2014 to 2021 (Alexandre, 2021). Only fully completed projects or those approved and in progress were included in the sampling process, and all of the projects in the sample had to demonstrate the existence of TT as a crucial part of the project scope.

A total of 219 projects were included in the final sample, with data collected through document analysis of an archive within the consulting firm. This involved the analysis of project folders, descriptive records, and communication records such as emails and CRM<sup>3</sup>. In cases where data was limited or doubtful, project managers were also directly consulted.

#### *4.4.2.3 Data collection and processing domains*

To ensure the collection of relevant data for the research, specific data variables and typologies were defined for the sample of 219 projects under analysis. The selection of these variables and the definition of its typologies were based on the research objectives and hypotheses, while also taking into account the characteristics and limitations of the sample data. For each project, data collection and analysis were conducted following each of the variables identified in Table 10.

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<sup>3</sup> CRM - stands for "Customer Relationship Management" and is a software system that helps business owners to easily track all communications and nurture relationships with their leads and clients.

Table 10 - Sample data variables to be collected and analysed

| <b>Variable label</b> | <b>Response Options</b>  | <b>Observations</b>   |
|-----------------------|--|---|
| <b>Sector_domain</b>  | Industrial<br>Automation/Robotics<br>Biotechnology<br>TICE<br>Energy<br>Mechanical & Materials<br>Chemistry<br>Agri-food<br>Building & Construction                              | - Key sector/domain of the projects analysed.<br>- The response option was selected following the segmentation used by ANI <sup>4</sup>   |
| <b>Origin_Type</b>    | University/TTO<br>Research Centre/Interface<br>Private Consultant (case study firm)<br>Recipient company<br>Other Public Intermediary<br>Other Private Intermediary              | - Type of entity responsible for the project origin.<br>- Response options proposed by the author following a combination and clustering of ideas from (Howells, 1999) and from the tags used by the consultancy firm to be studied |
| <b>Previous_Int</b>   | Yes – No   | - Existence of previous contact/interaction between the consultancy firm and the project promoter.  |
| <b>Cont_Motivator</b> | Looking for Financing Options<br>Looking for Partners/Contacts<br>Looking for technical know-how<br>Looking for Project Management Support<br>Came due to WoM or good References | - Key motivations that lead NIS entities to contact/involve consultants in tech transfer projects – Response options were identified by the case study (CRM)  |
| <b>Source_Contact</b> | University/TTO<br>Research Centre/Interface<br>Private Consultant (case study firm)<br>Recipient company<br>Other Public Intermediary<br>Other Private Intermediary              | - Type of entity responsible to get the technology source contact for the project.  |

<sup>4</sup> ANI - is the Nacional (Portuguese) Innovation Association, which is the Portuguese governmental agency responsible for promoting knowledge transfer in order to create value for the national economy, establishing priorities and defining indicators focused on supporting the adoption of knowledge and technology by companies and society.

|                          |  |   |
|--------------------------|--|---|
| <b>Recipient_Contact</b> | University/TTO<br>Research Centre/Interface<br>Private Consultant (study target)<br>Recipient company<br>Other Public Intermediary<br>Other Private Intermediary | - Type of entity responsible to get the Technology recipient contact for the project.   |
| <b>Roles_Pri_Con</b>     | PS<br>MM<br>KDS<br>FF<br>TSMF<br>DI<br>BG<br>PMA<br>FTF<br>AQ<br>IPR<br>IKT<br>MBD   | - Identification of roles combination performed by the consultant in each project.<br>- Following the framework developed in literature review in Table 3.                              |
| <b>Other_Pri_Int</b>     | Yes – No   | - Existence of another private intermediary participating in the project.   |
| <b>Other_Pub_Int</b>     | Yes- No  | - Existence of other public (traditional) intermediary participating in the project.  |
| <b>Other_Pub_Roles</b>   | PS<br>MM<br>KDS<br>FF<br>TSMF<br>DI<br>BG<br>PMA<br>FTF<br>AQ<br>IPR<br>IKT<br>MBD   | - Identification of roles combination performed by the other public intermediary participating in each project.<br>- Following the framework developed in literature review in Table 3. |

All the data was collected under a structured table designed to be later used as input/entry to the statistical software to be used.

#### 4.4.2.4 Statistical analysis process

The data collected from the case study archive was structured according to the presented variables in Table 10, and subjected to various procedures, including data entry, sample descriptive analysis, and statistical tests using IBM® SPSS® (Statistical Package for Social Sciences) version 28.0. Given the qualitative nature of the variables which were mostly qualitative scales (i.e., nominal), specific statistical tools and tests were carefully selected based on initial descriptive analysis, as well as statistical associations and comparative analysis.

The initial descriptive analysis focused on conducting individual frequency tests for each variable collected, both nominals, ordinals, and scales. The descriptive analysis is summarized in the beginning of Chapter 6 using observational tools such as bar graphs. From the descriptive analysis conducted to the 219 TT project sample, the case study firm could be initially characterised, and thus this first analysis served as a foundation to adjust and conduct the following tests necessary to respond to the five hypotheses proposed.

To respond to these hypotheses, data variables were selected, and statistical tests were chosen based on variable typology and test assumptions. Table 11 presents five tests carefully chosen for their suitability to properly respond to each of the five hypothesis. Two main forms of statistical tests were used: 1) Chi-square's test of independence, and 2) McNemar's test of comparison.

Table 11 - Statistical tests selection by Hypothesis

| <b>H#</b> | <b>Hypotheses</b>   | <b>Statistical test options</b>   |
|-----------|---|---|
| <b>H1</b> | The roles played by private consultants are associated with the type of entity originating the project.   | The Chi-square test of independence verifying whether the variables "Roles_Pri_Con_" are likely to be associated or not with the variable "origin_type" |
| <b>H2</b> | The TT projects where the private consultant works beyond its network are linked to the type of entity originating the project.                             | The Chi-square test of independence verifying whether variable "Previous_int" is likely to be linked or not with the variable "origin_type".            |
| <b>H3</b> | The motivations for the contact and involvement of the private consultant in a TT project vary according to the type of entity that originates the project. | The Chi-square test of independence verifying whether the variables "Cont_Motivator_" are likely to be related or not with the variable "origin_type"   |



|           |   |   |
|-----------|---|---|
| <b>H4</b> | The existence of a partnership between consultants and traditional intermediaries in the same project is linked with the type of entity that originated it. | The Chi-square test of independence verifying whether variable "Other_Pub_Int" is likely to be linked or not with the variable "origin_type".                                       |
| <b>H5</b> | The roles of consultants fundamentally differ from those performed by traditional intermediaries in projects both participate.                              | The McNemar's test of comparing/checking if there are differences between two groups – "Roles_Pri_Con" and "Other_Pub_Roles" when the variable "Other_Pub_Int" is equal to 1 (yes). |

The first four tests were conducted in contingency tables of the Chi-square type, to verify the existence of a statistically significant association between the tested variables. The last hypothesis followed a comparative study of pairs, in 2x2 tables, by using McNemar's test, in which the focus is to identify a statistically significant difference between the responses of two groups within a chosen variable. The decision rule used for both types of tests consisted of detecting significant statistical evidence for probability values (i.e., test proof value) less than 0.05 ( $p \leq 0.05$ ).

In the Chi-square tests analysis, the main outputs consisted of minimal distribution tables where the responses regarding a binary variable were distributed by the response of another variable. This is a common statistical test used to verify the existence of an association/correlation between two variables in the sample and thus better understand such variables and the behaviour of the sample (i.e., the case study consultancy firm behaviour in association with external variables).

In the fifth hypothesis, two groups, the private consultancy firm (i.e., the case study) and the other traditional intermediaries operating simultaneously within the same TT projects, were compared following one response variable - the nominal variable of each role specialization. McNemar's test is the better-suited test of a non-parametric test designed for paired nominal data, used to determine if there are differences in a dichotomous dependent variable between two related groups. It can be considered to be similar to the paired-samples t-test but for a dichotomous rather than a continuous dependent variable. However, unlike the paired-samples t-test, it can be conceptualized to be testing two different properties (or in this case, groups) of a repeated measure dichotomous of an equivalent variable.

McNemar's output 2x2 tables are used when samples are paired to increase the accuracy of the comparison. Thus, in the circumstance under study (Hypothesis 5), one intends to compare the responses regarding the two response variables of "Role" (i.e., yes, or no), comparing them between an

equivalent set of individuals – The private consultancy (the case study) and the other traditional intermediaries. This test is the most appropriate to assess whether the proportion of discordant responses is the same in each category/group (i.e., intermediary type). A p-value less than 0.05 ( $p \leq 0.05$ ) would validate that the responses regarding the performance of specific role specialization in a project (i.e., yes, or no) fundamentally differ according to the respondent (i.e., the private consultancy firm or the other traditional intermediaries participating in the TT project).

**CHAPTER 5**  
**QUALITATIVE ANALYSIS: INTERVIEW**  
**RESULTS**

## **CHAPTER 5 - QUALITATIVE ANALYSIS: INTERVIEW RESULTS**

In this study, responses, excerpts, and significant ideas related to each interview question were selected (see Annex I for the interview script) and a set of codes/topics for each answer was defined (refer to Table 9). The coding of responses by key ideas is reflected in the structure of the discussion of results for each interview question. To ensure transparent and logically cohesive discussion, the content analysis and results discussion below followed the codification phase, using the key codes as sub-indexes within each question discussion.

The discussion of key ideas/answers to each question in this chapter is presented in a structured order, as previously presented in Table 9. The argumentative narrative of the discussion of the results follows a combination of interviewees' ideas, which are thoroughly referenced by their participant codes (e.g., #01) defined in the sample Table 8. Additionally, direct interview excerpts are highlighted wherever possible as examples to support the ideas discussed.

### **5.1 Perception and experience with public intermediaries**

The primary objective of this first question was to assess the interviewees' knowledge and familiarity with public (i.e., traditional) intermediation organizations. To achieve this, a diagnostic question concerning public intermediaries was asked during the interviews. Although the object of the research is private consultants as innovation intermediaries, the discussion began with a strategic focus on traditional/public intermediaries as a reference level, in the same way as a control question. The intention behind asking this question was to identify the interviewees' perceptions and prejudices about public intermediaries and to use the findings as a reference point for comparison and relative positioning of the private consultants' role. To facilitate the correct identification of the object of discussion, reference examples of national public intermediaries such as Technology Transfer Offices (TTO) and Technology and Innovation Centres (TIC) from universities and research centres were used.

During the interviews, it was found that the majority of the interviewees had a great familiarity with traditional intermediaries, having previously worked or interacted with them. Through the analysis of the responses from the various participants, a set of key ideas was identified. These key ideas were used in content codification and grouped in a structure that is strictly focused on reading coherency. The structure does not aim to convey any hierarchy of importance between the topics covered, but aims to provide a logical structure for the discussion:

- Roles and value proposition;
- Resources and responsiveness;
- Market positioning.

Overall, the combination of the diagnostic question and content analysis of the interviews provided valuable insights into the interviewees' knowledge and perceptions of traditional intermediaries, which served as a reference point for the subsequent analysis of private consultants' role as innovation intermediaries.

### **5.1.1 Roles and value proposition**

Regardless of their helix origin, most interviewees recognized traditional intermediaries as the main players in innovation intermediation, as they hold the most formal role as intermediaries and are even recognized as such by the Portuguese NIS (A05). During the discussion, several examples of university and polytechnic TTO and TIC were provided, which led to some consistency in the perception of the roles of traditional intermediaries.

However, it became clear throughout the discussion that this intermediary encompasses a large set of intermediation roles. Many of these organizations advertise themselves as performing a large number of functions, but in reality, they can only perform a much smaller number and range of functions/roles.

*“They offer much more than what they manage to accomplish afterwards.” – A01*

*“(...) essentially they take part in fostering the generation of ideas, and maybe not much else.” - A11*

Most interviewees perceived that traditional intermediaries tend to offer a wide range of theoretical functions beyond what they can perform in the market. Some interviewees emphasized key roles in which they believed these intermediaries have a real impact or value, such as disseminating knowledge created in academia either through the creation and promotion of networking events, or dissemination of project results in co-promotion or training (A02, A05).

## 5.1.2 Resources and responsiveness

### Limited resources

Regarding to this perceived exaggeration of the value proposition promoted by public intermediaries, a set of perceptions emerged based on the previous experiences of the interviewees with this type of intermediary. They mostly focused on the lack of responsiveness and the incapacity to perform the comprehensive set of roles that are often expected from them. The lack of resources to support an effective response to their role as intermediaries was a key aspect highlighted by several interviewees (A04, A05, A08). This lack of resources mainly pertains to personnel and the associated skills. It was likewise mentioned that *"the lack of human skills, training, and even the lack of strategic guidance of the teams"* (A04) are great limitations to what they can do.

*"Resources are lacking. It's almost embarrassing. Too much is demanded from them."*

- A05

The emergence of new types of public/semi-public intermediaries, particularly the TIC, represented by some interviewees (A08, A05), is perceived as a NIS strategy to expand beyond those more traditional and academic-like intermediaries, providing an additional dose of resources to respond beyond what other smaller offices can do.

*"I think that a TIC such as ourselves, emerge to respond to what small TTO cannot do due to their lack of resources."* - A08

Nevertheless, several interviewed players, especially those linked to academia (A14) and government (A16), feel that the best resources and skills tend to leave the public sector in search of better opportunities in the private sector, where there is a greater appreciation of their competencies. While the public sector continues to struggle to attract and retain highly qualified human resources in positions supporting TT, *"there will always be more competitive opportunities on the private side to unbalance the scale"* (A16).

### Quality discrepancy

This *"discrepancy"* (A16) is not only apparent between public and private intermediaries but also among public intermediaries themselves. Specific examples of traditional intermediaries were deemed

unhelpful contextualization as they were perceived as highly relative by some of the interviewees. Traditional intermediaries comprise various distinct entities, both academic and public/semi-public in nature. According to several interviewees, there is a significant discrepancy between the quality of intermediaries and their outcomes. While some national TTO and TIC are recognized abroad as excellent examples, others that should be standardized within the NIS have revealed unsatisfactory performances from several NIS perspectives.

*"In the last ten years, we have seen more competencies and new entities, but they are not homogeneous. They vary a lot in quality and performance."* - A16

*"There are different ways of working, some closer or farther from companies."* - A12

*"There are several examples and experiences, some with better results, others with worse. But the experience we have, at least so far, I perceive as being good."* - A18

The notion of discrepancy/variability in the quality of public intermediaries was widespread among interviewees. The perceived quality appears to be heavily dependent on the resources of the organization, the way it is managed, and its proximity to businesses, as the technology recipients. Also noted was the lack of strategic orientation among some traditional intermediaries, which fail to focus on concrete results instead of business events (A17).

*"There are dissemination events that are nothing more than show-off moments"* - A17

Interviewee A14, who has a background in academia, private consulting, and links to a public intermediation entity, clarifies that, from his experience, *"there is no correct or incorrect way of working"*. However, an organization's existing culture dictates a large part of its results, and the academic culture has a specific set of interests that are misaligned with the key objectives of TT. This misalignment represents a barrier to TT opportunities with many companies. In addition, this misalignment can be found in many academic intermediaries known by the participant (A14).

In defence of these institutions, several other interviewees recognized the efforts that personnel from traditional intermediary organizations often make, which are sometimes beyond the scope of their

responsibilities. The dependence on personal morale and voluntarist attitude characterizes several experiences reported by interviewees (A01, A04, A07, A14, A17, A18).

*“(...) they present very different realities (between the best and worst examples of traditional intermediation). I think it is associated with their lack of resources (...). I feel that the attitude of the institutions (i.e., the people) is also noteworthy. I mean, facing the mission they have, sometimes even without proper resources. (...) but when there is a will of the people, things can be accomplished.” - A07*

Focused on mitigating the perception that public/traditional intermediaries have difficulties and limitations performing their role, some interviewees insisted on stressing the importance of the “*voluntarist attitude*” (A04) of the personnel behind this type of organization. The lack of financial and human resources is a reality. Even so, positive results can be achieved when there is a genuine interest in project performance and not just in doing “*the bare minimum necessary to maintain its funding*” (A17).

### **Technical knowledge**

The high technical knowledge possessed by public intermediation institutions was highlighted. Scientific and technological knowledge, especially when it is at a state-of-the-art level, has inherent novelty and complexity. This is one of the factors that most increase the difficulty of TT processes, especially when crossing the valley of death (Gulbrandsen, 2009; Lindström & Silver, 2017), due to the perceived intangibility of academic R&D results by the market. Although many interviewees highlighted the distance from the market as a negative factor for the role of traditional intermediaries (A12), several preferred to see it positively for being closer to academia.

*“To keep up with the state-of-the-art, you have to be close with those who produce knowledge.” - A11*

*“Beyond conducting TT, I believe the more important aspect is to understand scientific and technological activities and to keep up with which researchers work (...).” - A08*

An evolution in the last decade of the role of some traditional intermediaries was noticed. Having lost some of its functions and responsibilities, either by the emergence of other public intermediary



mechanisms (A16) or by the evolution of the role of private intermediaries (A19). However, public intermediaries, such as the University TTO and Research and Technology Interface Centres (RTIC) tend to have a similar bias towards the interests of academia, as they represent and offer a closer position to academia and the knowledge sources. This proximity to academia and somewhat distanced from the market is perceived positively by companies (A01, A03, A17, A18, A19).

*“Public intermediaries are closed within their universities. (...) for more than 10 years, I have only worked with private consultants because they are much closer to the market. Still, all the R&D projects we develop have the participation of universities or TIC, filling roles of technical support, R&D consultancy, testing, and feasibility.” - A19*

### **5.1.3 Market positioning**

Regarding the positioning perceived by NIS agents, Portuguese NIS has evolved in the last two decades, increasingly recognizing the importance of TT in promoting market innovation. As previously mentioned, several interviewees see public intermediaries' role as not corresponding to what it is supposed to be theoretically. Since most of these intermediaries act from an academic perspective, several participants began to perceive public/traditional intermediaries as academic champions, positioned as the front-end of academia and R&D results.

Most interviewees from private organizations (i.e., consultants and companies) regard this championing and specialization in the front-end of academia not as a limitation on their intermediary role but as a strength for their proximity advantage to the academia and the source of technical knowledge (A01, A17, A18, A19).

### **Gatekeeping at University helix**

The positioning of proximity to academia generates a duality of interpretations on the part of the interviewees. On the one hand, this championing of the University's helix is well regarded for the technical knowledge it represents, for its proximity to technologies and R&D results, and whose positioning is benefited by the curriculum of the academia it represents (A18).

On the other hand, there are perceptions and experiences among the interviewees that point out a gatekeeping role for intellectual property resulting from projects at the university. In theory, this gatekeeping on behalf of the university *“has everything to work out great, however, as in almost all TIC, they end up becoming a repository of research personnel attached to the university”* (A17).

This perception is shared, albeit with less intensity, by one of the TIC interviewees who sees in his role a greater practical importance in the relationship with the university they represent than the importance of the performance of TT to the industry (A09). This gatekeeping positioning is also highlighted by both a consultant (A01) and industrial and technological companies (A18, A19) that increasingly perceive the traditional/public intermediary as an organism limited to a *"corner of their university without really interacting with the market"* (A01), thus being somehow disconnected from the interests of industries.

*"They are limited to universities and closed in their corner without really interacting with the market."* - A01

*"As a TIC, our world is to bridge the gap between universities and companies. But, in fact, we know that it is not only that. The academia bias turns out to be very important and has a greater weight."* - A09

*"I have already stopped trying to connect with public intermediaries, as they tend to present me with ridiculous conditions, it seems that they do it on purpose for companies to leave them alone."* - A17

### **Relevance and temporal focus in the R&D process**

There is a temporal perception of the positioning of traditional intermediaries in the TT process. According to some interviewees, the role of traditional intermediaries is more relevant in the early stages of innovation and TT. Specifically, they add value to the process through theoretical and fundamental R&D activities in projects that typically present less maturity, higher risk, and uncertainty, and have less involvement of companies (A17).

At the beginning of the innovation process, when there is a higher degree of uncertainty and risk, the TT needs to be addressed are often answered by academic/university institutions, where traditional intermediaries add more value (A02). This is mostly because there continues to be a need for support and intermediation at various levels, even if at the end of the project there is not a concrete result (i.e., mature enough) to be successfully transferred to the market. (A05, A11).

*"In my previous work on the public side (...) I came across thousands of promising ideas that ultimately didn't make it through the 'innovation funnel'. While this is a normal part of the process, I strongly believe that we need to support and test these ideas to ensure that they have a chance to succeed." - A11*

### **Misalignment with the Industry**

The interviewees with the most experience have a perception that traditional intermediaries are more focused on academia and tend to neglect the business side of the market (A12). This misalignment with the industry was noted in various domains, both in a general sense (A1, A12) and in terms of the intermediaries' lack of knowledge and alignment with the business culture (A14). The issue of temporal relevance is particularly highlighted, as companies operate at a different pace than academia, and as a result, traditional intermediaries cannot keep up (A14). This affects the objectives of companies concerning TT, as they must often adjust their operations to the temporal limitations of academic calendars and the limited allocation of academic personnel to R&D and TT projects (A14, A17).

*"I don't want to partner with public intermediaries. Mainly because I know that they will always be dependent on third parties (mostly universities) and that the project will be poorly managed because they are in offices (TTO) where personnel is inert (...) but there are better examples, few, but good, nevertheless. But from my experience, it is because they operate almost as private companies, with an attitude and presence much closer to the industry." - A17*

This misalignment in the operation of some traditional intermediaries, like the discrepancy in quality, is a variable that depends on the kind of time management used by the organization's leadership (A17). From the perspective of some companies, this misalignment is natural, as they are different types of organizations with different objectives (A1, A17, A19). For this reason, interviewee A19 emphasized that while he maintains relationships and partnership protocols with numerous academic institutions and TTO focused on "*sharing academic knowledge, exchanging researchers and trainees*", he still prefers private intermediaries (i.e., consulting companies) to manage and support their R&D and TT projects.

### **Self-sustainability first**

Due to their limited resources, there is a recurring concern about the financial sustainability of these organizations. This is particularly true as they rely heavily on publicly funded programs and projects

to maintain their technical teams. The difficulty of attracting and retaining qualified professionals has also been mentioned as a challenge (A04, A05, A08). As a result, many of these intermediaries have shifted their focus from TT project performance and results to financial survival. These TTO often have small teams that spend most of their time searching for, applying for, and managing publicly funded projects in partnership with university resources (A09).

Respondents who view the process from a more distant perspective or who have been involved with traditional intermediaries in the past have increasingly negative perceptions of these players as TT intermediaries. The perception is that these intermediaries focus more on obtaining funding than on the results and impact of R&D and TT projects.

*“I’ve been on both sides (i.e., public, and private) and unfortunately, it’s one of the worst places I’ve seen money invested (refers to public intermediaries), as there are no tangible results. When there are results, they have a bias. In short, there’s a lack of strategy (...) big TT projects are often conducted with a roadshow of show-off events, but then, everything (i.e., the results) is left in the ‘drawer’. All is just for that moment, to get funding and keep the entity with paid staff.”*

- A17

This negative connotation is especially relevant in the case of private entities that were interviewed (A01, A02, A03, A15, A17, A18, A19) and have a specific perspective of the Portuguese NIS. Despite recognizing the value of traditional intermediaries, they have been distancing themselves from academia and traditional intermediaries over the last decade (A19). They maintain relationship protocols only where they still see value in academia, specifically in brokering technical knowledge, trainees, and some R&D activities (A19).

## **5.2 Perception and experience with private innovation consultants**

The primary objective of this question, similar to the previous one, was to assess the level of knowledge and familiarity that the respondents have with private intermediation organizations, particularly private consulting firms. The diagnostic question regarding private intermediaries generated several relevant findings for the research, based on the background knowledge and experiences of the interviewees with this relatively new agent.

One of the most important questions of the interview was to analyse the perceptions and prejudices interviewees might have regarding private consultants as TT intermediaries. This question was

asked after a similar question about traditional intermediaries to allow interviewees to create a comparative relation between the two types of intermediaries. The aim was to validate previously found ideas in the international literature and to deepen the understanding regarding private consultants as an intermediary, as well as to further comprehend and analyse their role in the Portuguese NIS.

The discussion of this question was an open question where each interviewee was able to guide their conversation according to the main topic in a way, they thought most suitable. However, unlike traditional intermediaries, innovation consulting firms were not so familiar to some of the respondents, especially those operating in the academic and government domains. Nevertheless, all the participants demonstrated some level of knowledge regarding this kind of player. The main ideas discussed through the 19 interviews were grouped thematically in a logical sequence, not intended to represent any kind of degree of importance or sequence of discussion mentioned in the interviews. The structure below intends to organize the ideas and critical points of analysis coherently and analytically for proper discussion:

- Roles and value proposition;
- The emergence of private players.

### **5.2.1 Roles and value proposition**

When discussing the involvement of private consultants as intermediaries in TT, interviewees frequently highlighted the perception that these consultants bring a new level of proactiveness to the process, which benefits all stakeholders (A01, A02, A03, A04, A05, A07, A09, A10, A13, A15, A17, A18, A19).

*“Private consultants have economic interests, it is true. But maybe that’s the ‘carrot’ driving them to move and make things happen. The results speak for themselves.” - A01*

*“(…) they are more active, as they work for the results, they are more proactive.” - A10*

However, this perception was accompanied by a prejudice held by some interviewees towards private consultants' for-profit activity. This economic interest was seen as a *“carrot”* incentive (A01) that somehow stimulates the proactivity of their role as intermediaries. Some interviewees considered consultants as *“mercenaries”* (A19) whose proactivity, effectiveness, and performance are directly linked

to the potential revenue to be obtained from projects and clients. This created an *"invisible line"* (A14) separating the role of traditional intermediaries from private consultants.

*"Of course, there are interests, the consultants devalue activities that do not generate revenue for them, and there is when traditional intermediaries should be used."* - A14

Overall, interviewees highlighted the proactivity of private consultants' performance and their value proposition in TT. Despite being positioned in a different industry helix, consultants are known for their network of contacts within the source of knowledge and academia, aiming to foster the development of high-potential projects (A11).

*"Consultants have more expertise and global knowledge of things. But there is an economic bias in that. Still, they have a more realistic view than the traditional intermediaries."* - A12

The most frequently mentioned roles for private consultants in these interviews were linked to providing appropriate support in managing, monitoring, and evaluating TT projects between academia and industry. Additionally, private consultants were seen as facilitating the *"articulation with the public entities that provide financial support"* (A18, A19).

*"I've already worked with several consultants, from various regions of the country and with distinct specializations, mostly in project financing but also the legal part, intellectual property, market studies or the support for the economic viability validation of our new products (...)." - A19*

### **Complementary additional services**

This study conducted an in-depth analysis of the ideas identified during interviews regarding the role and value proposition of private consultants as innovation intermediaries. Many interviewees highlighted the key role of private consultants as a complement to the services provided by traditional intermediaries. According to several interviewees, private consulting firms operating in TT projects tend to specialize in domains that are not readily available within the NIS traditional structure. Thus, consultants act as an extension of traditional intermediaries' scope of action, taking innovation beyond

the valley of death and enabling its effective application in the industry (A01, A04, A09). Some interviewees with more traditional/public backgrounds also recognized that, given their current limitations, *"they strategically develop partnerships with several consultants to fulfil the little gap that traditional intermediaries such as TTO can't respond to"* (A09).

*"Private consultants have been the right arm of the public system for a long, allowing traditional intermediaries to better bridge the gap between the University and companies."* - A01

*"Private consultants provide services that are often not available in other institutions. (...) they are more selective and focused on the services they provide (...), I would say specialized."* - A04

Interviewee A10 identified that, although their R&D centre has a team dedicated to company relations and TT initiatives, the procurement and use of consultants continue to be a regular practice. This is due to the possibility of obtaining key inputs and identifying R&D needs from the industry, as well as opportunities to apply the knowledge and technologies developed in established industrial companies.

*"I don't know if the problem is the money or the mentality. In public intermediaries few people have the proper experience. (...) we typically go through the private sector (i.e., consultants) because they are active in our facilities bringing us opportunities to do projects with companies."* - A10

Therefore, private consultants have a prominent role as a strategic complement to traditional intermediaries operating in the Portuguese NIS due to their specializations in additional/complementary roles and activities (A04) and their greater proximity and knowledge of the industry and its companies (A10).

### **Focus on financing**

Private consultants in the Portuguese NIS are known for their specialized roles in financing innovation, R&D, and TT activities. This was identified as a key role of private consultants as innovation intermediaries and was unanimously recognized by all interviewees. This role is likely due to the unique characteristics of the Portuguese NIS, which offers a range of financial and tax incentive programs for

innovation in companies. In addition, there is an additional financial incentive if an academic or R&D entity is involved in the innovation project as a TT initiative.

Therefore, the involvement of private consultants in financed innovation projects is prominent in Portugal, as *"very few technological innovation projects are done without a consultant involved"* (A01). Private consultants are recognized as a key part of TT projects, as *"without them, we would not see the results we all know today in the market"* (A02). This role is acknowledged by most NIS agents interviewed, both on the academic and industrial sides. Private consultants' expertise in designing and building innovative projects to be submitted to public funding programs is highly valued (A01, A08, A11, A17, A19).

*"The success rate of project funding approval is much higher than that of traditional intermediaries."* - A08

The importance and recognition of this specific function of obtaining funding from national and European programs to encourage innovation have led to an increase in the number of players (i.e., consultants) in the market with different value propositions (A02). Some private consultancy firms are seen as *"merely writers of project proposals"* (A15), but there is still a need for these agents in the NIS, especially among small and medium-sized Portuguese companies that *"have little or no culture of R&D investment"* (A11). Hence, many of these smaller companies are encouraged by the proactivity of consultants in identifying opportunities and the financial support associated with these innovation investments (A11).

### **Freeing key stakeholders**

According to the interviewees, consultants possess two key characteristics: proactivity and accountability. Consultants are responsible for their functions and work autonomously to solve problems and meet project stakeholder expectations and deadlines without their involvement.

*"The good thing about working with consultants is that they work for us, and we only need to involve a university or TTO when we have a concrete project on the table."* - A07

Several interviewees (A04, A08, A12, A13, A15, A17, A18, A19) believe that this sense of accountability stems from the fact that consultants are for-profit entities and must respond to the needs



of their stakeholders, who are mainly private companies acting as their clients. As intermediaries, consultants have professionalized their roles and gained recognition in the market for their ability to achieve intended results.

*"(...) when we need high-quality work and want to make money, we have to work with the best. I'm not saying that there aren't good professionals in the public sphere, but paying for a service provided by a well-paid and experienced consultant is a guarantee of a job well done."*

- A19

There is a prevailing opinion that each entity, especially intermediaries, should take full responsibility for their actions as experts. This allows other stakeholders to focus on their core roles (A03, A18, A19). This professionalization of consultants as intermediaries has gained recognition in the market for their performance and, their ability, to achieve the intended results. There was an opinion that each intermediary entity should take full responsibility for what they do as an expert, thus freeing the remaining stakeholders so that they can also dedicate themselves to the core role they should play (A03, A18, A19).

*"(...) projects pose as a big bureaucratic burden. It's highly impractical to manage these kinds of projects as the promoting company or a consortium partner."* - A18

*"We feel at ease because we have someone to guide us (i.e., the private consultant). Typically, we come up with the original idea, but the consultant guides us through the design and execution of the project."* - A17

In TT projects, activities linked to project support functions are considered soft-innovation activities that are best left to specialists, namely private consultants. This approach allows other stakeholders to focus on the core activities of their projects, which are deemed essential (A17, A18). TT projects often involve project support functions that are considered soft innovation activities by key stakeholders (i.e., both sources and receivers), despite their recognized importance (A17, A18). These activities are typically delegated to specialists such as private consultants, allowing other stakeholders to focus on the core activities of their projects (A18).

*"(...) that's where consultants come in: to make the necessary connections and get things moving. Then, it's up to us in R&D to deliver the hard results."* - A11

*"We've had fantastic experiences working with private consultants. They are great support because they free us from the most mundane activities and allow us to focus on the development and innovation activities that are central to our projects."* - A18

### **Continuous work and maintenance of relationships**

The specialization of consultants, which frees project stakeholders to focus on core activities, requires a laborious role in managing expectations and communication between parties before, during, and after projects. It was evident that consultants establish continuous working relationships within the system, mainly at the R&D, innovation, and TT levels. Some interviewees expressed trust and loyalty to this new intermediary partner.

*"I have worked exclusively with private consultants for over 10 years."* - A19.

*"We have been conducting R&D projects continuously for several years, and I always choose to work with private consultants."* - A17

*"Private consultants have become increasingly involved with us, especially in co-promoting technology transfer projects."* - A06

Continuous work with customers or strategic contacts allows for a more regular presence and participation in innovation projects, as well as intrinsic knowledge of stakeholders and the sector in question. Consequently, private consultants identify opportunities for innovation for their network of clients and partners and often conceive and propose project opportunities themselves.

*"It has become natural for us to work closely with several consultants because they are the ones who 'walk the walk'. They have more contacts and often bring us pre-designed projects that are ready to start. We maintain regular communication with several consultants in different sectors where we aim to carry out projects regularly."* - A08

Acknowledgement of this role in creating and maintaining network relationships has led to higher involvement and impact of consultants, resulting in new roles and broader scopes. Currently, consultants are even partnering with business associations to strategically define the future of entire regions or sectors of activity (A02, A15).

*“The strategic relationship between associations and innovation consultants has grown stronger. Private consultants now tend to have a regular presence in associations (i.e., business/regional), in addition to their current involvement with academia and even government. Many entities nowadays cannot do anything without private consultants, making them an essential part of innovation in our country.” - A15*

## **5.2.2 The emergence of private players**

### **The emergence of private players**

The ideas shared by the interviewees revealed a set of perceptions linked to the evolution of this intermediary and its role in the NIS, particularly its exponential emergence over the last decade (A16). Along with the consultancy firms' emergence, there is awareness regarding their role within the system and their increasing involvement, not only with recipient companies but also with public and academic entities.

*“Consultants are indispensable key players in the system, as well as for traditional intermediary agents. This is evident from the high number of consultancy firms emerging in the market.” - A15*

*“(…) these days, I deal with private consultants every day. Over the last decade, they have become much more active, and new entities are popping up all the time. Consulting has always existed, but in the past, consultants were merely reactive to the challenges they faced. Nowadays, they are more proactive, bringing project opportunities to companies and even to academia.” - A16*

During the interviews with entities of the R&D system, as well as some companies, it was stated that this relationship of private consultants with other public and academic players often stems from the organization founders. Many times, specialized human resources move from academia and traditional

intermediaries to the private sector, not only through expert phishing but also through the spin-off of experts and academics looking to capitalize on their knowledge and skills.

*"Most of these consultancies are founded by professors or former members of the academic community." - A06*

*"Consultancies seek out HR from traditional intermediaries because the salaries are always better in the private sector for those who are good professionals." - A16*

This topic will be discussed in greater depth in a further section related to the competition or complementarity between public and private intermediaries. Still, the perception remains that this emergence of consulting entities in the market to collaborate with public and academic entities is seen almost as a natural evolution of the market resulting from a real need felt by companies, mostly.

*"Many private consultants are emerging because the industry has the capabilities and is creating mixed teams and partnerships to solve their problems without dependencies on public organizations. Consultants make it happen." - A17*

### **Systematic implications**

Finally, some notes and opinions linked to the perceptions and prejudices discussed by various interviewees are highlighted, during which some ideas of potential implications for the NIS were presented. Starting with innovation consulting themselves (interviewees) stated that despite favouring the market growth trend, the increase of private players is making it difficult to manage meaningful relationships in the private sphere. This seems paradoxical as consultants themselves promote the model of open innovation (Bianchi et al., 2016; Diener et al., 2020). Yet, their expertise and networks are often under strict confidentiality agreements, as knowledge is power, and there is a growing competition within the private consultancy sector (A02, A03).

*"(...) consultants still have a lot of room for improvement. They have difficulties relating to each other, even though they are great with all the NIS agents. However, between themselves, they compete fiercely, which ends up limiting open innovation." - A02*

There is difficulty in understanding the innovation consultant as a concept of a private intermediary due to a *"great discrepancy of agents and fields of intervention, as well as of the capabilities and resources they possess"* (A04). This generates a perception of a significant discrepancy/distinction regarding the private consultants, their role, and the quality of their work. This culminates in a perception that, in the Portuguese NIS, the innovation consultant as a private intermediary has a less comprehensive role compared to other more evolved NIS in foreign markets.

*"(...) The range of services provided by private consultants in our country is comparatively limited in comparison to those offered in many other European countries."* - A04

### **5.3 Role value proposition**

After assessing the interviewees' familiarity and knowledge of traditional intermediaries and private consultants, the interview shifted focus towards the research's main objective of comprehending the role of private consultants as intermediaries.

Through the preceding questions, a range of roles and responsibilities were identified by the interviewees, mainly focused on specialized tasks such as project design, securing funding, project management and monitoring, creating and sustaining contacts, and market opportunity surveillance. Additionally, other significant characteristics were emphasized as value propositions, contributing to their role perception, particularly the way they position themselves in the NIS by providing supplementary and complementary services to those offered by traditional intermediaries, with a focus on financially supporting TT projects. The value of the consultants' role was also recognized for their ability to relieve TT stakeholders of less core project activities and ensure successful execution, allowing stakeholders to concentrate on innovation activities. Furthermore, the continuous involvement of private consultants in maintaining dynamic relationships within their networks to encourage ongoing investment in R&D and innovation was emphasized.

Respondents were also asked about the additional characteristics, skills, and specialized roles they deemed most essential and desirable in consultants, which was a continuation of the preceding question discussion. Five main components of the value proposition of private consultants' roles emerged from a direct analysis of the discussion content:

- Proactivity;
- Responsibility;
- Competence;

- Relationships (Network);
- Financing.

### 5.3.1 Proactivity

The most prominent factor, as previously mentioned, was the sense of proactivity and attitude demonstrated by private consultants in the NIS as intermediaries for innovation. The majority of interview participants identified *"proactivity"* (A01) as the most significant value proposition factor. This factor even seems to impact participants' perception of other roles and their impact on TT outcomes, as this private intermediary is widely recognized for its ability to *"make it happen"* (A01), *"idealize opportunities"* (A12), and prevent *"ideas from ending up in the drawer"* (A08).

The proactivity of private intermediaries, specifically consultants, provides them with greater agility compared to traditional intermediaries. As a result, they can achieve different results (A02). In an interview with a private consultant (A01), *"proactive, open, and accountable"* were identified as highlights of their organization's value proposition. This value proposition aims to differentiate the consultant's intermediary role in the market, assuring their customers, mainly companies, that they can *"rest easy when they leave things to the consultants"* (A01). However, it is important to note, as emphasized by traditional intermediaries and academic entities (A07, A10, and A13), that despite having departments focused solely on supporting technology transfer, private consultants continue to be viewed as specialized subcontractors. This perception of consultants as a strategic opportunity for subcontracting by public organizations and academics is also supported by their perceived proactivity in finding and securing financing solutions for academic innovation and R&D projects.

### Proactivity and innovation catalysts

Additionally, several indirect ideas and topics of discussion among interviewees perfectly align with the same notion of proactivity. These impacts of their proactivity are specifically seen when consultants support organizations, mainly companies, in identifying where and how to innovate. Private consultants continuously generate a stream of innovation opportunities to attract and pitch to potential clients. This characteristic of proactivity is perceived by some as a catalyst for innovation in the NIS.

*"We don't usually reach out to consultants. They are the ones who typically approach us with new challenges from potential client companies or even their own project ideas to be developed with our skills."* - A11

*"Companies require assistance not only in identifying internal opportunities but also in establishing connections with the scientific community to explore opportunities that they would not have found otherwise." - A16*

According to some interviewees, this proactivity of innovation consultants is merely a natural response to the market since companies are too busy with day-to-day activities and lack the time for strategic and innovation tasks. Innovation consultants offer these companies the opportunity to select pre-screened and substantiated innovation opportunities.

*"Companies often lack the time and resources to focus on strategy and innovation. Consultants bring culture and legitimacy to break the status quo as many organizations have their staff dedicated to such activities. External consultants have the time and outsider perspective to follow trends and deal with everything, including project due diligence. Additionally, they have more training, and they offer these skills for sale." - A15*

This value proposition of presenting innovation and technology transfer opportunities in the form of investment project opportunities, along with identifying potential financial incentives and estimated prospects of financial return, is highly attractive in keeping companies generating innovation.

*"Even companies with in-house R&D seek the services of consultants. However, they primarily look for specialized support in strategic planning, developing business opportunities, finding financing, and generating innovation. I also believe that companies will increasingly demand for TT support. This is why private consultants have been creating new offers and differentiating themselves through their proactivity and agility in the market." - A16*

### **5.3.2 Responsibility**

Closely related to the value proposition of proactivity is the responsibility and accountability with which consultants perform their tasks and represent the interests of their clients. Private consultants offer an intermediary role that is especially geared towards providing support and accountability for soft innovation activities (Pinto, 2018) to manage the execution of TT projects. This role aims to free their

clients and other stakeholders from tasks that are less related to the concrete objectives of R&D and TT activities, also known as hard innovation tasks (Pinto, 2018; Silva et al., 2018)).

*"The value of my private partners (i.e., consultants) is that they enable me to focus on other things. It's not up to me, or anyone else in my company, to keep up with legislation or do technological surveillance. My private partners have been working with me for a few years now. When I ask for a service, I don't even question the price anymore because I know exactly what I'm going to receive and that I'm paying for quality."* - A19

*"We do what clients do not want to bother with. (...) such as project financing, responsible management of internal processes, management of partner networks or the preparation of studies of strategic nature."* - A03

Private consultants cannot successfully exercise this role of responsibility and accountability if their clients and the system itself do not have confidence and trust in their work. There is a perception that the evolution of the role of private consultants has been carefully thought out to gain the confidence of NIS players. As such, a closer involvement of private consultants in innovation and TT projects is necessary, both in terms of accountability and risk sharing (A12, A17).

*"They offer established and trustworthy relationships in partnerships and consortiums."*  
- A12

*"They are aware of the consequences and risks of the project and are willing to take responsibility."* - A17

### **Alignment with companies**

Part of the factors that have led to a higher level of trust between NIS players and private consultants stems from the perception that private consultants stand out for their focus on achieving concrete outputs in TT projects, namely the technologies or products to be placed on the market.



*"Companies seek more commitment and focus on technology transfer projects, not just R&D services, to quickly bring the final product to the market. This is why consultants are becoming more involved."* - A10

*"The roles are well defined. Companies want to focus on development and outsource administrative support for other essential parts to achieve the objectives required by a financed project. Professional support from consultants is crucial for achieving good results by the end of the project."* - A18

The orientation of private consultants towards results leads to a set of alignments of their internal activity with that of their clients. Several interviewees have noticed the importance that consultants place on being properly aligned with their clients' objectives (A14) and their companies' work pace (A14, A17). This is perceived as an integral part of the responsibility and accountability that consultants offer to the system.

*"Consultants comprehend companies' expectations for time and objectives."* - A14

*"They work at the same pace as companies."* - A17

This alignment with the objectives and the way of working of private companies make private consultants highly regarded as ideal intermediaries to partner with. This is especially because there is a recognized gap resulting from the misalignment between the work pace of traditional intermediaries and that of companies.

### **5.3.3 Competence**

The interviewees recognized the competence of private consultants in the specialized execution of their intermediation roles. The main idea identified about competence and competencies is that different consulting organizations might offer different sets of skills, but always look to complement their clients with skills that they do not have in-house or do not have time to perform (A12, A18). Proactive positioning would not be as highly regarded by the interviewees if they did not also recognize the competence of private consultants in their specialized roles.

*"Companies lack the necessary expertise and thus rely on consultants." - A12*

*"Private consulting firms are becoming more specialized, and top public resources tend to migrate to them." - A14*

Overall, private consultants were perceived as competent in their functions due to their integrated one-stop-shop offer of know-how and specialized teams with skills tailored to the needs of their projects and customers (A02).

*"They handle everything, from developing the initial idea into a viable and innovative project to giving it a name, a form, and even securing funding." - A07*

*"We aim to work with consultants who not only understand funding proposals but also possess a technological background that can be applied to the submitted projects. A coherent project design is critical. After submitting the project for funding and approval, the consultant receives a fee for managing administrative tasks during the project execution, which may take years." - A12*

This recognition of private consultants' competence as intermediaries in innovation and TT projects leads companies, as most of their clients, to outsource their manpower, skills, and expertise. This role of supplying increasingly specialized tasks goes beyond what the literature recognized as part of the role of the innovation intermediary.

*"Consultants may also assist us in project design, depending on the project's requirements. They can play their role in both meeting the recipient company's needs and fulfilling the project's merit based on funding program criteria." - A09*

*"They collaborate with R&D centres like ours on funded projects, writing proposals, and the management component. They are necessary to support us with Economic and Financial Feasibility Studies (EFFS), from assessing the suitability of the idea to the project to contracting processes." - A12*

It is perceived that consultants “offer technical know-how not only related to the technology but also to the economic context” (A17). Their role and intervention are not linear or standard, unlike some traditional intermediaries. Although consultants offer multiple competencies highly recognized and demanded by the market, it is ultimately up to the customers to decide whether or not to use these competencies as paid services within the scope of their TT projects.

#### **5.3.4 Relationships (Network)**

Another important element of private consultants' value proposition from the perspective of several NIS agents is the network of contacts that private consultants possess and their continuous work in maintaining these relationships with perspectives of future monetization. This recognized privileged relationship with the business environment (A02) is highlighted by several interviewees as one of the main reasons for involving consultants in their projects. Their knowledge of specific sectors and their relationships within a network of close contacts is regarded as highly valuable to the success of TT projects. Thus, consultants greatly increase performance in matching technology sources with technology receivers and connecting with other system players along the way.

*“They are highly specialized in what they do and are highly valued by those they know and keep in touch with.” - A08*

*“(...) On our side, we see value in them for their ecosystem and their contacts as they present real business opportunities.” - A13*

*“The consultants' network is vast and up to date, including ENESIS<sup>5</sup>. We entrepreneurs do not have time to build and maintain networks. The consultants bring us the best part of it, including news, contacts, and more.” - A17*

The market demand for intermediary pivots with contacts at both ends of the TT process means that consultants, even though they work mostly within the industry helix, are increasingly developing work

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<sup>5</sup> ENESIS is a Portuguese NIS categorization given to non-entrepreneurial entities of the R&I system such as 1) Higher education institutions, their institutes, and R&D units; 2) State or international laboratories with head office in Portugal; 3) Non-profit private institutions whose main object is R&D activity; and 4) Other non-profit public and private institutions developing or participating in scientific research activities.

ties with public and academic entities. Thus, they are acting not only in innovation pushing but also innovation pulling.

*“Undoubtedly, their most valuable role is to bring companies to the table. They analyse our skills and always find a recipient company that is suitable and interested in something we are capable of developing.” - A07*

*“They always have the contacts we need, and they know what companies need or what might be of interest to them.” - A09*

### **Proximity to the market**

Some interviewees revealed that private consultants offer more than a list of contacts but a set of well-maintained relationships that are built and groomed over years of previous interactions, usually in specific sectors (A02, A03). There is recognition of the advantage private consultants possess compared to traditional intermediaries in terms of their proximity to companies (A10).

Consultants have established relationships based on trust and previous experiences with benchmark companies, and as such, they are regarded as intermediary champions linking and representing the interests and objectives of these companies (A07, A19).

*“Private consultants tend to have much more interaction with the market, and they are really close to some of the main companies - A10*

*“The consultants assure us that we can focus on our R&D work because they take care of the whole process, including every moment of interaction with the company. The consultants are present to make sure that both parties are comfortable.” - A07*

### **Extension of the public**

The proximity of private consultants to companies is increasingly seen as an attractive value proposition, not just by corporations, but also by the public sector. This is because the latter recognizes the potential of complementing their traditional roles with subcontracted consulting services (A08, A10), particularly as a *“variable cost strategy”* (A10).

*“I see consultants as external personnel that we also have available but that it would be financially impossible to incorporate them within the TIC. So, I see it as a variable cost in our operations. We do the most technical part of the projects, and the consultants ensure that the project runs successfully from start to finish.” - A08*

The quantity and quality of relationships established by consultants in the NIS make consultants a specialized tool to better reach companies like no other intermediary can. These relationships, added to their resources and specialized skills, allow public and academic entities to subcontract what they often lack, or have limitations to perform.

*“Consultants have great knowledge of project management and the business reality like no other agent has.” - A15*

*“We subcontract (private consultants) practically at every opportunity because our TTO has no resources. (...) Scouting for internal skills and diagnosing needs in potential recipient companies stands out to later promote a good match.” - A06*

### **5.3.5 Financing**

Another significant aspect of private consultants' value proposition, which interviewees often take for granted, is their role in obtaining funding. Although none of the interviewees initially identified this as a top-of-mind awareness<sup>6</sup> factor (Karlan et al., 2016), when asked about the value proposition of private consultants, it suddenly becomes highly relevant within the NIS players in Portugal.

The growth of private consultants' operations in Portugal appears to be influenced by the existence of national and European funding programs that provide financial support for innovation projects. Private consultants have become increasingly prominent in this area and are seen as specialized agents for public innovation policies and resulting financial incentive programs such as PT2020 (Alexandre, 2021).

*“Monitoring public policies and funding schemes (...) They have great knowledge of the political, legal, financial environment, and innovation.” - A15*

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<sup>6</sup> Top-of-mind awareness – Something (as product, service, or brand) that occupies a privileged position in public memory, being the first that an interviewed individual recalls spontaneously, on being questioned regarding a specific category in a notoriety assessment test (Karlan et al., 2016).

*"They are always aware of financial schemes and funding programs to take a project forward." - A17*

Initially, private consultants were hired as proposal writers for these funds (A01, A19), but they have since gained significant technical knowledge of innovation legislation and innovation policies (A03). This, together with the other identified components of their value proposition, has opened the door for private consultants to become intermediary innovation agents, recognized by various agents of the NIS (A02).

*"Consultants often hold a considerable dominance over private market agents, including companies and others, as well as general markets and their needs. They also have knowledge of political agents, their established priorities, and the ability to communicate between both parties."*  
- A03

Overall, the core of the value proposition of a private consultant acting as an innovation intermediary in the NIS is centred on *"the application for funds, without a doubt. (...) but then there is a lot that consultants end up doing as well, despite their role revolving around funding"* (A11).

## **5.4 Public and Private intermediaries overlapping scopes**

Comparing public (i.e., traditional) and private innovation intermediaries in the context of the NIS is inevitable. Some participants, including private consultants, recognize that there are overlapping roles between both types of intermediaries.

To gauge the level of opportunity or threat that private consultants pose to traditional public intermediaries in Portugal's national innovation system, participants were asked whether they viewed private consultants as competitors or complementary to traditional public intermediaries. Responses from different NIS agents' perspectives indicate that while there is some overlapping regarding the role of private consultants, they are mostly seen as complementary to traditional intermediaries. Private consultants may overlap in some cases, but they mostly partner or complement with traditional intermediaries, rather than compete with them, according to most participants.

Overall, private consultants are perceived as an opportunity rather than a threat to public intermediaries, despite some overlapping. However, other perspectives were also discussed, including

the existence of potential roles which private consultants may pose as competitors. The analysis of participants' responses was divided into two major threads of thought:

- Strategic complementarity;
- Residual overlapping.

#### **5.4.1 A strategic complementarity**

Most participants view private consultants as complementary to traditional intermediaries, and they are increasingly being used by different agents, from companies to more traditional/public entities from the NIS. Private consultants are considered a strategic *"instrument"* (A18) by some to achieve better results in ITT.

Two ideas stood out in the discussion of this issue: one from a traditional intermediary (A08) and another from the perspective of a private consultant (A02).

*"They complement each other. Although we may perform some of the same tasks, it's up to us to decide whether it makes sense for us (TIC) to do them. Often, it's strategic to have consultants perform tasks that we could do ourselves." – A08*

*"Private consultants are as essential as public intermediaries. Neither is more important than the other. Is there competition? Yes, there is some. But each one has adapted and specialized differentially. That is why we end up complementing each other more than competing." – A02*

#### **Distinguishing scopes**

Despite the overall recognition that public and private intermediaries can sometimes play similar roles, some participants highlighted the distinction between the key specializations of each player, which biases the role of each intermediary and minimizes overlaps. For several interviewees, the scope of the role of each type of intermediary (i.e., public, or private) was obvious. Public intermediaries have roles that are more focused on the dissemination of results (A01) and are in a more embryonic stage of innovation where R&D and technological knowledge are more relevant (A17).

*“(...) the roles of the public intermediaries are mostly linked to the dissemination of knowledge, event management, and so on.” - A01*

*“Traditional intermediaries tend to offer services of a more technological nature. It is an earlier role. They may provide advanced and/or applied scientific and technological knowledge, technical services, instrumentation, research, and development, (...).” - A04*

Private consultants, acting as innovation intermediaries, can operate downstream of the TT process. They do not only assist in securing financing (A17) but also work closely with the market and its demands (A19).

*“There are excellent examples of public intermediation and technology transfer in Portugal, but they mostly focus on the technical component. However, few traditional intermediaries in Portugal can be as effective as consultants in working closely with companies and obtaining financing for their innovation goals.” - A17*

*“When working with public intermediaries, we always have to follow their pace as they tend to have a slower pace than private companies.” - A19*

### **Overcoming limitations**

It is clear that private consultants, motivated by their for-profit nature, do not aim to fulfil all the roles and specializations that intermediaries may possess, even if they possess the required skills and resources. As *“mercenary”* players (A19) in the NIS, consultants tend to provide services that are more specialized and aligned with the goals and interests of their paying clients, rather than the conventional services offered by traditional intermediaries within the system.

*“Private companies prioritize the roles that have the greatest impact on their clients’ project outcomes.” - A01*

On one hand, traditional intermediaries have an advantage in terms of their technological knowledge and proximity to academia. On the other hand, private consultants offer a complementary value proposition with administrative and project support services, including management, networking,



and strategy development, as well as funding acquisition (A04). As previously mentioned, private consultants' potential for complementarity has been strategically leveraged by various NIS players, including public and academic intermediaries, who use their services to expand their reach and overcome some of their limitations.

*“The private sector, especially consultants, tends to be more proactive and focused on bringing innovative products to the market.” - A10*

*“Consultants have their 'carrot,' which is the profit goal, making them agile and investing in acquiring more tools and information. They do not suffer from the inertia that public intermediaries have.” - A17*

*“(regarding traditional intermediaries' limitations of resources and their distance from the companies) (...) hence, there is a market failure resulting from traditional intermediaries' limited resources and distance from companies. Consultants have monetized this failure, and while they may be mercenaries, they are effective. If we want the job done correctly, we have to pay for their services.” - A19*

## **Opportunity for the NIS**

In light of the aforementioned perspectives, the Portuguese NIS perceives an opportunity in the role of private consultants. The idea of complementing the performance of other intermediaries arises from the evolving relationships that various system agents, including traditional intermediaries, have developed with private consultants. Many have used these consultants to facilitate and improve the increasingly complex TT processes and, consequently, enhance the outcomes to be taken to the market.

*“They are complementary. Here at the TIC, we have ongoing projects involving dozens of companies, universities, and even other consultants. These two-year projects have scopes of activities worth millions of euros. No leading organization can control everything. Therefore, it is always ideal to have a neutral third party involved to take responsibility for the project, while researchers and companies do what they must do.” - A08*

*"(...) I cannot picture any TTO or TIC operating without consultants. Nevertheless, the opposite is also true." - A02*

*"Not only are consultants and public healthcare systems complementary, but they cannot exist without each other. For example, the National Health Service and private clinics are dependent on each other. It would be impossible for the public system to meet all needs without outsourcing private support." - A06*

*"They are complementary. I find it challenging for them to function without us (TIC), and us without them. If we had more resources, the story might be different. However, the issue is that the private sector always pays better. So, the best individuals doing projects always end up going to the market, to private companies or private consultancies." - A09*

There is a perception of each agent's reach, mainly among intermediary players, whether private or public. Hence, there is increasingly a relationship of complementarity rather than mutual exclusivity (i.e., competition) between traditional intermediaries and private consultants, although there is some overlap in roles. The recognition of each player's limitations has given rise to organic specialization in the NIS, where the traditional intermediary maintains its position where it has the most significant value (in proximity to academia) and uses the services of private consultants as subcontractors or partners to enhance the TT process and its outcomes for all stakeholders involved.

*"More of an opportunity than a threat. We see private consultants as strategic partners that can add value, specifically by taking advantage of their unique competencies and creative proposals. (...) We appreciate them for their specific expertise and their networks." - A13*

*"TT stakeholders have different speeds, positions, language, bureaucracy, and proactivity. Therefore, private consultants are an opportunity. They are essential to the Portuguese NIS." - A15*

*"Upon further reflection, traditional intermediaries have a different objective that does not coincide with private consultants. (...) In my opinion, private consultants are an opportunity, (...) but traditional intermediaries already have an established role within the NIS." - A16*

*“Of course, private consultants will compete with us at some point, but it will depend on the size and supply of the organization. I feel there is always something missing in our projects. We do not manage them as well as we could.” - A12*

#### **5.4.2 Residual overlapping**

The fundamental answer to the question, as summarized by A04, is that private consultants and other intermediaries *“are more complementary than competitive”*. However, there are some areas of overlap or *“intersections”* (A04) between the roles of private consultants and other agents. As previously discussed, some public and academic intermediaries recognize their limitations and may view private consultants as a potential threat. Nevertheless, they see private consultants as a strategic opportunity to address their limitations (A07) and to specialize in a role closer to academia (A16).

*“Yes, I suppose private consultants are competitors to the OTIC<sup>7</sup>. But we would never achieve these results with OTIC alone. I think private consultants are much more of an opportunity, and they bring the work previously prepared to us, so we typically focus on dealing with the bureaucracy (service contracts and consortia, etc.) with the polytechnic and leave them to execute the project.” - A07*

*“I recognize that there might still be overlapping of functions, but I think it is a common matter of the free market. Little by little, each intermediary will eventually specialize in their own part.” - A16*

#### **Levels of competition**

Some interviewees recognize that private consultants represent a strategic opportunity for complementarity, but they may also pose some level of competition, depending on the perspective. This perception may stem from comparing the theoretical roles attributed to each type of intermediary in the literature alone. However, in reality, the actual roles played by intermediaries may differ from their

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<sup>7</sup> OTIC – *“Oficina de Transferência de Tecnologia e Conhecimento”*, can be directly translated as a “Technology and Knowledge Transfer Workshop”. It is a commonly known designation given to TTO mostly found in Portuguese polytechnic institutions.

theoretical descriptions. As a result, it may be difficult to fully understand the competition among intermediaries based on interviewees' responses alone.

*“They are both competitors and complementary. There is always some kind of competition. Everyone wants to do everything. Knowing how to decide who does what is the key to success. Every organization has strengths and weaknesses; we must leverage them to create a winning team.” - A11*

*“They are false competitors. Theoretically, both have the same roles, but in practice, they do not.” - A01*

Other participants believe that there is some competition between public intermediaries and private consultants, but they view it as a beneficial aspect of a free-market dynamic. In a free-market environment, organizations compete to deliver the most value, and private consultants may offer services that traditional intermediaries cannot provide, thus creating greater value for the innovation market.

*“(…) despite overlapping roles, competition is beneficial; that is how everything ends up evolving.” - A14*

*“I know that university TTO might also do a lot of what private consultants do. But we know the best resources are where the money is. Proof of this is that if there was no market demand for it, there would not be so many consultants. As much as we want them to, public intermediaries cannot respond to all the needs in the market.” - A19*

### **Role specialization possibilities**

Finally, some interviewees, particularly those from the industry, argue that private consultants and traditional intermediaries may not compete or complement each other, as they play entirely distinct roles. These interviewees view public and private intermediaries as different players with separate specializations within the same intermediary role (A18). This idea is reinforced by the understanding that different intermediaries and value propositions may serve different parts of the projects or even different market segments. Thus, despite overlapping roles, they do not represent any form of competition in the NIS (A19).

*“They are clearly different. We have access to several public organizations, technology centres, and other intermediaries, which sometimes also provide consultancy and project management services. But in this case, they are focused on acquiring and developing knowledge. Then there are external and private entities (i.e., consultants) that are dedicated to project management. In my opinion, I think that mixing the two concepts is not good for anyone, as it might result in a conflict of interest. They are completely complementary.” - A18*

*“(regarding the non-overlapping roles) (...) it might be because the type of customer that goes to the public intermediaries is not usually the same segment that goes to the private sector (i.e., consultants).” - A19*

## **5.5 External factors**

The involvement of private consultants as intermediaries in innovation and TT projects, as discussed in previous questions, follows a free-market logic. Therefore, the decision to involve a private consultant in the process can be influenced by a variety of factors. Participants were asked what other external factors could influence their decision to hire or involve a private consultant. Several interviewees found it difficult to answer this question unassisted. On the one hand, they were unable to distinguish the impact of factors internal to consultants (such as roles and value proposition) from the impact of other external factors on the decision to involve an intermediary in the TT process. On the other hand, the involvement of private consultants in ITT projects is already established and systematized in their organizations, and therefore, the decision seems to become a habit or routine (A17).

To avoid biasing participants' responses, additional tangible examples were not provided. Even so, six main types of external influence that could affect the decision to involve a private consultant in a TT project from several interviewees were selected:

- The sector of activity and geographical zone;
- Business interests;
- Time factors - pace and urgency;
- Occupation and limitations of stakeholders;
- Financial resources and the size of companies;
- Financial opportunities.

### **5.5.1 The sector of activity and geographic zone**

The most easily identifiable factor by respondents that can influence their decision to choose a private consultant as an innovation intermediary within TT projects is the sector of project activity itself. Each sector of activity presents specific challenges, different players, and different demands from companies.

In the Portuguese NIS, most consulting firms present some type of specialization, *"usually sectoral and/or geographical"* (A01). This means that depending on the sector of activity of the project and the geographical region where it will be developed, different consulting firms might be better suited than other general traditional intermediaries as they have specialized knowledge within the sector and a network of contacts to support the project.

*"Sectors that require specialized development and/or improvement of processes, and regions with similar needs, tend to look more for the private consultants." - A04*

*"The sector of activity and the maturity of the technology greatly influence the type of development of the idea, the speed (a.k.a. pace), the financing obtained, and even market entry. Some consultants have previous experience we can benefit from." - A13*

The geographic location of private consulting firms is often tied to their network of contacts, with many operating within their region of origin. As networks of contacts with other agents of the NIS are crucial for creating and maintaining relationships with companies, geographic proximity, along with the sector of activity, is widely recognized as key factor in the decision to involve private consultants as intermediaries in innovation processes (A14).

*"Factors such as geographic proximity are crucial. Collaborative experiences have also been fostering closer relationships between public entities and private consultants." - A14*

### **5.5.2 Business Interests**

The proximity relationship, which refers to the existence of previously established contacts and relationships with certain companies and stakeholders, especially those with good results, tends to lead companies in such networks to maintain relationships with known consultants. Having trusted partners with whom they have had previous good experiences or heard good references creates loyal relationships.

This loyalty can be the basis for companies to look for or even recommend the involvement of certain private consultants with whom they already have experience and confidence (A08). Companies are organizations that do not like uncertainty (A08), so it is in their best interest to maintain partnerships with those they know and can expect certain outcomes from.

In the Portuguese NIS, companies involved in TT projects, usually the recipients of innovation, tend to be the lead promoter and the stakeholder with the greatest importance. Therefore, their mere reference or trust in a private consultancy firm carries great weight in the final decision, even when other public and academic stakeholders are involved in the consortium.

In projects that aim to push R&D results to the market, R&D centres, and even traditional intermediary agents (e.g., TTO and TIC) are the ones who strategically look for the consulting firm with the best contacts to reach companies with the greatest potential for receiving the technology (A08).

*“(...) there is a preference for a private consultant as soon as a (recipient) company request it.” - A06*

*“It is difficult to make things happen without good consultants. (...) When talking about involving a recipient company, especially if we do not have previous experience or a relationship with them, a consultant is always the most suitable option. With a consultant present, we can always talk freely as they mediate both interests and expectations.” - A08*

### **5.5.3 Time factors – pace and urgency**

Time is a key resource for companies, and it tends to be scarce for most of them. This factor was also highlighted by the interview participants who emphasized its importance from different perspectives.

Firstly, the speed or pace of work of an intermediary. In previous questions, it was clear that companies and academia have different paces, leading many companies to feel the need to involve an intermediary agent with a management and work pace that is similar to that of their organizations (A17, A19). As such, many companies prefer to involve and pay a private consultant to work with them side by side than to be dependent on the academia's pace and schedule.

Secondly, the project phase. Like any other process, each temporal phase of the TT project presents different challenges and requirements. Therefore, there are phases where private consultants are preferred for their skills and expertise (A04, A08). Different phases might necessitate different kinds of intermediaries. The idea of complementarity between various types of intermediaries, both public and

private, gains importance from this perspective, as each intermediary is used according to its specialization (A09) to meet the challenges of each phase.

Lastly, the third perspective focuses on the level of technology maturity of the innovation, which is akin to a technology/product lifecycle. As with project phases, each maturity level might require different support activities. During the interview, several participants, especially those with closer ties to academia and traditional intermediaries, acknowledged that private consultants' involvement could be useful in specific technology maturity levels, mostly higher levels (A02). According to the Technology Readiness Levels (TRL) scale, traditional and public intermediaries are more engaged in lower TRL, where there is greater uncertainty in the technology (A16). Private consultants, however, are typically involved when the innovation takes shape, i.e., in higher TRL, and there is an interest in preparing the innovation for launch in a financially viable manner by involving the market (A01).

*“Private consultants are called in when academic needs are relatively more mature, and there is already a more concrete product to work with.” - A06*

*“When the project is still very fundamental, we (an academic research entity) get the grants and some funding. But when you start to demand more concrete results, as in the demonstrators<sup>8</sup>, we must involve companies, and things get complicated. Typically, that is when the consultants come in handy to help us bridge the gap in the market. But everyone has their own role, and the important thing is that they all do it well.” - A09*

*“I would say that fundamental R&D projects, which entail more uncertainty, are more likely to be fulfilled by the public intermediaries. Private parties are only interested in getting involved when there is true potential for technology transfer. (...) I find private parties to be most involved in more market-oriented actions.” – A16*

### **Urgency and perceived risk**

The sense of urgency was also found to be a factor when deciding to involve private consultants in the TT project. The level of urgency is linked to the importance attached to the project by its key

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<sup>8</sup> “*Demonstrators*” are a type of funded TT projects that aim to create a pilot product or solution using new technology or R&D results that are not yet available on the market. These projects are implemented in a recipient company to conduct performance tests and demonstrate the potential of the technology to other companies within the sector.



stakeholders. When the risk perceived by companies with the TT project is high or there is urgency involved, hiring a private consulting firm is viewed as a "safe bet" (A18) since they possess more expertise or experience in the matters and are recognized/referenced within the market for that same reason (A02).

*"(...) but more importantly, is the time resource, urgency, and involvement expectations in the project from the part of the company. If it's something important that needs to get results as soon as possible, they come to private consultants." - A01*

*"Often it is a show-off strategy, as it is well-seen to put a high reputation private consultancy firm collaborating with a public entity. It gives the project a more robust and trustworthy appearance." - A02*

#### **5.5.4 Occupation and limitation of stakeholders**

Concerning the roles of private consultants as intermediaries, it was noted that one of their primary functions is to relieve their clients and project stakeholders from tasks that may be peripheral to the core innovation. Thus, in the context of external factors, the decision to engage private consultants may also be influenced by the business level of their clients and other stakeholders. In this way, consultants help to overcome the limitations of the organizations involved in the TT project. They perform tasks and duties in a more specialized manner, thereby maximizing the core outcomes of the project by freeing up another member of the consortium (A17).

*"Consultants come to free us from unnecessary tasks. Paperwork, payment requests, dissemination events. When we must deal with too many peripheral responsibilities, the best thing to do is to subcontract." - A11*

*"An intermediary might enter a project as a partner, focusing on the development and technical competencies, or it may enter with a more commercial nature focused on the fundamental objective of enforcing the management and objectives of the project. These are different approaches. This, I think, is an increasingly natural trend and obvious, since, depending on the company, they might not be able to dedicate entirely to what the project demands. As such, outsourcing a private consultant to work part of the project as if it were from our own team is a strategic decision to make." - A18*

As such, private consultants, in addition to their intermediary role, are often perceived as being more willing to take on extended responsibilities as temporary specialized workers to fulfil tasks that other stakeholders cannot or do not want to do.

### **5.5.5 Financial resources and the size of companies**

#### **Financial resources**

As discussed earlier, in the face of limitations and difficulties, private consultants always end up becoming a preferred quick solution, according to most of the interviewees. However, private consulting firms, being for-profit organizations, have higher costs that vary depending on their level of expertise and market recognition. Therefore, not every organization, whether a company or academic entity, facing a TT project might have the financial resources to pay for such services.

Another external factor mentioned in the interview that can determine whether to hire a private consultant is the financial capacity of the lead or decision-making entity. If the company or contracting entity has the financial capacity, it is often seen as desirable to hire private consultants as specialists to perform their specialized roles (A17, A18, A19).

*“(...) the financial capacity of a company is what dictates what a company can or cannot do. As with any investment, hiring a consultant can be perceived as an investment. (...) Are they more expensive? Yes. But for me, they sure are worth our money.” A19*

*“There is always a benefit in involving a consultant, but this implies a lot of additional costs. Consultants come to the decision when there is already something concrete that we want to do, and we need them to make it happen. But of course, only if we can finance it.” - A17*

On the other hand, companies, and organizations without the financial capacity to hire services from private consultants for their ITT projects have limited options. They tend to opt for other, less expensive, and even free solutions, such as smaller private intermediary agencies. Typically, small companies go for semi-public entities with strong links to academia or other more traditional entities such as TTO and TIC (A08, A17).

*“(...) we know that the best resources lie where the money is. Proof of this is that if there was no market demanding it, there would not be so many consultants. As much as we want them*

*to, the public (intermediaries) cannot give a response to all the needs of the market. This resulted in a market failure that consultants began to monetize. They are mercenaries so to speak. But good mercenaries. If we want the job done right, we must pay for it.” - A19*

### **Company size**

The size or dimension of a contracting organization also poses a factor weighing in the decision of involving private consultants as TT intermediaries, alongside their financial capacity. Large organizations, mostly due to their financial resources, prefer hiring a private consultant (A04, A17). This is either because they want to rest easy with the work carried out by a specialist (A17, A19) and dedicate themselves to the core activities aligned with their strategic objectives, or because the notoriety and recognition that some consulting firms present within a sector of activity can guarantee, in part, a greater impact, recognition, and dissemination of the project (A08).

In contrast to these ideas, smaller companies, like start-ups, tend to have strong connections with universities and incubators. Not only due to the lack of financial resources, but they also maintain their relationship with more formal intermediaries within the NIS.

*“I would say that whoever goes to public intermediaries may be mostly start-ups, micro-companies, or researchers with technologies that are not yet ready-to-market products. For small or more fundamental R&D projects, public institutions are ideal partners. In the rest, if a company wants results and the product on the market to generate revenue, it has to pay for it.” - A19*

### **5.5.6 Financial opportunities**

Finally, an external factor that is intrinsically linked to the key role that has stood out in previous discussions is the support for financing. As previously discussed, the emergence and evolution of private consulting firms' role within the NIS seem to be associated with the existence and requirements of innovation policies, particularly programs designed to fund or financially incentivize innovation practices in the Portuguese market. As discussed in the literature review, Portuguese programs incentivizing innovation and technology development are being fostered by consecutive European Union directives and policies.

From several discussions throughout the interviews, the role of consultants as the single most important intermediary when it comes to financing ITT projects emerges as a specialization of these consultants, who keep up with an external factor by meeting funding program requirements and

timetables. By providing their intermediary role and specializations, consultants increase their perceived value proposition, which revolves around a central offer to their clients: financial support to get the project through (A01, A19). This possible association with these programs and policies might mean that the demand for private consultants as innovation intermediaries might change when funds are not available (A03, A07).

*“Consultants are always on top of these matters (i.e., financing options). If there is an opportunity for us to apply a project idea to a national or European funding program, they will make it happen. They go through project ideas and partners that fit the program objectives to make sure proposals get a high rate of approval. The existence of public funded programs to be unveiled is without a doubt an external factor.” - A07*

*“If there are incentives for investment, it is vital to take advantage of them”* (A19). This idea is recognized by several interviewees who understand that *“there is still little innovation culture in Portugal”* and that *“company decisions tend to depend on existing financing options”* (A10). Consequently, several intermediaries, both public and private, have begun to specialize in understanding these policies and programs to foster innovation, as well as in writing proposals for these programs. Private consultants have become recognized as the preferred intermediaries when it comes to identifying and obtaining financial support opportunities for companies' investments in innovation, R&D, and consequently in TT projects (A16).

One of the main factors that influence the decision to hire private consultants as innovation intermediaries is the availability of funding opportunities. Consultants can support their customers in obtaining funding from national and European programs that offer financial incentives for business innovation projects. As long as these programs are available, there will be consultants specializing in finding, designing, and submitting ambitious project proposals with business entities and the scientific system (A01, A17).

## **5.6 Private intermediaries' recognition in NIS**

The last question of this semi-structured interview aimed to complete the analysis of the interviewees' perception of private consultants as innovation intermediaries in the NIS. Specifically, it sought to understand the perceived positioning of consultants within the NIS by examining the recognition these private intermediaries receive from other players and policymakers heading the Portuguese NIS.

To facilitate the interview participants, the question was divided into two shorter and more direct questions. Firstly, it sought to identify whether the interview participants recognized private consultants' role as innovation intermediaries. Secondly, it aimed to define the opinion of the interviewees regarding the recognition that private consultants' role as innovation intermediaries might receive from Innovation Policies and the decision-making level in the NIS. Participants were allowed to further elaborate on their answers.

In summary, the sample of entities interviewed, as agents within the NIS, recognized the consultants as having a role as innovation intermediaries. However, there is a perception that private consultants are not properly recognized as intermediary agents of innovation at the political level heading the Portuguese NIS. This lack of formal recognition as innovation intermediaries is perceived to be reflected in the design of innovation policies, programs, and initiatives launched in Portugal (A15).

During the further elaboration on the recognition of consultants, some interviewees raised questions and discussed the reasons behind their perceived low recognition. Furthermore, they proposed ideas on how the involvement of private consultants could be regulated and improved, and what the implications of such changes could be. The analysis of this final question was divided into four main points, in line with the research aims:

- Peers' recognition;
- Not properly recognized by NIS;
- Distinguishing intermediation roles from consulting services;
- The last line of application for innovation incentive policies.

### **5.6.1 Peer recognition**

About the first part of the question, the majority of the interviewees demonstrated recognition of private consultants' role as innovation intermediaries within the Portuguese NIS. They perceive consultants as actively performing key intermediary functions alongside other agents. Overall, most players in the system openly recognize and value private consultants as TT intermediaries.

The interviews revealed that all participants exhibited some level of familiarity and knowledge regarding private consultants, with some even considering them as a strategic opportunity for the system (A02, A04, and A06). The exponential emergence of new consultancy firms has led to greater familiarity among several NIS players with the presence of consultants in the market (A07, A09). It is perceived that

market demand highly influences this recognition, with companies being the most likely to value and recognize private consultants in their role as innovation intermediaries.

*"I think companies tend to look more highly on consultants than universities and TTO."*

- A11

*"In my field of work (engineering), all entrepreneurs I know regularly work with private consultants. (...) innovation can take many forms, not just in product technology. By working with strategy, marketing, or internationalization consultants, we gain valuable insights that accelerate our results and give us greater confidence to invest in innovation." - A19*

Despite the greater recognition from the industry sphere, the continued emergence of private consultants in the market has made their presence a common sight for most types of players in the NIS (A07). The familiarization with both private consultants and their role has also obtained some level of recognition from more traditional intermediaries who increasingly interact and collaborate with consultants to find synergy opportunities (A08).

*"I see consultants all over the place, so I think it is good for them. But consultants are often perceived as self-interested, as they are always around our ideas. But after building a good relationship with them, I believe that perception eventually falls apart." - A07*

*"It is difficult to discuss financed TT projects with recipient companies without involving a consultant." - A08*

The notion that the recognition of private consultants as TT intermediaries might be dependent on the current political ecosystem and the decision-making level in the NIS was emphasized. This perception suggests that the use of the term *"recognition"* by some interviewees might be informal, being more related to their own opinion as individuals with professional experience rather than to the systematic vision of the organization they represent (A08, A16).

*"I believe consultants have gained more recognition, but it depends on the political cycle. The guidelines may favour either the public or private sector, depending on the government in power." - A16*

### **Informal recognition**

It is, therefore, possible to identify an informal perspective regarding recognition by other NIS agents. Some consultants feel like they are operating in a grey area or *"shadow"* (A01) of the NIS where, despite not having the proper credentials, they maintain their role as innovation intermediaries. On the one hand, companies demonstrate greater recognition and appreciation of the consultant's role. On the other hand, other players (mostly public or semi-public) show some *"institutional distancing"* (A02) from their consultant partners, even though they know and work with different consultants regularly, as they are the legitimate intermediaries recognized by the system.

*"Companies recognize it, but the public system does not. That is, they may consider it as a player, but maybe they do not give them importance in TT that they should have." - A12*

*"Consultants are recognized by their peers in the public sector, but they are not directly involved in strategic formulation or policymaking. However, they may have indirect involvement due to their close relationships with universities and sectorial associations." - A15*

*"They are recognized, but not necessarily in the way they intend to be. I foresee the future involving the creation of a club of consultant suppliers, comprised of only the good ones. Consultants are becoming increasingly vital, even for state organizations, as they are always involved in projects, initiatives, funds, and studies." - A17*

### **5.6.2 Not properly recognized by NIS**

This *"institutional distance"* (A02) between public and academic entities and private consultants is also perceived by other respondents as a result of the lack of formal/official recognition of private consultants' role by the NIS. Some respondents linked to academia (A04) and government innovation entities (A16) highlighted relevant theories regarding the importance of increasing interactions with various external agents, such as the concept of Open Innovation (Bogers et al., 2018; Chesbrough, 2003).

However, they perceive that there is no formal recognition of private consultants as innovation intermediaries by the government and decision-making entities at the top of the NIS.

*“Consultants are not properly recognized in public policies or by entities governing the national innovation system. However, with the increase in the diversity of innovative agents and the complexity of the innovation process, consultants will tend to be increasingly recognized and used.”* - A04

Interviewees mentioned a kind of misalignment of national innovation policies with the reality operating within the system. This is reflected in the financial incentive programs and funds to support R&D and innovation projects, which regularly involve the participation of companies in a TT perspective. According to the opinion of the agents interviewed (A02, A07, A18), the lack of recognition from policymakers regarding private consultants as intermediary agents acting beneficially within the NIS is reflected in the design of these innovation policies and programs.

This lack of recognition translates into policies, programs, and incentives that fail to mention or include the participation of private consultants in projects as innovation intermediaries. As a result, most expenses, and expenses that TT stakeholders (i.e., companies, universities, and traditional intermediaries) might have with consultant's services tend to be ineligible for incentives and not accepted for reimbursement.

However, most interviewees related a different reality in which consultants' services are still used, nevertheless. In some cases, the consultant's involvement is entirely charged to the recipient company of the TT project, even if they were not the originating leaders of the projects. In other cases, private consultants' involvement is more diffuse, as TT stakeholders use grey areas of program regulation to get them involved, even if it means *“bending the law”* (A07).

*“I think consultants are not recognized by policies. For instance, project management support provided by external consultants is not reimbursed by national or European directives.”*  
- A18

*“The mentality of public agents (i.e., recognition) has been changing, but it is still not reflected enough in the financial incentive programs, which force consultants to work less transparently.”* - A02



*"I don't know if the government recognizes consultants as it should. Perhaps they should facilitate the public contracting processes of university offices regarding consultants. This is just an example because the cheapest option does not always mean the best, and sometimes we have to bend the law to ensure the expected results." - A07*

Despite operating in the "shadow" (A01) of the NIS, private consultants continue to flourish within the national innovation market, including being highly involved in very large and expensive projects and programs promoted by the public sector and government (A14). In this fact, it is identified that the system, although unofficially, recognizes the professionalism and specialization of the strategic involvement of private consultants in supporting their innovation projects. The involvement of private consultants in the NIS also suggests that there are needs/gaps that are not being adequately addressed within the resources currently and officially recognized by the system. If so, the NIS has an opportunity to learn from the role of these private consultants (A10).

*"I am not sure if the NIS recognizes consultants as it should. We should learn from the private sector and better train public institutions to facilitate their interaction with private players." - A10*

*"The regulators (e.g., the local government) do not officially recognize private consultants, but they tend to involve them, nevertheless. Unfortunately, the national TT strategy still assumes that the necessary skills and competencies for TT exist within universities." - A14*

*"Everyone recognizes the importance of consultants in the ICT sector, but we cannot be seen as 'official.' Perhaps it is the consultant's role to stay in the shadows and deliver results to their clients." - A01*

## **Playing in the grey area of NIS**

Private consultants in Portugal are perceived as having an intermediary role that operates in a grey area of the system, as previously analysed. Despite not being formally recognised by the system,

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<sup>9</sup> Portuguese contracting processes within public system tend to give more weight to the price of a service proposal than other criteria. Meaning that many times services contracted are from consultants who can compete with lower prices.

some interviewees believe that their presence and recurrent involvement in innovation and TT projects can be considered as a form of recognition of their importance to the system.

*“Consultants, in a way, represent the interests of the company that hires them. In Portugal, if we talk about financing and innovation, it always involves some kind of consultant. So, from that point of view, that is a kind of recognition.” - A11*

*“It seems to me that everyone knows what consultants are and what their role is. Perhaps the government fails by not adjusting financing programs to take into account the expenses of consultants. They want companies to make investments and take risks, but from the moment we start writing a project proposal, we are already paying for a set of activities that will not be eligible for reimbursement.” - A19*

Most interviewees who have previously led innovation and TT projects have had their consulting services' expenses denied reimbursement. As a result, many of these project promoters, who are mostly recipient companies, end up paying private consultants without any incentive, despite acknowledging their vital role in the innovation and TT projects (A18). Consequently, many express dissatisfaction and push for recognition of the expenses associated with specialised consulting in innovation projects as part of the innovation activities that should be hired from specialised intermediaries (A17, A18).

However, other interviewees with more experience in funded projects, both national and European, are beginning to notice some evolution in the innovation programs. There appear to be some minor shifts towards the possibility of involving the work of private consultants as innovation intermediaries in funded projects in an eligible way.

*“I think programs are starting to recognize consultants, as there are increasingly more eligible categories of consulting expenses.” - A06*

*“It is necessary to increase the possibility of sharing our expenses with consultants. The entities that manage funds in Portugal are not like the European ones. When we have European projects, expenses with consultants are many times recognized and eligible. I think those responsible for financing programs in Portugal have not yet realized that companies are often dependent on consultants.” - A08*

*“If we look at the European Union, within the H2020<sup>10</sup> program, there were more opportunities for private consultants because consulting expenses are better seen and eligible. Should the government reinforce the eligibility of some program lines in Portugal to accommodate consultants? I do not feel that there is a need to reinforce them, as consultants ultimately benefit from their involvement and effect in projects.” - A16*

*“(…) but the involvement of private consultants still depends on the type of funding program or the existence of public contracting opportunities.” - A01*

### **5.6.3 Distinguishing intermediation roles from consulting services**

On the other hand, some of the interviewed participants downplay the need for formal recognition of private consultants' role as innovation intermediaries by the NIS. They suggest separating and distinguishing the concept of an innovation intermediary from the role of private consultants, as there are also liberal professionals responding opportunistically to market needs, and systematic gaps, by developing and providing various specialised consulting services to make a profit. Thus, private consultants could be considered any partner to whom services can be subcontracted (A18).

Nonetheless, the same interviewee representing a group of industrial and technological companies perceives consultants as a distinct kind of innovation intermediary - a soft innovation intermediary. This perspective emphasises the need to separate technical roles (i.e., hard innovation) from management roles (i.e., soft innovation). According to the interviewee's experience (A18), incorrect involvement of intermediaries can lead to bias in the objectives and results of the projects themselves.

*“When you hired a private consultant, whose objective should be executing the general management of the project, I see it more as just a firm that is being subcontracted for this purpose alone, rather than as a project development partner.” - A18*

*“From my experience, whoever manages a TT project should not be involved in R&D intermediation, and vice versa, otherwise there will be a bias in the results and, therefore, a conflict of interest.” - A18*

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<sup>10</sup> Horizon 2020 (a.k.a. H2020) was the EU's research and innovation funding programme from 2014-2020 with a budget of nearly 80 billion euros.

The idea of distinguishing roles and agents is not a new concept in literature (Howells, 2006; Intarakumnerd & Chaoroenporn, 2013; Zajko, 2017). However, some interviewees found it difficult to identify the boundary between an intermediary entity with a concrete and formally recognized role and a professional partner firm executing high-impact roles in a TT project. Furthermore, private consulting firms, like public and semi-public intermediaries, can exhibit great variation in their roles (as discussed in previous questions). The impact of private consultants' roles, as well as their level of involvement and access, as external and unregulated entities, raises questions and concerns about their recognition as traditional intermediaries (A09, A13, A14).

*"Everyone (i.e., different intermediaries) specializes in something. But it is hard to know who the best option is since they all seem to offer the same services." - A09*

*"I am not able to say whether they are recognized or not. Consulting companies are very different from each other, but there is always some consultant involved in any initiative we do. They are partners and must continue to be partners." - A13*

### **Regulating the market for intermediaries**

When asked about their opinions on the recognition of private consultants, participants were allowed to further elaborate on their views. The most common perception was that the future of private consultants would involve their role as innovation intermediaries, ultimately achieving official intermediary status. However, despite a convergence of opinions and proposed solutions to recognize consultants as innovation intermediaries, many highlighted the need to develop some form of accreditation to regulate their practice (A04, A06, 012).

The need to regulate private consultants stems from the diverse value propositions and perceived output quality of firms in the market. The creation of a concrete accreditation (A06) would enable NIS players to select from a pool of screened and regulated private consultants with specializations/roles recognized and accredited by state regulators.

*"Due to the diversity of these agents, it is difficult to outline general measures. However, public policies must be created to reinforce the role of these agents (i.e., private consultants). For instance, we could develop some kind of criteria for the inclusion of this type of agent within project consortiums financed by public entities." - A04*

*“There should be some kind of prior accreditation - for example, by the ANI<sup>11</sup> - for the control and evaluation of consultants, through an advising platform with information such as the team's constitution, previously approved projects, and reviews.” - A06*

According to some interviewees, the main implication of this idea is the need for greater transparency in the involvement of private consultants in financed projects. The idea is to create conditions conducive to due recognition and regulation of their role within the system, in line with the evolution of innovation policies. With proper accreditation and regulation of consultants' role as innovation intermediaries, the expenses related to their participation in financing programs could be recognized and eligible. The regulation of private consultants should be in line with project outputs, as their participation and performance should be properly evaluated (A14). These regulations and accreditation could benefit all stakeholders in the NIS, as the decision to involve a private consultant would be less risky and transparent.

*“The participation of consultants should be more transparent, and their expenses should be eligible in the project. This way, the process would be clearer. I would propose to regulate the involvement of entities with their consultants because current regulations are impractical since they almost force you to be less transparent.” - A12*

*“The participation of private parties should be clear and transparent through the evaluation of their performance.” - A14*

*“It would be important to make the process more transparent and reward those who do not regularly use innovation incentives to fund their day-to-day operations. However, I'm afraid that by creating a verification process of real innovation consultants, we may be creating another bureaucratic layer. (...) It's almost like that idea of who will guard the guards themselves?” - A15*

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<sup>11</sup> ANI is the Portuguese National Innovation Agency. ANI is responsible for promoting knowledge transfer in order to create value for the national economy, establishing priorities and defining indicators focused on supporting the adoption of knowledge and technology by companies and society.

#### 5.6.4 The last line of application for innovation incentive policies

It is still relevant to highlight the idea that underlies several opinions and proposals to regulate and accredit the role of private consultants within the NIS. This idea is based on the perception and vision of some interviewees, who consider the role of private consultants to be of great importance to the system, with both micro and macro impacts. Private consultants (A01) see themselves as playing an active role in applying innovation policies and funds. Companies also appreciate the proactive role of consultants in creating and encouraging innovation opportunities in the market, which can impact not only individual companies but also entire sectors of the economy (A17, A19). Private consultants play a key role in keeping up with regulations and enforcing them in the market, both through guidance and by applying the funding programs designed by the state.

*“They are an opportunity, and they are agents playing a fundamental role in the interconnection of agents of the national innovation system.” - A04*

*“Innovation incentive programs and other financing policies and instruments fail by being thought from the top-down. (...) They should be designed together with consultants since we know the reality in the market.” - A01*

A17 identified an opportunity to foster the strategic involvement of private consultants in a complementary way, working in mixed teams with academic and traditional intermediary entities. The idea is to take advantage of consultants' expertise in management to professionalize the innovation and TT process. A strategic decision by NIS decision-makers to involve private consultants in a controlled manner could contribute to the effective marketing and capitalization of innovation and TT outcomes. The aim is to prevent great ideas from ending up in the *“back of the drawer”* (A17) after project funding runs out.

Researchers and traditional intermediaries often move on to the next funding opportunity, leaving previous projects' results and outputs improperly implemented in the market and stuck in the *“valley of death”* (Lindström & Silver, 2017), where they are too mature to receive R&D funding and yet too intangible (i.e., not ready to market) for recipient companies to invest in. Therefore, getting consultants' expertise in product management and marketing early in the TT process could support the effective launch of project results into the market in the form of new products, technologies, or knowledge, and thus enhance the success rate of TT to the market and society.

*“It seems to me that after the regional entities that manage the funds, it is up to the consultants to distribute and apply such funds and programs in the companies.” - A08*

*“They are innovation agents because they take the product to the market. Since they are close to the recipient companies, they know how to deal with them and how to get them to invest in innovation.” - A10*

*“(...) it is necessary to realize the potential of creating mixed teams. They can be both academic and technical, but they must have professional management almost like companies. With private consultants roaming freely within the triple-helix, we would see a lot more projects implemented in the market.” - A17*

## **5.7 Role Specializations**

All the roles previously identified and discussed during the interviews with various stakeholders in the NIS emerged as top-of-mind awareness roles or were logically correlated with the line of thought of the answers. To conduct a more in-depth analysis of the roles of private consultants as innovation intermediaries, the list of thirteen key role specialization identified in the literature review was used (Table 3, p. 72).

The table below summarizes interview answers regarding the intermediation roles of innovation and TT that respondents recognized in private consultants through assisted notoriety<sup>12</sup>.

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<sup>12</sup>Assisted notoriety (a.k.a., aided awareness) refers to products/services/brands whose name interviewees do not remember spontaneously but that they can immediately identify them if, and as soon as, they are presented (Laurent et al., 1995; Romaniuk et al., 2004).

Table 12 – Results of the assisted list of intermediary’s role specializations

| <b>Role specializations</b>            | A01 | A02 | A03 | A04 | A05 | A06 | A07 | A08 | A09 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19 | <b>%</b> |
|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| Policy & Strategy                      |     |     |     | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 5%       |
| Mediation & Mobilization               | 1   | 1   | 1   |     |     | 1   |     |     | 1   |     | 1   |     | 1   |     |     |     |     |     | 1   | 42%      |
| Knowledge Diffusion & Support          |     | 1   |     |     | 1   | 1   |     |     |     |     |     |     | 1   |     | 1   |     | 1   |     | 1   | 37%      |
| Funding & Finance                      | 1   | 1   | 1   |     | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 95%      |
| Technology Scouting & Market Foresight | 1   | 1   | 1   | 1   |     | 1   | 1   | 1   | 1   |     |     | 1   |     |     | 1   | 1   | 1   |     | 1   | 68%      |
| Design & Idealization                  | 1   | 1   | 1   |     |     |     |     | 1   | 1   |     |     | 1   | 1   |     | 1   |     | 1   |     | 1   | 53%      |
| Brokering & Gatekeeping                | 1   | 1   |     |     |     |     |     |     |     |     |     |     |     |     | 1   |     | 1   | 1   | 1   | 32%      |
| Project Management & Assessment        | 1   | 1   | 1   |     | 1   | 1   | 1   | 1   | 1   |     | 1   | 1   |     |     | 1   | 1   | 1   | 1   | 1   | 79%      |
| Financial & Technical Feasibility      | 1   |     | 1   |     |     | 1   | 1   | 1   | 1   |     |     | 1   | 1   |     |     |     | 1   | 1   | 1   | 58%      |
| Accreditation & Quality                |     | 1   | 1   |     |     | 1   |     |     | 1   |     |     | 1   |     |     |     |     |     | 1   |     | 32%      |
| Intellectual Property & Rights         | 1   | 1   |     | 1   | 1   |     |     |     |     | 1   |     |     | 1   | 1   | 1   | 1   |     |     |     | 47%      |
| Implementation & Knowledge Transfer    |     |     |     |     |     | 1   | 1   |     | 1   |     |     |     |     |     | 1   |     | 1   |     | 1   | 32%      |
| Marketing & Business Development       | 1   |     | 1   | 1   | 1   |     |     | 1   | 1   |     | 1   | 1   | 1   |     | 1   | 1   | 1   | 1   | 1   | 74%      |

Thirteen intermediary’s role specialization were presented to the interviewees, and they were asked to indicate whether they had experienced or perceived each role being performed by private consultants as intermediaries, providing a yes or no answer. As the research was qualitative in nature and the sample size was small, the results were not statistically significant. Nevertheless, given the relevance of the interviewed participants, the results provided valuable qualitative insights into the research objectives and should be thoroughly analysed. Six role specializations could be highlighted, as they were pointed out by more than half (50%) of respondents:

1. Funding and Finance (95%);
2. Project Management and Assessment (79%);
3. Marketing and Business Development (74%);
4. Technology Scouting and Market Foresight (68%);
5. Financial & Technical Feasibility (58%);
6. Design and Idealization (53%).

After analysing the content of several interview questions that had more open-ended responses, the researcher identified a slightly different set of six key roles that were mentioned by the participants. These key roles were identified as follows:

1. Project Management and Assessment (PMA);
2. Funding and Finance (FF);
3. Design and Idealization (DI);



4. Mediation and Mobilization (MM);
5. Technology Scouting and Market Foresight (TSMF);
6. Financial & Technical Feasibility (FTF).

The top two roles identified in the study were Project Management and Assessment (PMA) and Funding and Finance (FF). PMA was ranked first because project management support, responsibility, and proactivity were highly valued by most of the interviewees (A01, A02, A17, A18, A20), according to the researchers' interpretations of the interviews. FF was ranked second not because of the number of mentions but just because interview participants considered it to be important when the subject was directly discussed.

The third key role identified was Design and Idealization (DI), which was considered to be important by companies, research centres, and interface institutions (TIC). This was because consultants played a crucial role in developing project scopes that responded to the needs of all stakeholders, from researchers to recipient companies, and even financing entities.

In fourth place, but perceived as very close to the third position, were Mediation and Mobilization (MM), as the consultants' role in building project consortiums using their networks was highly recognized (A07, A08, A10, A12).

The roles of Technology Scouting and Market Foresight and Financial & Technical Feasibility (TSMF) were ranked lower on the list, reflecting the specialized nature of these roles. TSMF was mentioned by participants from academia (A05, A07, A08, A11, A12) and by private companies and consultants (A02, A03, A17, A19), who valued the consultants' ability to provide technology scouting and marketing intelligence research, freeing up project stakeholders to focus on other areas.

Economic knowledge to validate project ideas and results from a marketable perspective was also regarded as a specialized role that was hard to find, both within companies and in traditional intermediaries (A03, A04, A08, A14, A18). The interviewees highly regarded the market knowledge of consultants, but the specific role specialization of Marketing and Business Development (MBD) did not appear in the top six since its mention during the interviews was not as significant.

It is also worth highlighting the significance and importance that many interviewees placed on the proactive and continuous work of private consultants in maintaining relationships and accessing knowledge through their networks, not just as a hired service but as an inherent characteristic of their role. Some interviewees (A01, A02, A17) saw this role as having a high impact on TT and NIS dynamics. As consultants become increasingly embedded in these systems (A06), they can go beyond their

traditional functions of mediating project stakeholders and mobilizing groups and consortiums during projects. This activity is regarded as part of their proactivity, as they proactively increase their role in maintaining and fostering their contacts to keep up with companies' needs and research pipelines, continuously finding opportunities to make innovation and TT projects that suit all parties (A01).

## **5.8 Preliminary discussion**

The analysis of 19 interviews conducted with various players and stakeholders of the Portuguese NIS revealed that private consultants have already established themselves as innovation intermediaries within the system, even though they are not yet officially recognized as such by NIS decision-makers. As a result, private consultants are currently absent from strategies and programs aimed at promoting innovation. Overall, the qualitative study, conducted through semi-structured interviews, allowed for a theoretical exploration of knowledge that was in line with the research objectives of identifying and understanding the role of consultants in TT projects.

Additionally, the study identified other factors related to consultants' value proposition that could motivate their involvement in such projects and explored the recognized impact of consultants as innovation intermediaries in the Portuguese NIS. While much of the literature tends to group different types of agents under the umbrella concept of “innovation intermediary”, it is important to recognize the complexity of understanding the multiplicity and heterogeneity the functions and activities that each intermediary agent may perform. The qualitative analysis of the data collected in the interviews allowed the identification of a set of traits and characteristics that define the roles and specializations that private consultants may offer in the innovation market alongside other intermediation agents, particularly traditional ones.

The main roles played by private consultants were explored in the analysis of the interview results, which revealed a wide range of specializations that were properly aligned with the thirteen roles outlined in Table 3. It is worth noting that, according to the qualitative analysis, there were two levels of role identification. First, there was the identification of roles within the context of answering the questions posed and within the narrative of other development issues. This followed a “top-of-mind awareness” logic, which is aligned with the theory of consumer psychology (Karlán et al., 2016; Laurent et al., 1995), where interviewees naturally mentioned roles more relevant to them, from a set of options more accessible from their memory without much thought.

Second, through a direct question for them to recognise (i.e., yes, or no) from a list of innovation intermediation roles presented as an aid, which followed a logic of aided awareness (Laurent et al., 1995;

Romaniuk et al., 2004). By presenting this list to assist participants' memory, several additional roles were pointed out by the participants as also being part of the offer and specialization of private consultants. Still, many of these roles were only identified by the participants after the interviewer presented them as an option. While these roles were also confirmed, interviewees had less awareness of them, as they could not identify them spontaneously within the narrative of the previous responses of the interview (i.e., by top-of-mind).

The results of the interviews revealed different perspectives, but it is important to consider whether the participants' backgrounds (i.e., their entities) influenced their responses. Comparing the identified roles from the assisting list with the overall results of the interviews, some differences were found. Analysing the results' table (Table 12) as a heatmap<sup>13</sup>, a concentration of responses can be observed, with more roles being identified in both extremes of the table. The left columns showed responses from private consultants and the right columns from recipient companies, suggesting that there may be some correlation between the two, as they are both private organisations, from an industry-helix perspective.

However, as this was a qualitative research method, some discrepancies were found in the interview content analysis, particularly about the highest-regarded role of Funding and Finance (FF). Public and hybrid institutions, such as universities, TTO and TIC, gave more significance to the FF role played by consultants, as they are seen as vital in accessing public funds to fuel TT projects. In contrast, private entities, such as consultants, recipient companies and semi-public associations, showed a superior appreciation of the role specialization of Project Management and Assessment (PMA). As TT is a systematic process with different dimensions and players, it can be theorized that the roles played by a private consultant as a private intermediary may vary depending on the client typology. In other words, the entity that originated the TT project and is the key responsible for the consultant's involvement might influence the roles to be played by the consultants later.

The interviews revealed that the role of the intermediary as a concept is complex and that it goes beyond the specific services and functions performed. The qualitative approach showed that it is not possible to truly understand the role and involvement of an innovation intermediary solely from the tasks performed by them in a TT process. Interviewees perceived the importance of the value proposition of the private consultant as an innovation intermediary as not just a "role", but a set of role specializations and other motivators. Several additional aspects and factors, such as intrinsic characteristics, attitudes,

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<sup>13</sup> Heatmap is a data visualization technique that shows the magnitude of a phenomenon as colour in two dimensions.

and resources, were found to contribute to the defining and understanding of the consultant's role as a concept. The “proactivity” and “responsibility” with which consultants tackle their functions, as well as the competencies of their personnel, the size and quality of their contact network, and even the existence of financing opportunities, were all found to be key factors weighing on private consultants perceived value proposition and highly influencing the decision to hire a private consultant to the detriment of another traditional intermediary.

In particular, the highest regarded characteristic of consultants' performance was their proactive attitude towards their network. Consultants work to build their network of contacts, identifying opportunities for TT both upstream and downstream, and acting as a catalyst to maintain stakeholders with a continuous pipeline of innovation and TT projects. Due to their for-profit profile, consultants seek to work more closely with businesses as they are their potential clients. They work in an innovation “demand-pull” dynamic (Godinho, 2003; Rothwell, 1994; Silva, 2003), seeking to identify innovation needs and technological gaps in the products and processes of companies that could be answered through TT projects.

However, this proactivity may be fuelled by the economic interests of the private consultant and might be specially directed towards potential paying clients such as recipient companies. It should also be considered whether this consultants' proactivity is limited to their contact networks, with which they have previous experience, or whether they are actively expanding the reach of their innovation catalyst effect. The extent to which consultants are proactive in catalysing new TT projects should also be explored to better understand their role as project originators. Additionally, projects in which the originating entity has a previous interaction with the consultant might be influenced by the type of organizations originating it, as both consultants and stakeholders seem to prefer working with players with whom they have had previous good experiences.

The second research objective of this study was to identify the key motivations, reasons, and factors that contribute to the value proposition of consultants, leading to their involvement in TT projects. The findings suggest that maintaining a strong contact network is a decisive role specialization for consultants. In particular, their proactiveness in keeping in touch with previous clients (both private and public) appears to be the basis of most new TT projects. However, this idea requires further research to be fully validated.

Moreover, the study identified several external factors that may influence the decision to involve a private consultant as an innovation intermediary instead of a traditional one. The motivations varied from the need for funding or technical support in managing financed projects, mainly mentioned by

business entities, to the supply of contacts for project consortia, as highlighted by academic, research, and technology intermediation entities. Due to their different realities and specific needs, different types of entities may have different perspective on the value proposition of private consultants, and they may involve them for different reasons/motivations.

In general, the lack of formal recognition of consultants' role and positioning as innovation intermediaries in Portugal is a concern, as discussed in this study. However, all agents interviewed acknowledged the increasing trend of entities seeking the help of consultants to respond to innovation and TT gaps, especially through accessing funded opportunities. Although private consultants' value proposition may not be fully understood, *"they are here to stay"* (A03) and their role in TT processes is expected to continue growing, mainly fostered by private entities.

Two different perspectives emerged from the interviews conducted. Public and academic interviewees confirmed that consultants complement their value proposition and often act as partners in several TT projects alongside traditional intermediaries. However, they expressed concern about the possibility of consultants' roles intersecting with those that should be solely provided by traditional intermediaries, leading to competition. On the other hand, private entities, such as consultants and companies, emphasized the clear separation/distinction of roles, stating that traditional intermediaries' value proposition is only theoretical, as they lack resources to perform many of the roles. In these unfulfilled gaps, consultants are perceived to thrive, and therefore, they might not compete with traditional intermediaries. However, further research is necessary to fully understand private consultants' roles and compare them to the roles of traditional intermediaries.

**CHAPTER 6**  
**QUANTITATIVE ANALYSIS: CASE STUDY**  
**RESULTS**

## **CHAPTER 6 - QUANTITATIVE ANALYSIS: CASE STUDY RESULTS**

### **6.1 Sample descriptive analysis**

The second part of the research focused on collecting and analysing data from the document archive of a private consulting firm. The case study included 219 innovation and TT projects between 2014 and 2021, in which the consulting firm acted as an intermediary. To perform the analysis and statistical tests, IBM® SPSS® Statistics version 28.0 was used. This case study involved the systematic survey of document data in archives and utilized statistical tools based on a descriptive study through observed frequencies and bar graphs, given the qualitative nature of the variables involved.

The first part of the analysis, known as Sample Descriptive Analysis, provided an overall presentation and exploration of the sample processed through SPSS. This descriptive analysis provided a base context for the subsequent statistical analysis, which was aligned with the five research hypotheses formulated. The first part enabled a global perspective of the characteristics of the sample. In the second part of the qualitative analysis, a statistical analysis was conducted, specially designed to test the five hypotheses formulated and further deepen the understanding of the role of private consultants.

Through the quantitative analysis of the results from the document analysis of the case study consultancy firm, the data was presented in a synthesized way, particularly designed to directly respond to the needs of the research. Further elements resulting from the statistical testing conducted, such as raw tables and other outputs from SPSS, can be found and consulted in Annex II.

#### **6.1.1 Sector/Technology Domain**

To determine the scope of services provided by the case study and identify any areas of specialization, the sample of TT projects was analysed by identifying the product or technology being developed or transferred.

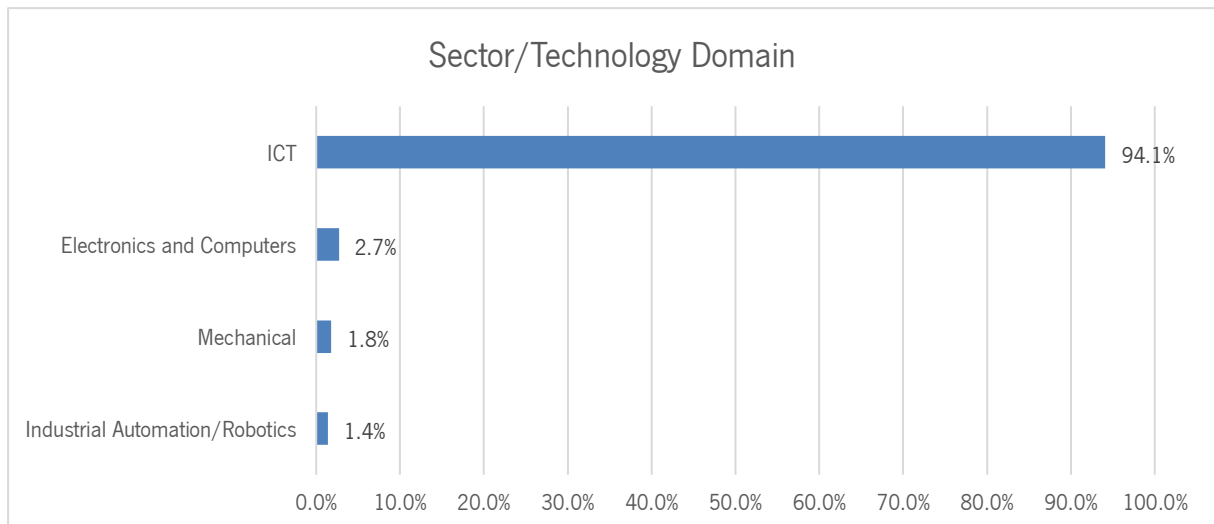


Figure 10 – Sector/Technology domains of the TT projects in the sample

Figure 10 shows the sector and technology domains of the TT projects in the sample. From a descriptive perspective of the sample, it is possible to identify a sector specialization towards digital technology domain projects, specifically within the scope of Industry 4.0<sup>14</sup>, such as Information and Communication Technologies (ICT), Electronics and Computers, and Industrial Automation and Robotics. These results support the discussions from the interviews which suggested that consultants were valued by their close network, and as such, typically develop their expertise in a particular field, sector, or technology domain.

In particular, the studied consulting firm demonstrated an overwhelming specialization in the field of ICT, which accounted for 94.1% of the total projects in the sample between 2014 and 2021. This evidence suggests that the consulting firm had a high level of specialization in its interaction with TT projects at NIS.

### 6.1.2 Entity originating the project

One of the key variables to be analysed is the entity that originated the project (*origin\_type*). Several authors describe consultants and KIBS as professional businesses known for adapting their characteristics and services to market needs (Canato & Giangreco, 2011; Costa et al., 2021), sometimes even client by client (Martinez et al., 2016). Additionally, interview results showed several disparities

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<sup>14</sup> Industry 4.0 – also called the Fourth Industrial Revolution, is the next phase in the digitization of the manufacturing sector, driven by disruptive trends including the rise of data and connectivity, analytics, human-machine interaction, and improvements in robotics.



between interviewees' answers. Through the analysis of the interview discussions, some possible patterns were identified by categorizing the entity each participant represented. Therefore, to better understand the role of consultants as innovation intermediaries in TT, their comprehension of their clients and TT stakeholders was deepened.

This frequency analysis did not focus on the paying customer since the studied consultancy firm's "modus-operandi" typically leaves this charge to the recipient companies, independently of which entity had originated the project. Thus, this variable focused on analysing communication records and CRM data to identify which entity came up with the project idea/opportunity and ended up contacting and involving the private consulting firm in the process. Out of the 219 TT projects analysed, more than half (58.4%) came from recipient companies (see Figure 11). This aligns with a market trend previously verified in the literature, the "demand-pull" (Jun & Ji, 2016; Laranja, 2009). Some interview participants also mentioned the idea, that the market (i.e., companies) is looking for opportunities to initiate technology transfer projects and do so by involving consultants.

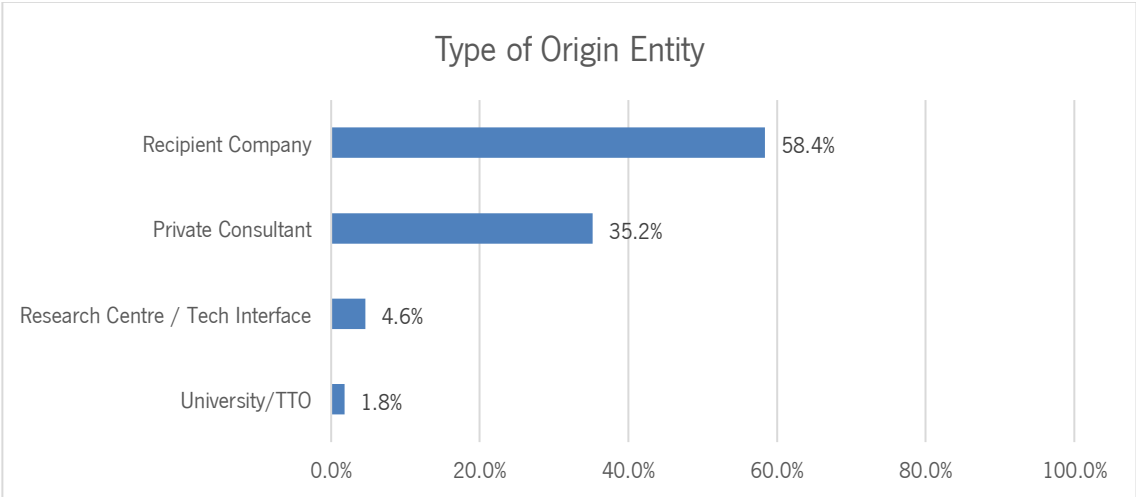


Figure 11 - Type of entities responsible for originating the TT projects

The second entity most responsible for originating technology transfer projects was the case study firm as a private consultancy. From the firm archives, in more than a third of the project sample (35.2%). The firm proactively came up with project ideas and opportunities, which were typically pitched afterwards to potential recipients (companies) and/or R&D partners, thus being the entity responsible for originating the technology transfer project. This single result greatly corroborates the discussion regarding the consultants' role as innovation catalysts and their highly valuable characteristic of proactivity debated by interviewees.

It should be noted that additional response options were defined and expected as originating entities, such as “other private consultants” and “other traditional intermediaries”. However, after data collection, no projects were found in the sample to have originated from other intermediaries (neither private nor traditional).

In this sample, it was still possible to identify projects originated by traditional/public entities, such as research centres & interfaces (4.6%) and universities & TTO (1.8%), in which the consultant was involved. Both entities pose as technology sources and intermediaries. However, in the CRM of the case study consultancy firm, these players appear merged as they can play both roles (i.e., sources and intermediaries). Even so, it is interesting to find that in only a residual part of the sample (6.4%), the project originated from these entities, which would appear to be following a more traditional process of innovation/technology push (Edquist, 2014). However, this descriptive result focuses on projects involving the consultancy firm, not allowing for the generalized comprehension of possible links between the involvement of private consultants and the TT projects approach – whether push or pull.

**6.1.3 Contact of the Source**

Intermediaries are often regarded as crucial network links between technology sources and recipients/users. The purpose of collecting this variable was to identify the party responsible for initiating contact with the main technology source in each TT project.

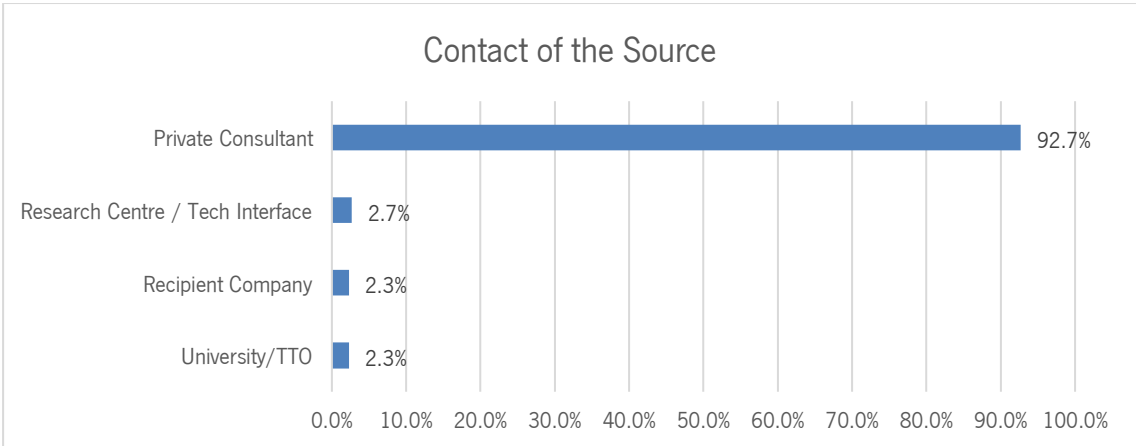


Figure 12 - Entity in the TT projects responsible for the technology source contact

Based on the data summarized in Figure 12, it was found that in 92.7% of the projects, the private consultant (i.e., the case study firm) was responsible for searching and intermediating the contact with

the technology source entity. Therefore, private consultants appear to play a strong gatekeeping role in accessing technology sources. In the remaining sample, the contact information for the technology source was primarily provided by other TT stakeholders, with an almost similar distribution.

### 6.1.4 Contact of the Recipient

Similarly, the collection of this variable aimed to identify the party responsible for procuring, selecting, and contacting the key recipient company (or companies) in each TT project. As shown in Figure 13, 58% of the TT projects within the sample were found to have a recipient company as the entity responsible for identifying and contacting the TT recipient company. However, this result is subjective because the previously presented descriptive results regarding the type of entities originating the project also showed that 58.4% of the TT projects were originated by recipient companies. Thus, this line of results cannot be considered conclusive because, in 58.4% of the sample, no contact with a recipient company was needed since the entity originating the project was the recipient company itself.

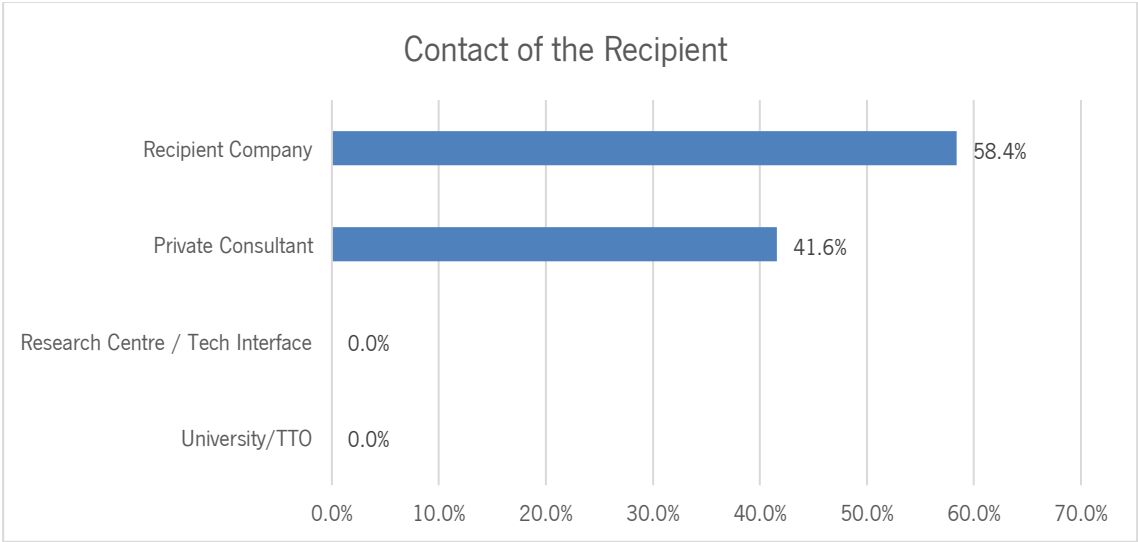


Figure 13 - Entity in the TT projects responsible for the technology recipient contact

In the remaining TT projects (41.6%), no other entity besides the private consultancy firm was found to be responsible for being the contact link with a technology recipient company. Therefore, in the sample, even for projects where the source entities originated the project, the private consultant was the intermediary responsible for searching and identifying companies in the market with potential and interest in the technologies to be developed/transferred. This result supports the ideas discussed in the

interviews, which mentioned the limitations of traditional/public intermediaries (A08) in reaching the market, which are sometimes addressed by involving or partnering with private consulting firms.

### 6.1.5 Projects within the consultant’s network

For each TT project in the sample, the originating entity, or the final client in the case of projects originated by the private consultant itself, was categorized as being within the consultant's network or not. The collected variable corresponded to the existence (i.e., yes, or not) of previous interactions, contacts, or experience with the case study private consultant.

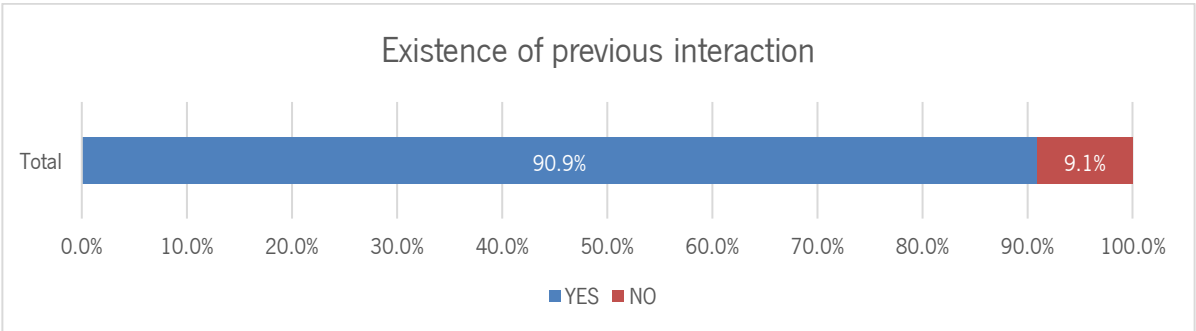


Figure 14 - Existence of previous interaction with the private consultants

The collected data revealed a strong first indicator against the consultant's proactivity to reach beyond its network. In Figure 14, the majority of TT projects analysed (90.9%) presented a key stakeholder (i.e., whether a client or the project origin) with a history of previous interactions with the private consultant. While this result could not entirely support or invalidate the proactivity argument discussed in the interviews, it did not verify the perspective presented by some interview participants regarding the consultant's market scouting (A08, A10) and proactivity in a constant search and reach beyond its comfort zone (i.e., their network).

However, in 9.1% of the TT projects collected, new contacts/stakeholders were reached without any history of previous contact with the private consultant. This part of the sample could provide a small validation to the interviews' discussion on consultants' proactivity and corroborate the literature's portrayal of consultants focusing on nurturing and monetizing their network of close contacts (Bettencourt et al., 2002; Martinez et al., 2016).

### 6.1.6 Key Motivations for consultant involvement

From CRM<sup>15</sup> and communications between the private consultant under the case study and the entities originating the project, or the final clients in the case of projects originated by the private consultant itself, key contact/lead motivations were recorded for future commercial analysis by the firm. This variable aimed to identify the key motivations leading to the contact and involvement of the private consultant in the TT projects. The sample was reduced to 142 TT projects as projects originated by the private consultancy firm itself were not considered.

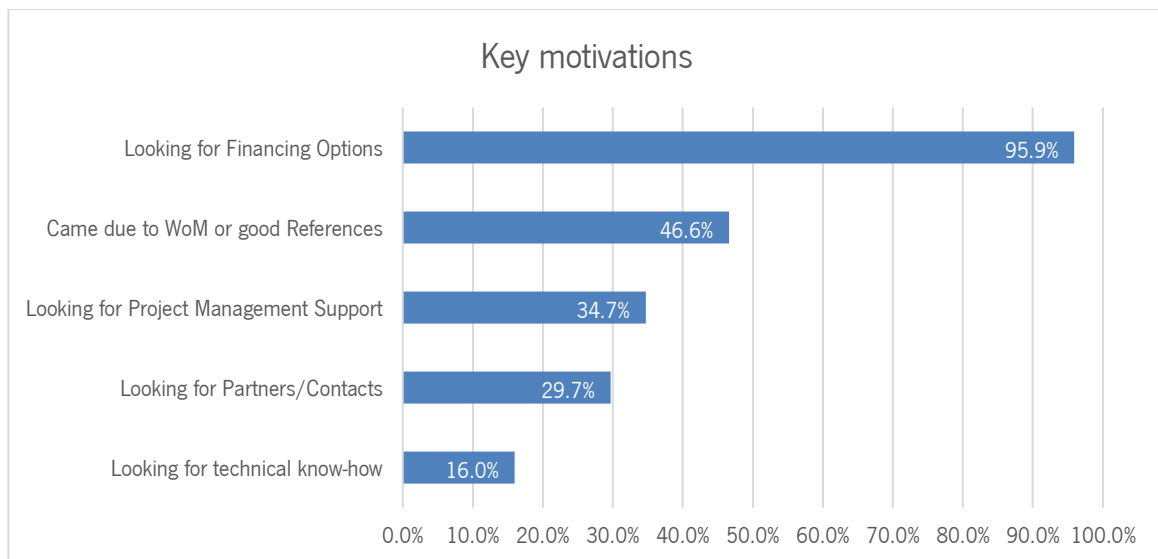


Figure 15 - Key motivations/reasons leading the contact or involvement of private consultants

After collecting and analysing the consulting firm's archives, one or more key motivations/reasons for the contact and involvement of the consultant were registered for each of the 142 TT projects. Five main motivations were found (Figure 15):

1. **Looking for financing options** – This motivation was present in 95.9% of the analysed projects. Private consultants are known for staying up to date with public funding program calls and other financial instruments that support or incentivize innovation developments. Many entities mostly reach out to private consultants seeking opportunities to finance their ideas and projects. This motivation is mainly an external factor as it depends on the financial incentives and innovation funds available. Many entities are motivated by the emergence of these financial

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<sup>15</sup> A Customer Relationship Management (CRM) is a software that helps track information and interactions between the company and their leads and customers.

opportunities to involve private consultants as they are perceived as experts who are up to date with the market's financing options.

2. **Came due to good references** – The contact/involvement of the consultant due to good references or previous good experiences was a motivation present in 46.6% of the projects/leads. In an innovation market filled with the most diverse range of players and services, many organizations (both private and public) have difficulty navigating and selecting the proper intermediary. As a result, many organizations involve private consultancy firms motivated by good references provided by other customers or by their own previous experience.
3. **Looking for project management support** – In more than a third of the sample (34.7%), the project-originating entity or key stakeholder opted to involve the private consultant to free themselves from the responsibilities and administrative burdens inherent to funded projects and the TT processes. This outsourcing of the consultant as a third party provides the TT project with an additional specialized ally. Also, it frees project stakeholders to fully dedicate themselves to hard innovation activities concerning the core technology to be developed/transferred.
4. **Looking for contacts/partners** – In about 29.7% of the sample, the consultancy firm was involved due to its network and resourcefulness to bring the right people/entities to respond to the TT project needs. The leads typically came looking for project support in scouting entities such as technology sources in academia, recipient companies in the market, or even additional partners to improve the project consortium.
5. **Looking for technical know-how** – Although less significant, 16% of TT projects presented this motivation. This focus on the market demands private partners with technical experience and expertise within the sector or regarding the technology to be transferred. Many entities are sceptical of involving a private intermediary without basic technical knowledge since even when not performing any kind of hard innovation role, intermediaries are expected to understand, communicate, and foster TT projects' core concepts. Also, on some occasions, recipient companies are not entirely familiar with the technology they are receiving. Thus, they look for an intermediary partner with the knowledge to champion their interests in the TT project (or consortium).

Based on a descriptive analysis of a sample of 142 TT projects, it is observed that entities tend to involve consultancy firms in order to mitigate financial risks associated with their innovation needs. This highly regarded value proposition in the market appears to be intrinsically linked and dependent on

external factors such as the frequency, dimension, and characteristics of innovation incentive policies and programs deployed within the Portuguese NIS. Without the existence of these funds and financial aid, the demand for private consultants would be greatly jeopardized.

The interviews revealed that the major motivations discussed were related to the need for financial advisory to navigate publicly funded programs. In addition, many interviewees expressed the desire to outsource the responsibilities and burdens that key project stakeholders do not want to bear to a competent third party. The collected data confirmed these motivations, and the case study also highlighted the importance of good references and previous experience with private consultants. Some interviewees (A1, A18) discussed how the perceived positioning and service quality of intermediaries greatly differ from one another. Consequently, they reduce uncertainty by following references from their trusted networks, maintaining business with entities with whom they have previously had good experiences working with.

However, even from the discussions within the interviews, the reasons, and motivations for organizations to work with private consultants varied greatly from interviewee to interviewee. The descriptive results of the sample alone do not allow for further elaboration on the relationship between motivation and the entities originating the TT projects.

#### **6.1.7 Collaboration with other intermediaries**

During the interviews, the existence of partnerships between private consultants and other traditional intermediaries was also discussed. They complemented each other by working together within TT projects. From the case study firm, two variables were collected from a sample of 219 TT projects:

- the existence/participation of other traditional intermediaries within the TT project;
- the existence/participation of other private intermediaries within the TT project.

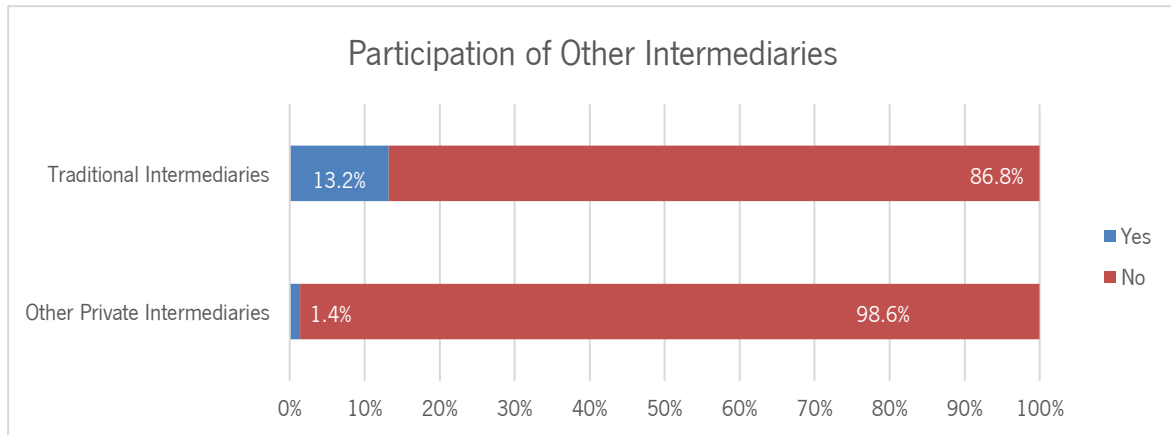


Figure 16 - Participation of other intermediaries alongside the private consultant

In 29 of the TT projects analysed (13.2%), a traditional intermediary was actively present and collaborated alongside the case study consultancy firm (see Figure 16). Mostly, the collaborating intermediary agents were TIC and academic TTO from universities and polytechnic institutes. These results confirm the accuracy of the reports collected during the interviews. However, while debatable, the subsample size where both private consultants and traditional intermediaries worked together is still not statistically significant, and thus cannot be generalized.

Furthermore, other private intermediaries (whether consultants or not) were also explored. However, this condition was only registered in 1.4% of the sample, which was too small to be considered in this research. This data may support the interview reports of private consultants acting as active promoters of open innovation across sectors and regions, but they also face strong competition among themselves (see A03, A14).

### 6.1.8 Roles performed by the private consultant

Examining the frequency of roles performed by the case study consultancy firm directly reflects the research's core. For each of the 219 TT projects in the case study, the performance of each of the thirteen intermediary's roles specializations identified from the literature review (see Table 3) was indicated as either "yes" or "no."



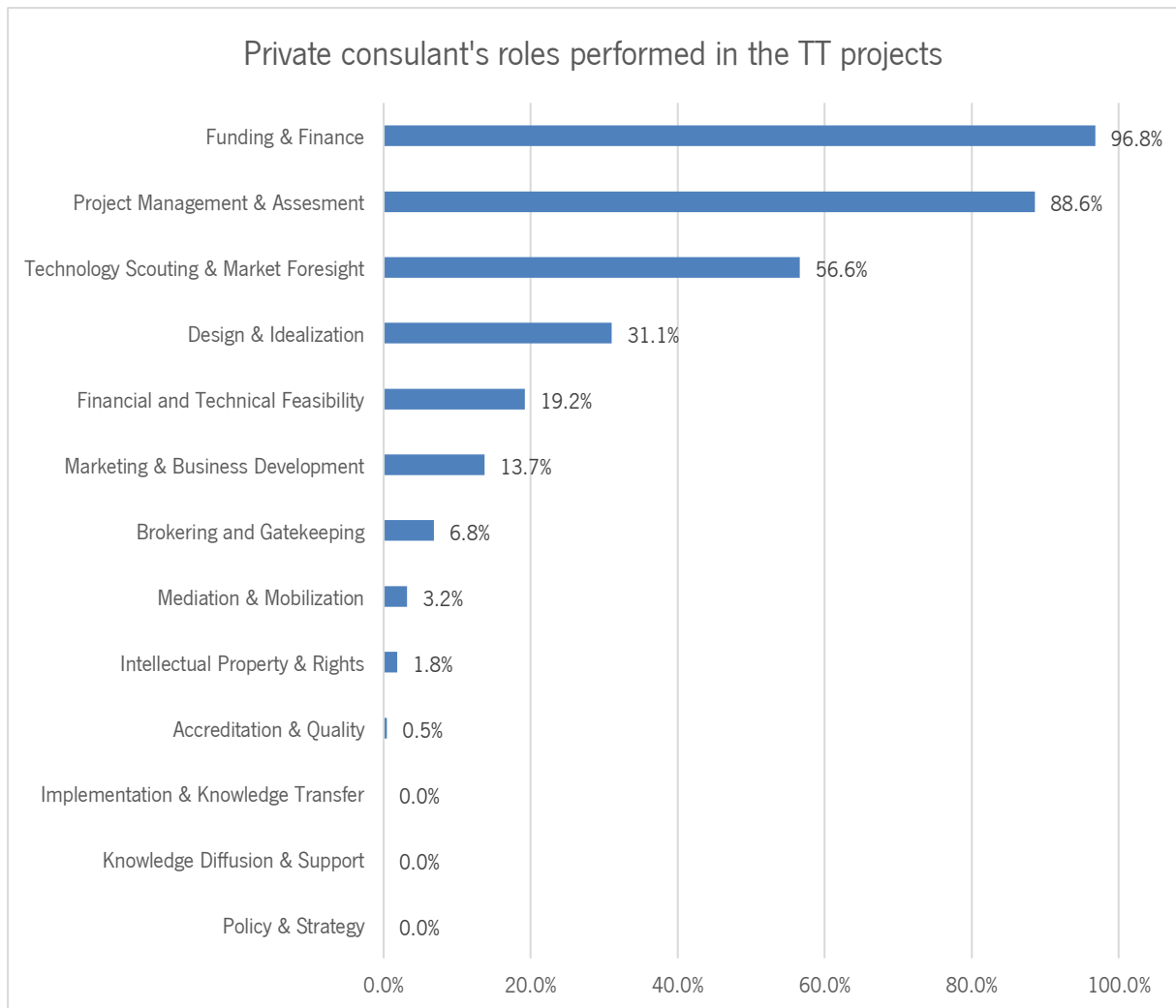


Figure 17 - Roles performed by the private consultant (case study firm) in the sample

From the descriptive analysis presented in Figure 17, the results can be divided into four main discussion perspectives:

- 1. The key roles;**
- 2. The common roles;**
- 3. The non-significant roles;**
- 4. The non-played roles.**

Firstly, the “**key roles**” can be highlighted, namely Funding & Finance (FF) and Project Management & Assessment (PMA), which were present in 96.8% and 88.6% of the projects, respectively. These were followed by the role of Technology Scouting & Market Foresight (TSMF), which was still considered a key role as it was performed in more than half of the sample (56.6%). These roles appear

to represent the core specializations of the private consulting firm under study. They are highly aligned with the interview results, both in open questions and the assisted table.

The “**common roles**” were those performed in a smaller number of the analysed TT projects, but which still had a significant weight within the sample. These roles demonstrated that the private consultant could perform them, when necessary, as they were present in less than a third of the TT projects analysed. They are Design & Idealization (31.1%), Financial & Technical Feasibility (19.2%), and Marketing & Business Development (13.7%).

Subsequently, there were also the “**non-significant**” roles, which although present in the sample, were considered residual and therefore, not significant, such as: Brokering & Gatekeeping (6.9%); Mediation & Mobilization (3.2%); Intellectual Property & Rights (1.8%); and Accreditation & Quality (0.5%).

Finally, it's also relevant to note that the sample results revealed a set of roles that the consulting firm in the case study did not play, “the **non-played roles**”. Specifically, in none of the TT projects within the sample was the private consultant found to be performing the roles of Implementation & Knowledge Transfer, Knowledge Diffusion & Support, or Policy & Strategy. These results align with the interview findings, as these roles were seen as more closely linked with traditional intermediaries.

Most of the more traditional roles mentioned in the literature (such as Brokering, Gatekeeping, or Mediation) seem to fall within some of last seven roles, both the residual (i.e., the “non-significant”) and the “non-performed”, representing a set of specialization domains that the case study firm did not address.

Therefore, despite marketing a broad value proposition as innovation intermediary, the private consultant does not focus on more than half of the roles in the framework of thirteen role specializations (see Table 3). It should be noted that these results are descriptive, and no assumptions can be made regarding the impact a hiring client might have on the services/roles performed by a private consultant. Additionally, these results do not consider other roles in the sample that may have been performed by other intermediaries or by the key TT stakeholders themselves.

Comparing the role' frequency results from the sample analysis of the case study with the results registered in the interviews, it is possible to highlight some differences. In the qualitative research phase (i.e., the semi-structured interviews), the thirteen-role framework in Table 3 was used as an assisted list, and the participants pointed out the roles they know or have experienced as being performed by a private consultant. The top six roles registered by the interview participants are greatly in line with the sample frequency results, as the exact same set of six roles was identified. However, some differences can be underlined from the Table 13 comparison.

Table 13 – Key roles comparison - Case study sample VS Interview’s assisted list

| # | Case study sample                     | %  | Interview’s assisted list             | %  |
|---|---------------------------------------|----|---------------------------------------|----|
| 1 | Funding & Finance                     | 97 | Funding & Finance                     | 95 |
| 2 | Project Management & Assessment       | 89 | Project Management & Assessment       | 79 |
| 3 | Technology Scouting & Market Forecast | 57 | Marketing & Business Development      | 74 |
| 4 | Design & Idealization                 | 31 | Technology Scouting & Market Forecast | 68 |
| 5 | Financial & Technical Feasibility     | 19 | Financial & Technical Feasibility     | 58 |
| 6 | Marketing & Business Development      | 14 | Design & Idealization                 | 53 |

The main two role specialization, Funding & Finance (FF), and Project Management & Assessment (PMA) are validated with similar frequencies. Despite the order, the role of Technology Scouting & Market Forecast (TSMF) also showed to have an equivalent response rate in both methods. However, there were more pronounced discrepancies in the remaining three roles. The role of Marketing & Business Development (MBD), seen as a highly regarded market advantage role, was identified by 74% of the interviewees, who perceived in it a great potential for the application of the consultants’ market knowledge. However, in the sample, the private consultancy firm performed this role in less than 14% of the TT projects within the sample. The roles of Design & Idealization (DI) and Financial & Technical Feasibility (FTF) were also performed at a lower rate than expected from the interview responses. Nonetheless, they were still among the set of six top roles performed in the TT projects under the sample.

### 6.1.9 Roles performed by other traditional intermediaries

To provide a more detailed analysis of the research discussion and results comparison, a highlight was made on the roles played by traditional intermediaries in each of the TT projects they participated in. However, a descriptive analysis for the entire sample was not conducted as the case study was focused on the private consultancy firm, also because the participation of another traditional intermediary was registered in only 29 TT projects. Therefore, a direct comparison between the two types of intermediaries would be biased. Nevertheless, a descriptive analysis of this subsample of 29 projects was conducted to gain a better understanding of the role of private consultants when collaborating with traditional intermediaries. The data collection involved identifying the thirteen roles developed from the literature review (p.72, Table 3).

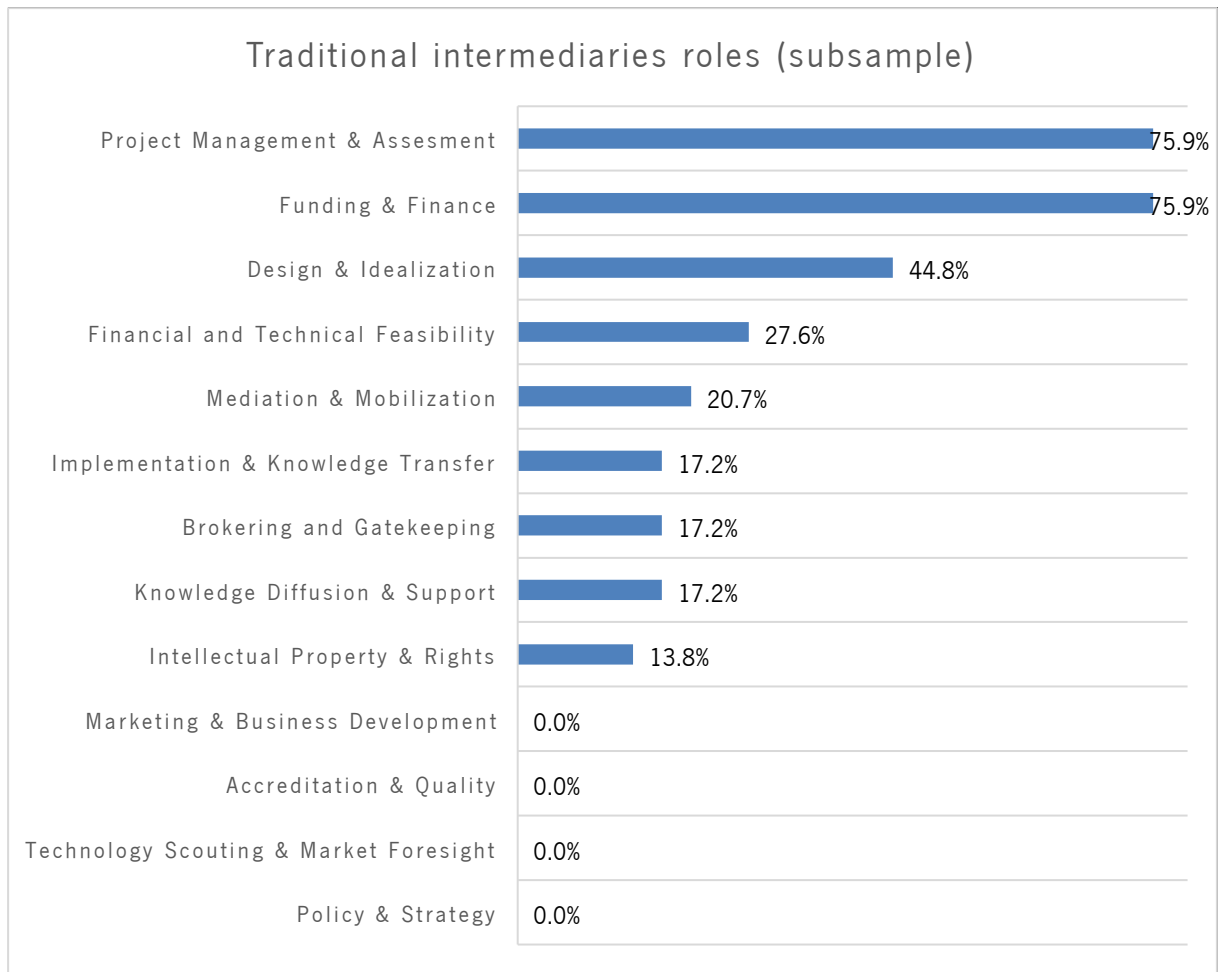


Figure 18 - Traditional intermediaries' roles (subsample)

In the subsample of 29 TT projects where traditional intermediaries had participated alongside other intermediaries, two key roles stood out: Funding & Finance (FF) and Project Management & Assessment (PMA). These roles were performed by a traditional intermediary in 75.9% of the projects within the subsample (see Figure 18), which suggests a potential overlap of roles between private consultants and traditional intermediaries. However, further research is necessary to draw conclusions.

Other roles had less significant presences, with the role of Design & Idealization (DI) being present in less than half of the TT projects (44.8%) and the Financial & Technical Feasibility (FTF) being present in just eight of the projects (27.6%). These findings partially corroborate the interview results, particularly where recipient companies (A17, A18, A19) recognized the quality of traditional intermediaries in conceptualizing technologies, testing pilot products, and conducting feasibility studies (A18).

The remaining roles had residual performance behaviours ranging from 13.8% to 20.7%. Roles such as Policy & Strategy (PS), Technology Scouting & Marketing Foresight (STMF), Accreditation and

Quality (AQ), and Marketing and Business Development (MBD), were not performed by traditional intermediaries.

Directly comparing the roles performed by the private consultancy firm in the total set of 219 TT projects with those of other traditional intermediaries should be avoided. Firstly, the roles performed by traditional intermediaries cannot be generalized to the global population due to the limited sample available, which might lead to biased results. Secondly, the behaviour of private consultants may differ when collaborating with traditional intermediaries. Thus, to explore the subsample of 29 TT projects where both private and traditional intermediaries collaborated, the roles performed by the private consultant were isolated for comparison.

There is a clear similarity between this subsample (29 TT projects) and the overall results from the main sample (219 TT projects). Comparing the roles between intermediaries in the subsample of 29 TT projects, two roles stood out: the roles of Funding & Finance (FF) and Project Management & Assessment (PMA). In the role specialization of Funding & Finance (FF), which was performed by both intermediaries, private consulting firm performed it in 27 projects (93.1%) while the other traditional intermediaries performed it in 22 projects (75.8%). The role of Project Management & Assessment (PMA) was also highly performed by both entities in the subsample. However, there was a considerable decrease in the private consultants' performance of PMA from the main sample, by 41 percentage points. In 29 TT projects, the PMA was performed by the private consultant in 14 projects (58.6%) and by other traditional intermediaries in 22 projects (75.8%).

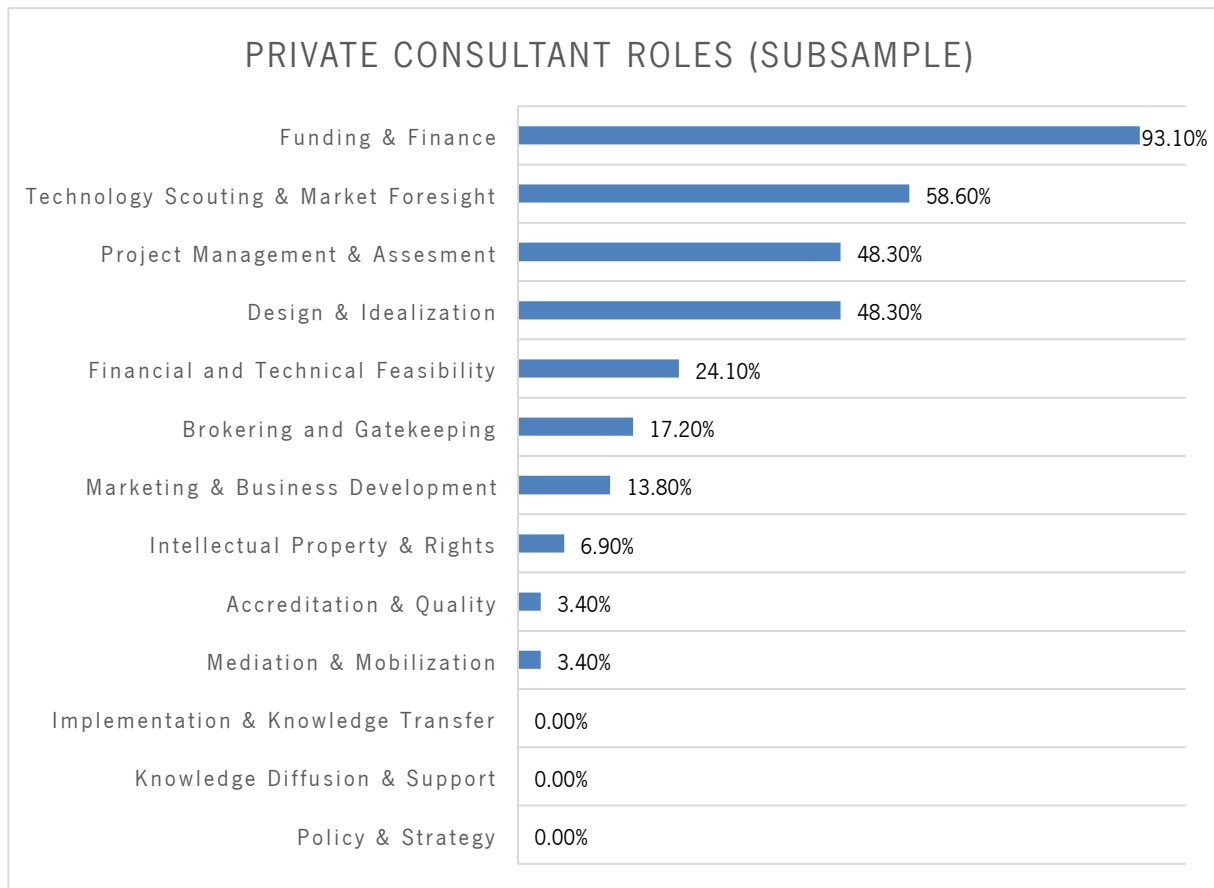


Figure 19 - Private consultant roles (subsample)

The results presented in Figure 19 suggest a potential overlap of roles between private consultants and traditional intermediaries, particularly in the role specialization of Project Management & Assessment (PMA). This is supported by the significant decrease in the performance of this role by private consultants from the main sample of the case study (219 projects), as shown in Figure 17. However, interviewees had differing opinions on the matter, with some viewing private consultants as a competitive threat to traditional intermediaries, while others see them as complementary opportunities. Some even believe that they play fundamentally different roles when collaborating on the same TT projects. Nevertheless, this descriptive analysis is insufficient to fully understand and validate such possibilities, as the data is based on the sample and not specific projects. Therefore, further research is needed to compare and comprehend this potential overlap and its implications.

## 6.2 Statistical Analysis – Testing Hypothesis

This section reports the results of the statistical tests conducted to support or reject the formulated research hypotheses. The tests aimed to verify the existence of associations between variables, and independence tests were used in contingency tables of the chi-square type. For the fifth hypothesis, a comparative study of pairs was conducted based on 2x2 tables, using McNemar's test for analysis.

The decision rule for all tests was to detect significant statistical evidence for probability values (i.e., test proof value) lower than 0.05. Raw tables and complementary outputs extracted from SPSS can be consulted and further analysed in Annex II.

### 6.2.1 Roles played by private consultants - H1 Tests

The first series of statistical tests aimed to establish a correlation between the private consultancy roles and the type of organization responsible for the project's inception. Through descriptive analysis of the case study sample, six key roles emerged as the most frequently performed by private consultancy firms in over 10% of projects (see Figure 17): Funding & Finance (FF), Project Management & Assessment (PMA), Technology Scouting & Market Forecast (TSMF), Design & Idealization (DI), Financial & Technical Feasibility (FTF), and Marketing & Business Development (MBD). Consequently, the statistical tests were based on these six key roles, while the remaining seven were considered residual and excluded from the tests.

Chi-square independence tests were conducted individually for each of the top six specialized roles, which confirmed, in five of them, a significant correlation between the role performed and the organization promoting or originating the project. Moreover, chi-square distribution tables were generated to demonstrate the different origin entities' responses regarding their roles' performance rate. This deeper insight into role disparities and patterns further fuelled discussion (refers to Chapter 7).

#### 6.2.1.1 Funding & Finance

The top-mentioned role in the interviews, Funding & Finance (FF) was performed by the consultancy firm on 96.8% of the studied sample. After carrying out the chi-square independence test, it was verified that there is a statistically significant association between the type of entity that originated the project (i.e., origin entity) and the consultancy performance of the role Funding & Finance ( $X^2(2)=8.032$ ,  $p=0.045<0.05$ ).

Table 14 - Distribution table - Role of Funding &amp; Finance

| <b>Origin Entity</b>           | Funding & Finance |            |            |
|--------------------------------|-------------------|------------|------------|
|                                | <b>No</b>         | <b>Yes</b> | <b>Qty</b> |
| University/TTO                 | 25%               | 75%        | 4          |
| Research Centre/Tech Interface | 10%               | 90%        | 10         |
| Recipient/Company              | 2.3%              | 97.7%      | 128        |
| Private Consultant             | 2.6%              | 97.4%      | 77         |
| <b>Total</b>                   | 3.2%              | 96.8%      | 219        |

By analysing Table 14, it becomes apparent that projects initiated or promoted by private entities (i.e., recipient companies and private consultancy) tend highly to involve the consultancy firm to perform the FF role. The content analysis of the interviews also reveals that private entities emphasize this role, confirming the results. Therefore, private entities are the main drivers of the consultancy firm's performance of the FF role when leading the TT projects. However, in the remaining sample, projects initiated or promoted by other entities (e.g., academia/public) also show a high tendency to involve the private consultancy firm to address this FF role.

#### 6.2.1.2 Project Management & Assessment

According to the literature (Cabral, 2018; Sismet, 1993) and the conducted interviews' results, PMA was a crucial role in the TT projects. The descriptive analysis of the case study sample shows that this soft innovation role was performed in 88.6% of the projects, highlighting it as a key value proposition of the consultancy firm.

Table 15 - Distribution table - Role of Project Management &amp; Assessment

| <b>Origin Entity</b>           | Project Management & Assessment |            |            |
|--------------------------------|---------------------------------|------------|------------|
|                                | <b>No</b>                       | <b>Yes</b> | <b>Qty</b> |
| University/TTO                 | 100%                            | 0%         | 4          |
| Research Centre/Tech Interface | 80%                             | 20%        | 10         |
| Recipient/Company              | 4.7%                            | 95.3%      | 128        |
| Private Consultant             | 9.1%                            | 90.9%      | 77         |
| <b>Total</b>                   | 11.4%                           | 88.6%      | 219        |



After conducting the chi-square independence test, it was determined that there is a statistically significant association between the original type of the project and the performance of the Project Management & Assessment role ( $\chi^2(2)=83.697$ ,  $p<0.001$ ). Private entities, such as private consultancy and recipient companies, shown to have a particularly strong association with the performance of this role in TT projects.

Recipient companies that initiate or promote TT projects tend to involve the case study private consultancy firm in the PMA role in over 95% of the cases (Table 15). Conversely, academic, and semi-public entities, such as universities and research interfaces, show a minimal involvement rate of the consultancy firm in this PMA role specialization. Therefore, the distribution table clearly shows a significant link between the entity type leading, or originating, the TT project and the private consultancy firm's performance of the PMA role.

*6.2.1.3 Technology Scouting & Market Foresight*

According to the interviews, Technology Scouting & Market Foresight (TSMF) was seen as an intermediation role in which private consultants have an advantage over traditional intermediaries. In the case study, over half of the projects in the sample (56.6%) involved the consultancy firm in tasks related to the TSMF role.

Table 16 - Distribution table - Role of Technology Scouting & Market Foresight

| <b>Origin Entity</b>           | <b>Technology Scouting &amp; Market Foresight</b> |              |            |
|--------------------------------|---|--------------|------------|
|                                | <b>No</b>   | <b>Yes</b>   | <b>Qty</b> |
| University/TTO                 | 25%   | 75%          | 4          |
| Research Centre/Tech Interface | 40%   | 60%          | 10         |
| Recipient/Company              | 46.9%   | 53.1%        | 128        |
| Private Consultant             | 39%   | 61%          | 77         |
| <b>Total</b>                   | <b>43.4%</b>                                      | <b>56.6%</b> | <b>219</b> |

However, after conducting the chi-square independence test, no statistically significant association was found between the type of entity that originated the project and the performance of the TSMF role ( $\chi^2(2)=1.845$ ,  $p=0.605>0.05$ ). Table 16 shows that despite the sample sizes, projects originating from academia (University/TTO) had the highest percentage of involvement from the

consultancy firm in the TSMF role, while recipient companies had the lowest involvement of the consultant playing this role (in percentage).

However, there is low variability in the performance rate of the TSMF role by the private consultancy firm across types of clients/project origins. This suggests that the TSMF role is widely recognized and demanded by different NIS agents within TT projects.

6.2.1.4 Design & Idealization

The interviews revealed that private consultants play a crucial role in TT projects beyond just providing soft innovation support. Some interviewees shared how private consultants contributed directly to the technical idea and design of the project (A08, A17). The involvement of the case study firm in the role of Design & Idealization (DI) was evident in almost one-third of the TT projects (31.1%), as confirmed by the sample descriptive analysis.

Table 17 - Distribution table - Role of Design & Idealization

| Origin Entity                  | Design & Idealization |              |            |
|--------------------------------|-----------------------|--------------|------------|
|                                | No                    | Yes          | Qty        |
| University/TTO                 | 50%                   | 50%          | 4          |
| Research Centre/Tech Interface | 60%                   | 40%          | 10         |
| Recipient/Company              | 78.9%                 | 21.1%        | 128        |
| Private Consultant             | 54.5%                 | 45.5%        | 77         |
| <b>Total</b>                   | <b>68.9%</b>          | <b>31.1%</b> | <b>219</b> |

The chi-square independence test revealed a statistically significant association between the type of entity that originated the project and the performance of the DI role ( $X^2(2)=14.434, p=0.002<0.05$ ). From Table 17, TT projects initiated or promoted by recipient companies were found to be less dependent on the private consultancy role of DI (21.1%). On the other hand, TT projects initiated proactively by the private consultancy firm (i.e., 77 projects) showed a higher likelihood of involving the consultancy firm in Design & Idealization (45.5%).

This finding aligns with the interview discussions regarding private consultants' proactivity in ideating and designing projects that could later be pitched as ready-to-implement solutions to recipient

companies (A19). The results also indicate that academic and traditional intermediary entities tend to seek private consultant support for the design of their TT projects.

6.2.1.5 Financial & Technical Feasibility

Interview participants highlighted the consultant's specialized role in testing the Financial & Technical Feasibility (FTF) of the technology or product to be transferred (A08, A018). However, the descriptive analysis of the case study sample showed that this FTF role was performed in less than one-fifth of the projects (19.2%).

Table 18 - Distribution table - Role Financial & Technical Feasibility

| Origin Entity                  | Financial & Technical Feasibility |              |            |
|--------------------------------|-----------------------------------|--------------|------------|
|                                | No                                | Yes          | Qty        |
| University/TTO                 | 50%                               | 50%          | 4          |
| Research Centre/Tech Interface | 60%                               | 40%          | 10         |
| Recipient/Company              | 75%                               | 25%          | 128        |
| Private Consultant             | 94.8%                             | 5.2%         | 77         |
| <b>Total</b>                   | <b>80.8%</b>                      | <b>19.2%</b> | <b>219</b> |

After conducting the chi-square independence test, a strong and statistically significant correlation was found between the type of entity that initiated the project and the performance of this FTF role ( $\chi^2(2)=17.761, p<0.001$ ). This correlation was particularly evident in projects initiated by the consultancy firm itself (Table 18). In these projects, the FTF role was performed much less frequently (just 5.2%) than in the other TT projects initiated by different entities, which might be related with consultant's focus on originating TT projects with previously checked financial and technical feasibility. Moreover, projects from academic and public entities had a higher rate of involving the consultancy firm in performing this FTF role specialization, which can be related with the fact that academy focus is on fundamental research with low Technology Readiness Levels (TRL), and thus with higher risks of not having market feasibility.

### 6.2.1.6 Marketing & Business Development

With a 74% response rate regarding the roles from the assisted list used in the interviews, the role of Marketing & Business Development (MBD) was highly regarded by the interviewees as the third most performed role by private consultants acting as innovation intermediaries. Despite innovation and management consultants being recognized for their market and business knowledge (Back et al., 2014), the consultancy firm in the case study sample only performed the MBD role in 13.7% of the TT projects analysed.

After carrying out the chi-square independence test, a statistically significant association was found between the type of entity that originated the project and the performance of Marketing & Business Development ( $\chi^2(2)=13.027$ ,  $p=0.005<0.05$ ). Consistent with the previous role distribution table, the MBD distribution table shows a lower tendency for projects originated by private companies (i.e., both the recipient companies and the consultancy firm) to have the consultancy firm perform the MBD role (Table 19).

Table 19 - Distribution table - MBD role

| <b>Origin Entity</b>           | <b>Marketing &amp; Business Development</b> |            |            |
|--------------------------------|---|------------|------------|
|                                | <b>No</b>                                   | <b>Yes</b> | <b>Qty</b> |
| University/TTO                 | 50%   | 50%        | 4          |
| Research Centre/Tech Interface | 80%   | 20%        | 10         |
| Recipient/Company              | 82%   | 18%        | 128        |
| Private Consultant             | 96.1%                                       | 3.9%       | 77         |
| <b>Total</b>                   | 86.3%                                       | 13.7%      | 219        |

The greater demand for the MBD role from academic and traditional entities when originating the TT projects might be associated with these types of entities being more inclined to follow a technology-push approach (Edquist, 2014).

### 6.2.2 Projects within the Consultant' Network – H2 Tests

The second hypothesis proposed that the involvement of private consultants in TT projects with lead entities beyond their current network is influenced by the type of entity that originates the project. This hypothesis was formulated to explore the proactivity perspectives discussed by the interview

participants. Descriptive analysis of the case study sample of 219 TT projects showed that in 90.9% of them, the private consultancy firm worked with lead entities with whom they had previous interactions and were therefore considered within their current network.

However, in just 9.1% of the TT projects, the consultancy firm established a completely new relationship with an entity beyond its usual network (e.g., client/partner). It is important to note that this 9.1% of TT projects with new contacts may not be solely derived from the consultancy firm's proactivity, as other variables should be considered, such as how many of these TT projects were not originated by the consultancy firm itself. An independence chi-square test was conducted to determine whether there was a significant link between TT projects involving entities within the consultant's network and the type of entity that originated the project, including the consultancy firm under study.

The results showed a statistically significant link between TT projects within the consultant's network entities (i.e., existence of previous interaction) and the type of entity that originated the project ( $\chi^2(2)=9.033$ ,  $p=0.029<0.05$ ).

Table 20 - Crosstabulation – The existence of Previous Interactions

|                                       |                             | Existence of a Previous Interaction |        |        |
|---------------------------------------|-----------------------------|-------------------------------------|--------|--------|
|                                       |                             | No                                  | Yes    | Total  |
| <b>University/TTO</b>                 | Quantity (count)            | 0                                   | 4      | 4      |
|                                       | % within this origin entity | 0,0%                                | 100,0% | 100,0% |
|                                       | % of previous interactions  | 0,0%                                | 2,0%   | 1,8%   |
|                                       | % of total                  | 0,0%                                | 1,8%   | 1,8%   |
| <b>Research Centre/Tech Interface</b> | Quantity (count)            | 1                                   | 9      | 10     |
|                                       | % within this origin entity | 10,0%                               | 90,0%  | 100,0% |
|                                       | % of previous interactions  | 5,0%                                | 4,5%   | 4,6%   |
|                                       | % of total                  | 0,5%                                | 4,1%   | 4,6%   |
| <b>Recipient Company</b>              | Quantity (count)            | 6                                   | 122    | 128    |
|                                       | % within this origin entity | 4,7%                                | 95,3%  | 100,0% |
|                                       | % of previous interactions  | 30,0%                               | 61,3%  | 58,4%  |
|                                       | % of total                  | 2,7%                                | 55,7%  | 58,4%  |
| <b>Private Consultant</b>             | Quantity (count)            | 13                                  | 64     | 77     |
|                                       | % within this origin entity | 16,9%                               | 83,1%  | 100,0% |
|                                       | % of previous interactions  | 65,0%                               | 32,2%  | 35,2%  |
|                                       | % of total                  | 5,9%                                | 29,2%  | 35,2%  |
| <b>Total</b>                          | Quantity (count)            | 20                                  | 199    | 219    |
|                                       | % of total                  | 9,1%                                | 90,9%  | 100,0% |

In addition to confirming the correlation between variables, the chi-square test generated a distribution table that allowed further elaboration on this link (refers to Table 20). Several perspectives on the proactivity of private consultants were considered during the discussion of the interview results. It was found that the private consultancy firm in the case study was responsible for originating over a third of the TT projects in the sample (i.e., 35.2%). The majority of these projects (83.1%) were performed with entities that the consultancy firm had worked with previously, indicating the existence of previous interaction.

However, in 16.9% of the TT projects that originated from the consultancy firm, the projects were done with entities outside of their current network of contacts. Compared to other types of entities responsible for originating projects (*origin\_type*), the consultancy firm stood out as the entity with the highest rate of originated projects with entities outside its network (16.9%).

Additionally, of the 9.1% of projects in the sample done with entities outside of the consultancy firm's network, the consultancy firm originated 65% of them. This indicates that the private consultancy firm actively sought out and collaborated with new entities to generate TT projects. However, it's worth noting that about 35% of the TT projects with new entities were originated by other entities, who then involved the consultancy firm as an innovation intermediary within their TT projects, even without any previous experience with this private consultant firm.

When working within the case study consultancy firm network (which accounted for 90.9% of the sample), it was found that most of the TT projects were originated by the recipient companies (61.3%). This supports the interview discussion on the role of private consultants in creating, nurturing, and monetizing their networks as the key asset of activity (Papagiannidis et al., 2009; Stoian et al., 2017). Despite the recipient companies within the consultancy firm network being responsible for the vast majority of the TT projects involving the case study firm, the consultancy firm was also highly relevant. Specifically, 32.1% of the TT projects within their current network originated from the consultancy firm, which suggests that they played a catalytic role in generating these projects (A18).

### **6.2.3 Involvement of private consultants – H3 Tests**

Aligned with the research objective of understanding the value proposition of private consultants as innovation intermediaries, the researcher formulated a hypothesis that the motivations/reasons for contacting and involving a private consultant in a TT project may vary depending on the type of entity originating the project. Therefore, it was assumed that there is an association between these two variables.

Descriptive analysis was conducted on a subsample of 142 TT projects because the private consultant was responsible for originating the remaining 77 projects, which were not considered. The researchers identified five key motivations for involving private consultants, which were in line with the same motivations discussed during the interviews. For each motivation, a chi-square independence test was performed to verify whether there was an association with the "origin entity" response variable.

6.2.3.1 *Looking for financing options*

In 95.8% of the TT projects analysed, the main motivation was the project originator or promoter's interest in engaging a consultancy firm to explore financial options to support and boost their ideas and project requirements.

Table 21 - Distribution table - Motivation of looking for financial options

| <b>Origin Entity</b>           | Looking for financial options |            |            |
|--------------------------------|-------------------------------|------------|------------|
|                                | <b>No</b>                     | <b>Yes</b> | <b>Qty</b> |
| University/TTO                 | 25%                           | 75%        | 4          |
| Research Centre/Tech Interface | 30%                           | 70%        | 10         |
| Recipient/Company              | 1.6%                          | 98.4%      | 128        |
| <b>Total</b>                   | 4.2%                          | 95.8%      | 142        |

The chi-square independence test revealed a strong and statistically significant association ( $\chi^2(2)=22.925$ ,  $p<.001$ ) between the "origin type" and the motivation to "look for financing options". The recipient companies were highly likely (98.4%) to approach private consultancy firms in search of financing opportunities to realize their innovation projects (Table 21). Conversely, origin entities associated with the academic and public spheres were less inclined to engage consultancy firms for the same purpose (70-75%).

6.2.3.2 *Came due to Good References*

The relationship and previous experiences with private consultancy firms emerged as a primary motivator for entities to involve them in their TT projects. Since the projects originated by the consultancy firm were not considered, the subsample analysed consisted of 142 projects. Within this subsample, the

entities' previous positive experiences with the consultants and positive Word-Of-Mouth<sup>16</sup> (WOM) referrals from third parties were identified as the second most common reasons for engaging a private consultant.

Table 22 - Distribution table - Motivation by WOM and Good References

| Origin Entity                  | WOM and Good References |       |     |
|--------------------------------|-------------------------|-------|-----|
|                                | No                      | Yes   | Qty |
| University/TTO                 | 0%                      | 100%  | 4   |
| Research Centre/Tech Interface | 30%                     | 70%   | 10  |
| Recipient/Company              | 46.1%                   | 53.9% | 128 |
| <b>Total</b>                   | 43.7%                   | 56.2% | 142 |

However, the chi-square independence test found no statistically significant association ( $X^2(2)=4.167$ ,  $p=0.125>0.05$ ) between the "origin type" and the motivation to involve the consultancy firm due to WOM or good references. This suggests that the consultancy firm's reputation and market positioning may act as a common motivator among project all origin entities, regardless of their type (refers to Table 22).

6.2.3.3 Looking for Project Management support

While not directly related to the role of PMA, this motivation pertains to the desire of project origin entities and stakeholders to delegate the responsibility of the project mindset, freeing themselves from non-technological tasks and concerns. Consequently, many entities have shown a willingness to enlist the services of private consultancy firms (such as the case study) to complete tasks without worry, allowing them to maintain focus on their primary activities, whether related to the TT project or their day-to-day responsibilities. This motivation was the driving force behind approximately one-third (32.4%) of the sampled entities' decision to engage the private consultancy firm.

Table 23 - Distribution table - Motivation of looking for Project Management support

Project Management support

<sup>16</sup> WOM - Word-of-mouth is a form of marketing that focuses on getting consumers to talk about and share their positive experiences with a product or service with other people.



| <b>Origin Entity</b>             | <b>No</b>    | <b>Yes</b>   | <b>Qty</b> |
|----------------------------------|--------------|--------------|------------|
| University / TTO                 | 75%          | 25%          | 4          |
| Research Centre / Tech Interface | 60%          | 40%          | 10         |
| Recipient / Company              | 68%          | 32%          | 128        |
| <b>Total</b>                     | <b>67.6%</b> | <b>32.4%</b> | <b>142</b> |

However, when the independence test was conducted, no statistically significant association was discovered between the "origin type" and the reason for contacting or involving the consultant for "Looking for Project Management Support" ( $\chi^2(2)=0.372$ .  $p=0.830>0.05$ ). This outcome suggests that this motivation is a common factor among entities that outsource private consultants, regardless of their typology.

#### 6.2.3.4 Looking for Partners/Contacts

During the interviews, the consultant's network and their key relationships within the market were highly discussed, as they constitute their portfolio of contacts. However, despite being one of the five key motivations, the descriptive sample analysis only registered this motivation in 26.8% of the TT projects analysed.

Table 24 - Distribution table - Motivation of Looking for Partners/Contacts

| <b>Origin Entity</b>             | Looking for Contacts/Partners |              |            |
|----------------------------------|-------------------------------|--------------|------------|
|                                  | <b>No</b>                     | <b>Yes</b>   | <b>Qty</b> |
| University / TTO                 | 50%                           | 50%          | 4          |
| Research Centre / Tech Interface | 70%                           | 30%          | 10         |
| Recipient / Company              | 74.2%                         | 25.8%        | 128        |
| <b>Total</b>                     | <b>73.2%</b>                  | <b>26.8%</b> | <b>142</b> |

The independence test revealed that there was no statistically significant association between the motivation of "Looking for Partners/Contacts" and the "origin type" ( $\chi^2(2)=1.218$ .  $p=0.544>0.05$ ). However, according to the distribution Table 24, academic entities originating the TT project were shown to be more likely to contact and involve private consultancy firms that were motivated by the consultant's network potential.

### 6.2.3.5 Looking for Technical Know-how

Finally, the descriptive analysis indicated that 16.2% of the projects also presented as motivation for the involvement of private consultants, their technical know-how and experience, whether in the technology to be transferred or in the market/sector where the transfer is to be applied. To determine if there was an association between this motivation and the type of entity originating the project, an independence test was conducted.

Table 25 - Distribution table - Motivation of Looking for Technical Know-how

| <b>Origin Entity</b>             | <b>Looking for Technical Know-how</b> |            |            |
|----------------------------------|---------------------------------------|------------|------------|
|                                  | <b>No</b>                             | <b>Yes</b> | <b>Qty</b> |
| University / TTO                 | 100%                                  | 0%         | 4          |
| Research Centre / Tech Interface | 70%                                   | 30%        | 10         |
| Recipient / Company              | 84.4%                                 | 15.6%      | 128        |
| <b>Total</b>                     | 83.8%                                 | 16.2%      | 142        |

By comparing the responses from each type of entity originating the project in contingency Table 25, research centres and tech interfaces were found to be the project origin entity most involved with private consultants motivated by their technical know-how (30%). However, there was no statistically significant association between the "origin type" and the motivation of "Looking for technical know-how" ( $\chi^2(2)=2.208$ .  $p=0.332>0.05$ ).

### 6.2.4 Collaborative projects with Traditional Intermediaries – H4 Tests

Based on the semi-structured interviews conducted, it was found that the role of private consultants as innovation intermediaries has yet to be fully understood and formally recognized by NIS governance entities and decision-making stakeholders. Reports from the interviews about informal partnerships between traditional intermediaries and private consultants in the same TT projects were confirmed by the descriptive analysis of the case study sample. However, the case study consultancy firm only collaborated side by side with other traditional intermediaries (i.e., TTO and TIC) in 13.2% of the total TT projects analysed.

During the interviews, it was found that private companies (i.e., technology recipients) were more interested in using private consultants as their first line intermediaries (A17) over other traditional and more academic intermediary entities. Therefore, it is important to understand if the TT project lead, as the entity originating the TT project, also promotes collaborations between different types of intermediaries. To test this hypothesis, a chi-square independence test was conducted to analyse whether the partnership between the case study firm and traditional intermediaries in the same project was associated with the type of entity that originated it.

Table 26 - Distribution table - TT projects in collaboration with other traditional intermediaries

| <b>Origin Entity</b>             | <b>Project in Collaboration</b> |            |            |
|----------------------------------|---------------------------------|------------|------------|
|                                  | <b>No</b>                       | <b>Yes</b> | <b>Qty</b> |
| University / TTO                 | 0%                              | 100%       | 4          |
| Research Centre / Tech Interface | 10%                             | 90%        | 10         |
| Recipient / Company              | 95.3%                           | 4.7%       | 128        |
| Private Consultant               | 87%                             | 13%        | 77         |
| <b>Total</b>                     | 86.8%                           | 13.2%      | 142        |

The independence test showed that there is a statistically significant association between projects with the participation of public intermediaries and the type of entity that originated the project, ( $X^2(2)=85.649$ .  $p<0.001$ ), indicating a strong association between the variables.

Therefore, the collaboration between intermediaries may be influenced by certain origin entities and not others (Table 26). From the distribution table, academic entities were found to be more likely to originate TT projects where the consultancy firm would have a collaborating intermediation role with other more traditional intermediary entities. On the other hand, recipient companies, being the largest part of the sample, were less likely to engage in these collaborations and preferred the consultancy firm to have a single intermediary role in 95.3% of the projects.

The background and connections of universities, research centres, and tech interfaces with traditional intermediaries (e.g., TTO, TIC, governmental agencies, etc.) could partially explain why such collaborations are more likely to happen when they are the entities originating the projects with the consultancy firm (90% to 100%). However, due to the sample size (i.e., 29 TT projects), further research is recommended.

### 6.2.5 Role's comparison between intermediaries – H5 Tests

Lastly, the study conducted a comparative analysis of the roles played by a private consultancy firm and other traditional intermediaries, in TT projects where both parties collaborate. Out of the total sample of 219 TT projects analysed, only 29 (13.2%) registered a clear participation by both intermediaries. To verify and explore the hypothesis that the roles played by consultants differ (and thus do not overlap) from those of other traditional intermediaries when both parties collaborate, paired t-tests were conducted in this sub-sample of 29 projects using McNemar's tests. The hypothesis was proposed following one of the perspectives shared in the interviews, in which some participants viewed private consultants as not posing any threat or competition to traditional intermediaries due to their substantially distinct role specialization.

For the sub-sample of 29 projects, each of the thirteen intermediary roles (refers to Table 3) performed by the consultancy firm was paired with the same role from the other traditional intermediary participating in the project. As both variables were binary, with responses being either Yes or No, 2x2 tables were used as the basis for analysis. McNemar's output 2x2 tables were employed as the samples were paired, which increased the accuracy of comparison. Thus, the study aimed to compare the responses to the two response variables between an equivalent set of individuals, the private consultancy, and the other traditional intermediaries, using this test to assess whether the proportion of discordant responses (i.e., the roles) differed between the two groups of intermediaries.

However, due to the limited number of projects in which both intermediaries participated, it was not possible to analyse every role specialization. For the roles of Policy & Strategy, Knowledge Diffusion & Support, Technology Scouting & Market Foresight, Accreditation & Quality, Implementation & Knowledge Transfer, and Marketing & Business Development, no statistical tests could be computed since the response variables were constant and there was no variability in these conditions. As a result, the study and analysis focused on the remaining role specializations.

The key aim of each test was to determine whether the p-value was less than 0.05 ( $p \leq 0.05$ ), which would indicate whether the responses regarding the performance of a specific role in a TT project differed significantly according to the respondent group (i.e., the private consultancy firm, or the other traditional intermediaries participating in the TT project). However, none of McNemar's tests conducted revealed the existence of a statistically significant difference between the role played by the private consultancy firm and the other traditional intermediary participating along the same TT project.

Although the results alone might suggest that the role specializations do not significantly differ according to the intermediary type, implying a possible overlap or competition between them, the

subsample used for this test was small, with only 29 TT projects. Therefore, the sample size was insufficient to be considered statistically significant, as statistically significant findings are much harder to detect within smaller sample sizes.

The output data from McNemar’s tests provide a valuable addition to the discussion surrounding the fifth research hypothesis. In the output results analysis below, a stylized version of the output table was used (see example in Table 27). A McNemar’s test was conducted for each of the roles, and the role execution (i.e., yes, or no) by each of the two players was paired. From the contingency paired 2x2 tables resulting from the tests conducted on each of the roles, an observational analysis can be made.

Table 27 - McNemar's contingency paired table 2x2 - Example

| <b>Role</b>             | <b>Traditional Intermediaries (TI)</b> |            | <b>Qty</b> |       |
|-------------------------|--|------------|------------|-------|
|                         | <b>No</b>                              | <b>Yes</b> |            |       |
| Private Consultant (PC) | <b>No</b>                              | a          | b          | a + b |
|                         | <b>Yes</b>                             | c          | d          | c + d |
|                         | <b>Qty</b>                             | a + c      | b + d      | n     |

Generally, when the significance (i.e., p-value) is below 0.05, the McNemar’s paired table will show high values in the cell “b” and/or “c”. This indicates the existence of a difference in intermediaries’ roles performance and reduced overlap. On the other hand, when the cell “a” and “d” reveal higher values, intermediaries tend to execute or not execute the role at the same time, and statistical significance will not be registered ( $p > 0.05$ ). In this case, the alternative hypothesis formulated would be refuted, maintaining the initial possibility that intermediaries do not significantly differ when performing the same role in collaboration projects and expressing their propensity to overlap.

Raw output tables extracted from SPSS tests conducted can also be consulted to in Annex II.

6.2.5.1 *Mediation & Mobilization*

The traditional intermediation role of Mediation & Mobilization (MM) was performed residually by private consultancies in the subsample (3.2%). This tendency was also observed in the subsample of 29 TT projects where both intermediaries collaborated, with the private consultant performing this role in just one project (3.4%). On the other hand, traditional intermediaries participating in the projects performed this MM role 20.7% of the occasions they worked together.

Table 28 - Contingency table between intermediaries - Mediation & Mobilization

| <b>Mediation &amp; Mobilization</b> | Traditional Intermediaries |               | <b>Total</b> |               |
|-------------------------------------|----------------------------|---------------|--------------|---------------|
|                                     | <b>No</b>                  | <b>Yes</b>    |              |               |
| Private Consultant                  | <b>No</b>                  | 22<br>(75.9%) | 6<br>(20.7%) | 28<br>(96.6%) |
|                                     | <b>Yes</b>                 | 1<br>(3.4%)   | 0<br>(0%)    | 1<br>(3.4%)   |
| <b>Total</b>                        |                            | 23<br>(79.3%) | 6<br>(20.7%) | 29<br>(100%)  |

The McNemar's test did not reveal statistical significance ( $p=0.125 > 0.05$ ), suggesting that the MM role did not significantly differ between intermediaries. However, Table 28 shows that the MM role was not performed simultaneously by both intermediaries in any TT project, indicating no overlapping.

#### 6.2.5.2 Funding & Finance

For the Funding & Finance (FF) role, the McNemar's test also did not reveal statistical significance (i.e.,  $p\text{-value } p=0.180 > 0.05$ ), indicating that the intermediaries' responses do not differ significantly. Yet, in projects where both intermediaries worked together, the FF role was performed in 100% of this subsample (i.e., in 29 projects). From the paired 2x2 table, it can be observed that in the majority (69%) of the TT projects in the subsample, both intermediaries played the FF role simultaneously, resulting in an overlap.

Table 29 - Contingency table between intermediaries – Funding & Finance

| <b>Funding &amp; Finance</b> | Traditional Intermediaries |              | <b>Total</b> |               |
|------------------------------|----------------------------|--------------|--------------|---------------|
|                              | <b>No</b>                  | <b>Yes</b>   |              |               |
| Private Consultant           | <b>No</b>                  | 0<br>(0%)    | 2<br>(6.9%)  | 2<br>(6.9%)   |
|                              | <b>Yes</b>                 | 7<br>(24.1%) | 20<br>(69%)  | 27<br>(93.1%) |

|              |               |               |              |
|--------------|---------------|---------------|--------------|
| <b>Total</b> | 23<br>(24.1%) | 22<br>(75.9%) | 29<br>(100%) |
|--------------|---------------|---------------|--------------|

This data aligns with the results from the descriptive analysis of the variables' frequencies, where both intermediaries showed a high rate of performing the FF role. Therefore, the results do not support the proposed hypothesis, suggesting an overlap of both intermediaries in the same role of Funding & Finance.

### 6.2.5.3 Design & Idealization

Although no statistical significance was observed (i.e.,  $p = 1.00 > 0.05$ ), McNemar's output table indicated a slight overlapping (10.3%) of intermediaries in the execution of the role of Design & Idealization (DI). Hence, it is not statistically significant to assume that the performance of the DI role specialization is significantly different between the private consultant (i.e., the case study firm) and other traditional intermediaries participating within the subsample.

Table 30 - Contingency table between intermediaries - Design & Idealization

| <b>Design &amp; Idealization</b> | Traditional Intermediaries |               | <b>Total</b>  |               |
|----------------------------------|----------------------------|---------------|---------------|---------------|
|                                  | <b>No</b>                  | <b>Yes</b>    |               |               |
| Private Consultant               | <b>No</b>                  | 5<br>(17.2%)  | 10<br>(34.5%) | 15<br>(51.7%) |
|                                  | <b>Yes</b>                 | 11<br>(37.9%) | 3<br>(10.3%)  | 14<br>(48.3%) |
| <b>Total</b>                     | 16<br>(24.1%)              | 13<br>(75.9%) | 29<br>(100%)  |               |

The DI role was performed in 82.8% of the TT projects with collaborative intermediation. In just 10.3% of the projects, intermediaries overlapped in this role. The paired Table 30 indicated that in the majority of the TT projects where this role is performed, it is evenly distributed by the intermediaries. The private consultancy firm played the DI role independently in 37.9%, but the other traditional intermediaries were responsible for playing the same role solely in 34.5% of the subsample.

#### 6.2.5.4 Brokering & Gatekeeping

Similarly, the previous traditional intermediation role of Mediation & Mobilization, as well as Brokering & Gatekeeping (BG), has a low rate of being played in the subsample of collaborative intermediation projects (31%). Since the McNemar's test did not reveal statistical significance ( $p=1.00 > 0.05$ ), it can be inferred that intermediaries tend to overlap when performing the BG role specialization.

Table 31 - Contingency table between intermediaries - Brokering & Gatekeeping

| <b>Brokering &amp; Gatekeeping</b> | <b>Traditional Intermediaries</b> |              |              |               |
|------------------------------------|-----------------------------------|--------------|--------------|---------------|
|                                    | <b>No</b>                         | <b>Yes</b>   | <b>Total</b> |               |
| Private Consultant                 | <b>No</b>                         | 20<br>(69%)  | 4<br>(13.8%) | 24<br>(82.8%) |
|                                    | <b>Yes</b>                        | 4<br>(13.8%) | 1<br>(3.4%)  | 5<br>(17.2%)  |
| <b>Total</b>                       | 24<br>(82.8%)                     | 5<br>(17.2%) | 29<br>(100%) |               |

Although this overlapping occurs in only 3.4% of the subsample, it is not sufficient evidence to support the claim that intermediaries tend to overlap when playing the BG role (see Table 31). Furthermore, in eight of the nine TT projects where this role was performed, both intermediaries performed it exclusively in four projects.

#### 6.2.5.5 Project Management & Assessment

The role of Project Management & Assessment (PMA) was frequently mentioned in interviews and was also supported by the descriptive analysis of variable frequencies for both types of intermediaries. In the overall sample of 219 TT projects, the private consultancy firm had a high execution rate of this role, which was recorded in 88.6% of the projects.

However, this performance dropped significantly in collaborative intermediation projects, with the private consultancy firm performing this role in less than half of the subsample (48.3%). In the subsample of TT projects, other traditional intermediaries demonstrated a higher tendency to be responsible for performing this PMA role (75.9%).



Table 32 - Contingency table between intermediaries - Project Management & Assessment

| <b>Project Management &amp;<br/>Assessment</b> | Traditional Intermediaries |               |               |               |
|--|----------------------------|---------------|---------------|---------------|
|  | <b>No</b>                  | <b>Yes</b>    | <b>Total</b>  |               |
| Private Consultant                             | <b>No</b>                  | 2<br>(6.9%)   | 13<br>(44.8%) | 15<br>(51.7%) |
|  | <b>Yes</b>                 | 5<br>(17.2%)  | 9<br>(31%)    | 14<br>(48.3%) |
| <b>Total</b>                                   | 7<br>(24.1%)               | 22<br>(75.9%) | 29<br>(100%)  |               |

For the role of Project Management & Assessment, the McNemar's test also did not reveal statistical significance ( $p\text{-value } p=0.096 > 0.05$ ). As such, 31% of the subsample registered an overlapping execution of the PMA role by both intermediaries.

In addition, traditional intermediaries demonstrated a tendency to be solely responsible for the execution of the PMA role in 44.8% of the collaborative TT projects. This implies that, as PMA is a major role played in TT projects, the consultancy firm tends to lose this role when collaborating with other traditional intermediaries.

#### 6.2.5.6 Financial & Technical Feasibility

The consultancy firm performed the Financial & Technical Feasibility (FTF) role in 19.2% of the global sample, but in collaborative projects, the firm executed this role in 24.7% of the TT projects, with no overlap with traditional intermediaries.

Table 33 - Contingency table between intermediaries - Financial & Technical Feasibility

| <b>Financial &amp; Technical<br/>Feasibility</b> | Traditional Intermediaries |            |              |
|--|----------------------------|------------|--------------|
|  | <b>No</b>                  | <b>Yes</b> | <b>Total</b> |

|                    |              |               |              |               |
|--------------------|--------------|---------------|--------------|---------------|
| Private Consultant | <b>No</b>    | 14<br>(48.3%) | 8<br>(27.6%) | 22<br>(75.9%) |
|                    | <b>Yes</b>   | 7<br>(24.1%)  | 0<br>(0%)    | 7<br>(24.1%)  |
|                    | <b>Total</b> | 21<br>(72.4%) | 8<br>(27.6%) | 29<br>(100%)  |

The statistical significance level (p-value) was greater than 0.05 (i.e.,  $p = 1.00 > 0.05$ ), indicating that the execution of roles did not differ significantly between intermediaries. However, there was no overlap in the execution of the FTF role in any TT project, and the FTF role was performed in 15 projects, none of which by both intermediaries simultaneously (refers to Table 33).

#### 6.2.5.7 Intellectual Property & Rights

The private consultancy firm performed the specialisation role of Intellectual Property & Rights (IPR) in just 1.8% (4 projects) of the global case study sample, with half of these records performed in collaborative projects with other traditional intermediaries. The McNemar's test did not reveal a statistical significance level (i.e., p-value  $p=0.625 > 0.05$ ), indicating that the IPR role did not significantly differ according to the type of intermediary. In 82.8% of the TT projects, none of the intermediaries performed the IPR role (Table 34), and in the remaining sample, only 3.4% registered an overlapping of the role by both intermediaries.

Table 34 - Contingency table between intermediaries - Intellectual Property & Rights

| <b>Intellectual Property &amp; Rights</b> | Traditional Intermediaries |               |              |               |
|---|----------------------------|---------------|--------------|---------------|
|   | <b>No</b>                  | <b>Yes</b>    | <b>Total</b> |               |
| Private Consultant                        | <b>No</b>                  | 24<br>(82.8%) | 3<br>(10.3%) | 27<br>(93.1%) |
|   | <b>Yes</b>                 | 1<br>(3.4%)   | 1<br>(3.4%)  | 2<br>(6.9%)   |
|   | <b>Total</b>               | 25<br>(86.2%) | 4<br>(13.8%) | 29<br>(100%)  |

# **CHAPTER 7**

## **RESEARCH DISCUSSION AND KEY FINDINGS**

## CHAPTER 7 - RESEARCH DISCUSSION AND KEY FINDINGS

### 7.1 Results overview

The statistical tests performed on the private consulting firm targeted by the case study served two main purposes. Firstly, they were of an exploratory nature aimed at describing the sample and the characteristics of the data collected from the 219 TT projects in which the private consultancy firm had participated as an innovation intermediary. This exploration built on the research conducted through the semi-structured interviews, exploring the key ideas found in those interviews and describing the case study sample. The focus of this exploration was to contextualize the case study by comparing the descriptive data with some of the key ideas previously found in the literature review and discussed in the semi-structured interviews.

The second main purpose of the statistical tests was to provide a more concrete and quantitative set of conclusions and findings, thus evolving from a qualitative set of findings to a quantitative one. The qualitative research followed in Chapter 5 further explores concepts found in the literature, allowing the formulation of key research hypotheses throughout the first phase of qualitative research (i.e., interviews). These five hypotheses were then used as guidelines to design and conduct the second phase of research, a quantitative analysis of a sample of 219 TT projects within a selected case study.

As introductory notes from the case study, it was observed that the results of the descriptive tests on the sample (see Annex II) analysed 219 TT projects in which the case study consulting firm acted as an innovation intermediary. The descriptive results were consistent with the case study firm's positioning perspective, particularly in the information technology sector (a.k.a. industry 4.0), which reflects the private consultancy firm's clear specialization within this sector. The sample of TT projects took place between 2014 and 2021, aligned with the Portugal 2020 program "calls" that had specific funding lines for business/industrial innovation and R&D projects.

Most projects were originated and promoted by private entities (58.4%), mainly recipient companies, demonstrating a strong "demand-pull" TT perspective (Jun & Ji, 2016). Still, the private consultancy firm also stood out as being responsible for the idealization and origin of a large part of the innovation and TT projects analysed (35.2%). This result further corroborates the previously identified idea of their pulling effect as the industry's champion within the NIS (Bessant & Rush, 1995; Tether & Tajar, 2008; Youn et al., 2015). In the discussion of the semi-structured interviews, the private consultant's "proactivity" in originating TT projects was highly regarded, both within and beyond their network of contacts.

The consulting firm played a crucial role in both “demand-pull” and “technology-push” scenarios, as it was responsible for scouting within and outside its contact network for technology sources (92.6%) and for technology recipients (41.6%), respectively. The majority of the TT projects in the sample were generated within the consultant's network of contacts, as evidenced by the high representation of projects with previous interactions between the consultant and the originating entities (90.9%).

As highlighted in the literature review, the role of an intermediary is a multifaceted concept that goes beyond core functions and services. This was also emphasized in the semi-structured interviews, as additional factors demonstrated to contribute to the perceived value of a private consultant as an intermediary. TT stakeholders often contact and involve private consultants for various reasons. Through the analysis of the main motivations leading the project origin entities to contact and involve the private consultancy firm under study, five key motivations were identified. The major motivation found in the case study sample was the existence of external financial options/opportunities to fund TT and innovation projects, which was registered in 95.8% of the TT projects in the sample. This data, combined with the results of the Funding & Financing role, mainly indicate a strong correlation (i.e., dependency) of the private consultant's role as innovation intermediary and the existence of funding options (e.g., funding program calls, grants, investors).

Regarding the consultant's relationship with the traditional system agents, contrary to expectations generated in the interview discussions, the participation of other traditional intermediaries alongside private consultants was highly residual in this specific case study. Only 13.2% of the sample registered the participation of other traditional intermediaries.

Regarding the key variables of analysis in the statistical study, the identification of the intermediation roles performed by the private consulting firm targeted by the case study followed thirteen roles identified in the literature review (p. 72, Table 3). Based on the 219 TT projects analysed, the case study firm seemed to be specialized in a reduced set of these roles. Although a wide range of roles was registered within the TT projects, only a few were performed consistently throughout the sample. From the thirteen roles framework (Table 3), only three roles were performed in more than 50% of the sample, and three others in more than 10% of the TT projects. The remaining seven roles had non-significant executions or no execution at all.

The main role played by the case-studied consultancy firm focused on providing access to financing instruments (i.e., Funding & Finance - 96.8%). Second was the role of Project Management & Assessment (88.58%), which followed the managerial support related to the administrative technicalities of handling funded projects within the scope of the national program Portugal 2020. The third key role of

the consultant was to set up or complete the project consortium, either upstream with the search for suppliers and technology, or downstream with the identification of target markets and companies interested in becoming recipients (i.e., Technology Scouting & Market Foresight - 56.62%).

In relation to the participation of traditional intermediaries alongside private consultants in TT projects, the dominant roles played were Funding & Finance (FF) and Project Management & Assessment (PMA), which were performed in more than 50% of cases. However, these roles were also performed by other traditional intermediaries in 75.9% of the TT projects where both intermediaries collaborated, which suggests a potential for role overlapping. To investigate this further, additional research was conducted, as it is possible that two intermediaries working together and performing the same role could have different meanings and reasons. Therefore, it was not possible to conclude whether there was a direct competition or a threat to current traditional intermediaries based solely on the descriptive results.

To address this issue, further statistical tests were performed on the quantitative analysis, which aimed to test five research hypotheses formulated from the results of semi-structured interviews. These hypotheses were derived from the discussion of key research topics and served as guidelines for the quantitative research. The statistical tests were carefully selected and designed to make the best use of the data collected, with a focus on verifying the statistical significance (i.e., p-value). The output results, such as distribution tables, were also used as a platform for elaborating the discussion, exploring relationships between key variables, such as the consultancy firm's roles, proactivity, and external variables, such as the type of entities originating the projects or collaboration with other traditional intermediaries.

The case study consultancy firm provided a relevant sample of 219 TT projects in which it participated as an innovation intermediary, allowing for the validation of previously discussed ideas and a deeper understanding of the consultancy firm's role as innovation intermediary. By analysing the output results of the statistical tests, relationships between key variables and external variables were explored, allowing for associative and comparative analysis.

Overall, the statistical tests served as a powerful tool for exploring the complex relationships between various variables relating to private consultant's role in TT projects, providing valuable insights for future research in this field.

## 7.2 Discussing the research hypotheses

After conducting a critical literature review and exploring the results of the semi-structured interviews, five theoretical hypotheses were formulated to guide the research. These hypotheses represent the primary focus of the research and were not only intended to be validated or disproved but also served as means to generate further discussion and reach significant findings. Thus, the process of responding to these hypotheses served to synthesize not only the findings of the research but also to deepen the understanding the proposed study of the thesis on the role and positioning of the private consultant as an intermediary agent in innovation and TT projects.

### 7.2.1 Discussing Hypothesis H1

The role of an innovation intermediary in TT was a central focus of this research and proved to be wide-ranging and complex. By compiling diverse author's contributions, a framework comprising 13 key roles was developed based on a critical literature review, representing different specialization activities an intermediary agent can undertake (p. 72, Table 3). Which of these 13 roles private consultants play as intermediaries was one of the main focuses in the semi-structured interviews.

By comparing the results from the interviews and the descriptive analysis of the sample, it was found that private consultants play essentially six of these roles as intermediaries. Also, it was noted that there was a high level of corroboration between the qualitative and the quantitative results, however some differences were also noticeable. From a triple helix perspective, a bias in the responses of interviewees representing distinct organisms in the NIS was identified after content analyses. The idea of private consultants adjusting their roles/services to their clients' interests was also identified in the literature (Basu & Taylor, 2010; Martinez et al., 2016).

In the case study sample, four categories of entities responsible for originating the TT project with the private consultancy were identified. Therefore, a series of statistical tests were conducted on the sample to identify if the roles performed by the private consultancy firm in TT projects were significantly influenced by the type of entity originating the project (being mostly their clients).

Chi-square independency tests were carried out on the set of six main role specializations performed by the private consultant, and it was found that there were statistically significant associations between five out of six roles analysed and the category of entity that gave rise to the project. Hence, the null hypothesis may be rejected, and the alternative proposed hypothesis accepted: **the roles played by private consultants are associated with the type of entity originating the project.**

The consultancy firm plays a set of six roles that most define their role as innovation intermediaries in the TT projects. In the role specializations of Project Management & Assessment (PMA) and Financial & Technical Feasibility (FTF), a strong association with the type of origin entity was found. For instance, in TT projects originated by more traditional entities such as Universities/TTO and Research Centres/TIC, the PMA was only performed residually by the private consultancy. In contrast, the same role of PMA was performed by the case study firm in more than 91% of the TT projects originated by recipient companies or the consultancy firm itself. This behaviour was also identified in the role of FF where TT projects originated by private entities (e.g., recipient companies and the private consultancy) showed a much higher rate of performance in this role (+97%). The performance behaviour of these two roles corroborates the bias noticed in the interviews. Private consultants and recipient companies also greatly recognized the performance and importance of private consultants in playing the FF and PMA roles as intermediaries in NIS.

The role of FTF was found to have a very strong association with the category of origin entity in the independency test, making it the second role to exhibit such strong association. This role was mostly executed by the case study consultancy firm in projects originating from academic entities such as universities and research centres. Interestingly, the FTF role was less likely to be performed in TT projects originated by the consultancy firm itself. A possible explanation for this could be the consultancy firm's internal policy of only supporting ideas, technologies, and projects with high probabilities of success, and thus feasibility tests were conducted before project initiation.

The roles of Design & Idealization (DI) and Marketing & Business Development (MBD) were highly regarded during the interviews, but their execution rates in the TT project sample by the private consulting firm were lower than expected despite being included in the list of key six roles previously defined. The independency tests also revealed an association between the execution of these roles and the category of entity responsible for originating the projects. The MBD activities were performed in just 13.7% of the sample, driven mostly by TT projects originating from academic entities and traditional intermediaries such as Universities/TTO and Research Centres/TIC. The distribution tables resulting from the tests on this role (refers to Table 19) showed its propensity to be performed in a “technology-push” perspective (Edquist, 2014), where academic entities and traditional intermediaries use the private consultancy firm's MBD role to push the technology/product to the market.

The role of DI was also less likely to be executed in TT projects originated by recipient companies (21.1%). Although the role was consistently performed in projects originating from academic entities, more than half of the projects where this role was registered (51.5%) were originated by the private



consultancy firm itself (i.e., the case study). Thus, this creative role, more directly related to the technology to be transferred, can be probably connected with the proactivity capacity/attitude of the private consultants, which was discussed highly in the interviews' results as a key factor in their value proposition as innovation intermediaries.

### **7.2.2 Discussing Hypothesis H2**

As the concept of the "intermediation role" has become increasingly wider and more complex, new factors have emerged that contribute to a full understanding of such a role, such as entity characteristics and external factors that pose opportunities or threats to the involvement of intermediaries (Howells, 2006; Pollard, 2015; Todeva, 2013). Discussions in interviews with different participants have revealed that private consultants' role as innovation intermediaries is intrinsically linked to the value proposition that client entities perceive in them, which may or may not lead to their involvement in TT projects.

Regarding private consultants, the differentiating factor most emphasized by interview participants was their "proactivity", which is the attitude with which they approach TT projects. Different perspectives regarding this proactivity were mentioned. To some, the proactivity of private consultants represents their role as innovation catalysts, continuously generating TT project opportunities within their network (A01, A17, A18, A19). To others, it is the way private consultants reach outside their network to identify new and interesting contacts (i.e., recipient companies and R&D sources) to propose TT projects (A07, A08, A12). The literature also shows that consultants rely on their networks as their comfort zone, which they nurture and maintain to monetize (Basu & Taylor, 2010; Dias et al., 2017; Martinez et al., 2016).

The statistical tests aimed to go beyond validating or rejecting the proposed hypothesis and to explore the proactivity perspectives discussed by the different entities interviewed. As such, for each of the 219 TT projects in the case study, it was examined whether the private consultancy firm had previously interacted or worked with the type of entity originating the TT projects. In the vast majority of the TT projects (90.9%), the consultancy firm worked with entities within its current network, as they had a history of previous interactions. This variable aimed to analyse the consultancy firm's activity beyond their network, which revealed to be low but still significant (9.1%). Four different types/categories of entities were found to be originating the TT projects in the sample, with the case study consultancy firm originating 35.2% of them, demonstrating the proactivity of private consultants to work beyond their network, as discussed in the interviews.

Based on the second hypothesis, an independence test was conducted to verify the existence of a correlation between these two variables. The chi-square test confirmed the hypothesis as **there was found to be a statistically significant association between the existence of previous interactions with the consultant and the type of organization originating or promoting the TT project.**

The output distribution tables from the statistical test depicted a “demand-pull” tendency (Edquist, 2014; Jun & Ji, 2016), with recipient companies leading the origin and promotion of TT projects (58.4%) in which the case study consultancy firm was involved. However, the consultancy firm demonstrated the highly discussed proactivity factor by originating 35.2% of the TT projects analysed.

Also, most of these TT projects originated by the private consultancy firm were within its current network of contacts (83.1%), corroborating the idea that private consultants act as innovation catalysts within their trusted network, keeping their clients (mostly recipient companies) innovative and with a pipeline of R&D and TT projects ongoing (A18). Additionally, the private consultancy firm demonstrated a high level of proactivity in prospecting new contacts and expanding its network by being responsible for originating 65% of the TT projects conducted outside of its current network. This finding is consistent with the proactivity perspective discussed in the interviews (A08, A10).

Moreover, it is worth noting that in the majority of TT projects originating from academic entities, such as universities/TTO and research centres/TIC, there was a pre-existing relationship with the consulting firm. This underscores the importance placed by the consultancy firm on nurturing and maintaining relationships and networks of contacts, particularly in the academic sphere where technology sources are abundant (Basilioa et al., 2019).

### **7.2.3 Discussing Hypothesis H3**

As noted earlier, the private consultancy firm was responsible for originating 35.2% of the TT projects in the sample, with the remaining 64.8% of projects involving the consulting firm under study as an innovation intermediary after being contacted by the originating entity. While previous literature has suggested that private consultants are primarily engaged to fill gaps in traditional intermediaries' sector-specific knowledge (Gråsjö et al., 2018; Howells, 2006), the qualitative research with representatives from various NIS players revealed that the reasons for contacting and involving private consultants in TT projects can be much broader.

These reasons include external factors, such as the availability of innovation funding programs that can support the consultant's operations (A08, A10), and the originating entity's self-motivations, such

as the need to innovate but a lack of interest in taking on responsibilities and due diligence for the innovation process (A19). While different interview participants highlighted different motivations for involving private consultants, independence tests were conducted on each of the key motivations to verify if there was an association with the type of entity originating the TT project.

In only one of the five key motivations (“Looking for Financing Options”) was found a statistically significant (and strong) association with the type of entity originating the project. In particular, with recipient companies stand out as the type of origin entity more prone to have this motivation (98.4%). No other statistically significant association was found in the sample. Thus, the alternative hypothesis is rejected, and the null hypothesis is maintained, which stated that **the motivations for contacting and involving private consultants in TT projects do not significantly vary according to the type of entity originating the project.**

Despite the lack of statistical significance, the data from the distribution tables of the remaining motivations can contribute to the research theme discussion. For instance, the University/TTO and Research Centres/TIC seem to be more motivated by good references or previous experiences with the private consultancy firm than recipient companies. Additionally, contacting and involving the private consultancy firm motivated by the consultancy's network of contacts appears to be more likely when Universities/TTO are responsible for originating the TT project.

#### **7.2.4 Discussing Hypothesis H4**

From the literature review and the conducted interviews, it is clear that the role of private consultants in innovation and specifically in TT is still not fully understood. As a result, they remain unrecognized as intermediary agents in the NIS where they operate. However, several interviewees reported the existence of TT projects where private consultants are collaborating as informal partners with traditional intermediaries. The analysis of the interview results revealed that recipient companies lead the interest in resorting to private consultants instead of traditional intermediaries (A17, A18). In addition, interviewees from academic backgrounds and even other traditional intermediaries (i.e., public and semi-public/hybrid) exhibited a high propensity to partner with private consultants as a strategic move to enhance their market reach and capabilities (A08, A10).

To explore and verify collaborative TT projects with these intermediary partnerships, a research hypothesis was proposed as a guideline. The descriptive analysis of the sample verified the interviewees' reports, showing that 13.2% of TT projects had another traditional intermediary intervening alongside the

private consultancy firm under study. The tests aimed to understand whether these collaborations might be influenced by the type of entity originating the project.

From the application of an independent chi-square test, a statistically significant and strong association was found between TT projects registering the participation of other traditional intermediaries and the category of the entity responsible for the project (i.e., the origin entity). This strong association ( $p < 0.001$ ) was particularly noticeable in the distribution Table 26 (p.201). TT projects originated by entities with academic backgrounds such as University/TTO and Research Centres/TIC demonstrated a high propensity, 100% and 90% respectively, to have a traditional intermediary partnering with the private consultancy firm.

In contrast, TT projects originated by private entities, such as recipient companies (the largest part of the sample), were the least prone to have other traditional intermediaries collaborating alongside the private consultancy firm (4.7%). When TT projects were originated by the private consultancy firm under study, they had a 13% probability of involving another traditional intermediary. Therefore, based on these results, the null hypothesis was rejected, and the alternative hypothesis was accepted. **The partnership between consultants and traditional intermediaries in the same project is indeed associated with the type of entity that originated it.** These results greatly corroborate the interview results where public and private entities displayed opposing views regarding these collaborations/partnerships.

### 7.2.5 Discussing Hypothesis H5

The collaboration/partnership between traditional intermediaries and private consultants in TT projects has been previously observed. However, formal recognition of the private consultants' role as innovation intermediaries may depend on a better understanding of their position within the system.

Through the conducted semi-structured interviews, different perspectives emerged regarding the "positioning" of private consultants, who are still a new and not fully recognized intermediary agents in the Portuguese NIS (A16). Some perceive private consultants as complementary partnership opportunities to traditional intermediaries (A1, A02, A08, A019), while others see them as potential competition to current NIS intermediary agents (A04, A13, A14, A17). Some interview participants even perceive a complete distinction between the roles of private consultants and traditional intermediaries (A16, A19), as if their roles fundamentally differ.

To address this discussion, the latter positioning perspective was used as the foundation for the last research hypothesis, which states that the roles of private consultants fundamentally differ from those

performed by traditional intermediaries in projects where both participate. Using an optimal subsample of TT projects in which a private consultancy firm actively collaborated/partnered with other traditional intermediaries, paired t-tests were conducted using McNemar's test to compare both intermediaries' roles execution in each project.

No statistical significance ( $p < 0.05$ ) was found in any of the tests. This is mainly due to the limited subsample size with the desired characteristics (i.e., 29 projects), which significantly reduces their statistical relevance and may even have compromised the results as statistically significant findings are harder to detect with small sample sizes. In addition, six of these response variables were constant, so no statistical test could be computed for them as there was no variability to test.

Despite the reduced sample, some key results emerged from the paired distribution tables of the seven roles computed, which can contribute to further research discussion. In the role specializations of Financial & Technical Feasibility (FTF), Mediation & Mobilization (MM), Brokering & Gatekeeping (BG), and Intellectual Property & Rights (IPR), from none (0%) to a residual overlapping of 3.4% was found. Although there was an inclination to validate the hypothesis that the intermediaries fundamentally differ in the roles they performed, these roles were registered in less than 60% of the TT projects in the subsample, which significantly reduces their statistical relevance and may have compromised the results.

However, in the roles with consistent execution rates in more than 80% of the subsample of 29 TT projects, some overlapping was found, such as in the role of Design & Idealization (DI) (10.3%) and in the role of Project Management & Assessment (PMA) (31%). The role of Funding & Finance (FF), performed in 100% of the subsample, was simultaneously executed by both intermediaries in 69% of the projects, demonstrating a high overlapping propensity.

The alternative hypothesis proposed had to be rejected, and the null hypothesis maintained, as **the roles of private consultants may not fundamentally differ from those performed by traditional intermediaries in projects where both participate**. Therefore, the roles performed by private consultants can overlap with those performed by other traditional intermediaries even when working together.

If this is the case, the overlapping of roles requires further study, as its meaning cannot be easily apprehended. Intermediaries playing the same role may not necessarily indicate competition but could also represent cooperation or complementation. Additionally, in most of the TT projects where roles of DI, PMA, and FTF were registered, they were performed either by a private consultancy or by the other traditional intermediaries. This finding requires further investigation as it could lead to several distinct interpretations.

### 7.3 Key Findings

Based on the analyses conducted in this research study, several key findings can be highlighted.

**The concept of the “intermediation role” has evolved into an umbrella term composed of multiple roles and specializations**, with distinct intermediaries performing specific functions to support the needs of innovation and TT processes. This finding is consistent with existing literature (Howells, 2006; Intarakumnerd & Chaoroenporn, 2013; Zajko, 2017). As a foundation for this study, the literature review gathered references to the roles, functions, and activities performed by any entity involved in intermediating or supporting innovation and TT. A framework of thirteen intermediary’s role specializations was developed (p. 72, Table 3) to cluster the key specializations in which intermediaries might engage.

**Private consultants play a role as innovation intermediaries in TT**, despite scattered and limited literature on the subject (Cesário et al., 2015; Pinto, 2018). The research methods used in this study, including semi-structured interviews and case study statistical analysis, identified, and validated six role specializations in which private consultants perform as innovation intermediaries: 1) Funding & Finance; 2) Project Management & Assessment; 3) Technology Scouting & Market Foresight; 4) Design & Idealization; 5) Financial & Technical Feasibility; and 6) Marketing & Business Development.

**The roles played by private consultants as innovation intermediaries may be influenced by the originator of the TT project.** As private and for-profit businesses, private consultants are widely depicted in the literature for their ability to create value for their clients by adjusting themselves constantly to what might be profitable (Butler, 2009; Costa et al., 2021). Conducted interviews explored different perceptions and expectations NIS players interviewed have from private consultants in TT processes. This idea that the role a private consultant plays in a TT project might depend on their client was verified in the statistical analysis conducted to a case study consultancy firm. Through a sample of 219 TT projects, in five out of six key roles was found statistical evidence that the role execution by the consultancy firm studied was associated with a type of entity responsible for originating the TT project.

**The role of private consultants in innovation and TT goes beyond the specializations they perform.** Various characteristics and factors perceived by NIS players contribute to the role and value of private consultants as innovation intermediaries, including their networks, experience, and responsibility. The proactivity of private consultants in performing their roles stood out among these factors. Private consultants act as innovation catalysts by creating value beyond intermediating TT

projects, creating and nurturing networks, and continuously seeking out project opportunities to pitch to potential promoters.

Analysis of the 219 TT projects found that the case study private consultancy firm was responsible for originating more than a third of them through its proactive approach to network building and collaboration. The firm also demonstrated the ability to proactively build and expand its network within a specific sector or field (Bianchi et al., 2016; Freire, 2008; Wright et al., 2012), as evidenced by its successful origination of TT projects with entities with which it had no prior interactions.

**The involvement of private consultants as innovation intermediaries in TT projects is motivated by more than just the roles they can perform.** Several reasons can motivate a TT stakeholder to resort to a private consultant as an intermediary to their TT project. Authors previously highlighted the contribution of external factors to the perceived value proposition a private consultant (Chesbrough & Rosenbloom, 2002; Tran et al., 2011). Five key reasons/motivations were identified and validated in the sample of TT projects studied. The motivation leading the contact and involvement of a private consultant in a TT process was the existence and interest in financing options to fund ideas and project pipelines. This motivation was largely driven by recipient companies looking to use innovation incentive policies (e.g., the PT2020 program) to build and finance their innovation activities.

**Private consultants can perform their role as intermediaries simultaneously with other traditional intermediaries in the same TT projects.** The literature regarding multiple intermediary collaboration within the same TT process is not thoroughly developed yet. Still, from semi-structured interviews conducted with players from NIS several mentions emerged concerning collaborative TT projects in which traditional intermediaries and private consultants worked together. This idea was validated in the statistical tests applied to the sample as 13.2% of the TT projects registered the participation of another traditional intermediary besides the private consultancy firm studied. Still, from independency tests conducted, the involvement of traditional intermediaries in addition to the private consultancy firm was shown to be much more highly prone to happen when an academic/traditional entity was responsible for originating the TT projects (e.g., Universities/TTO, Research Centres/TIC).

**The roles performed by private consultants may not fundamentally differ from those played by traditional intermediaries when collaborating within the same TT project.** Semi-structured interviews conducted with NIS players reveal that private consultants' role as innovation intermediaries are perceived differently, whether as an opportunity, a competitive threat, or completely distinct from traditional intermediaries. Comparative tests conducted on both intermediaries' roles when collaborating in TT projects revealed that they may not fundamentally differ between them. In the role of

funding and finance intermediaries, there is significant overlap. In the roles of DI, PMA, and FTF, they tend to be performed by either one intermediary or the other. However, direct conclusions cannot be drawn as further research is needed to fully understand the differences and similarities between the roles played by private consultants and traditional intermediaries in TT projects.



**CHAPTER 8 -  
CONCLUSIONS AND FUTURE  
DEVELOPMENT**

## **CHAPTER 8 - CONCLUSIONS AND FUTURE DEVELOPMENTS**

### **8.1 Conclusions**

The research proposed and conducted in this thesis emerges from an evolution in the literature on innovation systems and the need for a more comprehensive understanding of the role of intermediaries in technology transfer (TT), specifically focusing on the role of private innovation consultants. This research gap was combined with the researcher's personal motivations, as he has a professional background connected to consultancy in the Portuguese NIS and felt the necessity to expand and enhance the knowledge regarding the understanding and recognition of the private consultant's role as an innovation intermediary in TT projects.

The literature review uncovered fragmented, dispersed, and insufficiently explored knowledge about organizations functioning as innovation intermediaries and their specific roles in TT. Hence, a compilation of knowledge was undertaken to develop key research support frameworks, including the identification of thirteen key intermediary's role specializations presented in Table 3 (p. 72).

Following the ideas and theoretical frameworks found in the literature (Cabral, 2018; Howells, 2006; Oliveira & Teixeira, 2010), a comprehensive mixed research methodology was formulated and implemented. The study encompassed both qualitative research, employing an exploratory approach, and quantitative research, utilizing statistical analysis. For the qualitative aspect, semi-structured interviews were conducted with 19 diverse participants representing the Portuguese NIS. These interviews aimed to delve into various aspects of the NIS and provide valuable insights. In parallel, the quantitative research component involved a statistical analysis of 219 TT projects. These projects were examined through document analysis sourced from the archives of a specific private consulting firm, serving as a representative case study. By employing this mixed research methodology, a more comprehensive understanding of the subject matter was achieved, combining in-depth qualitative insights from interviews with the broader quantitative analysis of the TT projects.

With the analysis of the results of the interviews, a set of hypotheses was proposed and statistically analysed respecting the previously proposed research objectives. The resulting data of the final research stage of statistical analysis was cross discussed by comparing it with the literature's main ideas and interviews' most debated topics. In some cases, this allowed verifying and validating ideas and hypotheses, and in other cases fostered further discussion. Even so, the research achieved its initially underlined objectives, having also provided significant answers to the hypotheses proposed. Additionally, several research ideas emerged from the research stages with more exploratory natures, spilling over to future research.

From this research, seven key findings can be highlighted:

1. The concept of the “intermediation role” has evolved into an umbrella term composed of multiple roles and specializations;
2. Private consultants play a role as innovation intermediaries in TT;
3. The roles played by private consultants as innovation intermediaries may be influenced by the originator of the technology transfer project;
4. The role of private consultants in innovation and technology transfer goes beyond the specializations they perform;
5. The involvement of private consultants as innovation intermediaries in TT projects is motivated by more than just the roles they can perform;
6. Private consultants can perform their role as intermediaries simultaneously with other traditional intermediaries in the same TT projects;
7. The roles performed by private consultants may not fundamentally differ from those played by traditional intermediaries when collaborating on the same TT project.

The private consultant has proven to be an active agent with an intermediary role in the Portuguese NIS, particularly in TT projects. As a private player, it possesses a set of market-oriented characteristics that go beyond the existing knowledge provided by traditional intermediaries. Acting on a for-profit basis, private consultants stand out for their proactivity in the market, both upstream in collaborations with academia and mainly downstream in continued collaboration with potential recipient companies. Specifically, in the analysed case study, the external factor of the existence of financial incentives and funds to support R&D and TT activities proved to be external catalysts for the involvement of consultants in supporting projects and business objectives. The private consultant’s role and positioning in the Portuguese NIS proved to go beyond the activities in which they have specialized, with their value proposition based on the characteristics of the consultancy firm.

Although the existence of collaboration (in both ways) between the private and public sectors has been validated, further research is required regarding this relationship. Private consulting firms will remain in the Portuguese NIS and may represent some competition as their roles can substitute or overlap with the ones provided by formal mechanisms defined by the system. Even so, understanding the role of the private consultant as an innovation intermediary should be a decision basis for the regulation of the intermediation markets of ITT.

Private consultants' role as innovation intermediaries was widely known by the NIS players interviewed, yet informally. The value of this not-entirely-new intermediary, whether as a complement or a learning opportunity, is intrinsically linked to its formal recognition within the NIS. However, the recognition of private consultants by the NIS as Innovation Intermediaries might depend on the further development of the comprehension of where and how their roles are positioned within the system.

The findings of this research provide valuable insights into the role of private consultants as intermediaries in innovation and TT and could potentially inform policy and practice in the field. However, further research is necessary to explore and expand upon these findings.

## **8.2 Limitations and Future developments**

### **8.2.1 Discussing limitations**

As with any research project, this study was not without limitations. The study was developed over five years and faced several challenges and setbacks, which resulted in adjustments to the work plan and delays. Two major limitations were highlighted by the researcher.

**Limitations and necessary adjustments to the initially designed interviews were required due to the COVID-19 pandemic.** By early 2020, the COVID-19 pandemic had hit globally. It was a phase of uncertainty with constant changes to daily life, relationships, and work. Remote working and businesses working at half-speed allowed the researcher to advance the literature review and the design of the interviews to be conducted. However, it was difficult to reach people as never before. Presential interviews were prohibited, and many of those invited to participate in the interviews were having a hard time with remote working, overflowing with emails, phone calls, and video calls.

Forty-two people were invited to participate in the interviews to be a representative element of some NIS agents. Many did not respond to any contact attempt, and others indicated they were unavailable. Reaching people was limited to email and social media.

Also, interviewing the nineteen participants who graciously accepted the invitation had its challenges, as many participants had different preferences for the platform of video calling, and some even wanted to try the interview through phone calls and in-person (discarding the restrictions). Booking interviews was particularly challenging, recording interviews on multiple platforms was complex, and the process was not linear and standardized as initially idealized by the researcher.

**The secrecy and confidentiality within consultancy players restricted the sample size and representativeness.** Private consultants, as privately owned businesses with their methodologies and tools, tend to be highly confidential regarding their knowledge. As a KIBS, their

knowledge is a vital part of their value proposition. Additionally, as discussed in the research, the network of private consultants is a highly sensitive and key success factor for each firm. Therefore, access to sensitive details of the consultants' roles, participants, and lead origins from each TT project proved to be impossible for most private consultancy firms.

Using the researcher's professional network of contacts and partners, it was possible to reach and interview some consultants regarding a wide range of topics. However, only one firm permitted access to their archive, out of a pool of four consultancies solicited. The document analysis from the consultancy firm studied in this thesis was also limited, as some data was censored or purposely out of reach. From the interviews to the case study, many names, corporations, and organizations were involved. Some were open, while others were accepted with conditions of anonymity and further data validation before publication.

Still, the case study consultancy firm revealed a considerably large amount of TT projects, allowing the research to be conducted with statistical significance. However, the case study results, even statistically significant, may not be generalized to the overall population, as different types of private consultants, especially when operating in distinct sector/technology fields, may present different behaviours.

### **8.2.2 Future developments**

Based on the results achieved, several topics of discussion have emerged that go beyond the research objectives. As with any research, further developments are key to advancing the field. Therefore, based on the key findings and conclusions presented, four main future developments can be proposed.

**Replication of the case study in different private consultancy firms and sectors.** As previously discussed in the limitations found, private consultants are specialized KIBS operating in the market to create value where they can have a profit. Private consultants are highly dependent on their networks, and the innovation market is built upon several clusters overlapping between them. Each sector has its characteristics, needs, and limitations, and private consultants operate vertically in submarkets created by them within a specific field/sector.

Therefore, differences in intermediation role specializations are expected. Replicating this study in additional case studies would allow the identification of such differences, as well as similarities. These similarities across private consultants would contribute to a better understanding of the role of private consultants as innovation intermediaries.

**Further research developments into the role of private consultants**, specifically regarding additional factors contributing to their perceived value proposition both to businesses (as their clients) and also other NIS agents'. As highly discussed throughout the study, the true understanding of the role of an intermediary must include all the additional variables contributing to such value proposition. In the private consultant's case, it could be their characteristics, the specificities of the sector they operate in, external market conditions, or even organisations internal motivations (both public and private). Being for profit and highly specialized companies selling what could be in many cases the same role specialization offered freely by traditional intermediaries (as seen in the results of this study) additional research must be conducted to fully justify such market behaviour.

**Explore and define the positioning of private consultants within the innovation market.** A positioning mapping of key players operating within a NIS, combined with a definition of private consultants' positioning, could support policymakers and NIS regulators in visualizing and understanding their roles and relationships. In particular, it is yet to be understood to what extent private consultants may pose as a friend or foe to the currently regulated organisms (e.g., traditional intermediaries). With private consultants operating between academic sources and industry receivers of technology, taking advantage of systematic failures and market gaps, even traditional intermediaries such as TTO and TIC are beginning to rely on them, as seen in this study. The scope of role specializations of a traditional intermediary, as it is described in literature, might be changing, as market forces can be creating a new specialization distribution of roles by intermediaries. Yet, further research is needed to validate such a hypothesis.

**Identify and measure the impact private consultants' role and positioning have on the NIS.** This perspective of future work concerns the range of variables and factors that can be used to understand and measure what can be considered the impact of private consulting firms acting as innovation intermediaries in the Portuguese NIS, especially in technology transfer. There is valuable knowledge to be gained from the study of these intermediary agents who have become professionals in creating responses to the system's gaps. Policymakers must begin to recognize innovation consultancies for their role and impact on the system.

Only true recognition will allow lessons learned from the true impact of this network of private consultants, thus sustaining future strategic and political guidelines to control and regulate the performance of these private agents or a redefinition of innovation programs designed to take complementary advantage of the role of the private sector as an extension of the traditional mechanisms already in place.

## **SCIENTIFIC PUBLICATIONS**

**J. Soares**, F. Romero, and M. Lopes Nunes, "Innovation and technology transfer: a framework for clustering intermediation roles," 2020 IEEE International Conference on Technology Management, Operations and Decisions (ICTMOD), Marrakech, Morocco, 2020, pp. 1-6, doi: 10.1109/ICTMOD49425.2020.9380600.

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## **ANNEX I – INTERVIEW GUIDE**

As in the previous contact, my name is João Soares, I am a PhD student at University of Minho (ID8079) researching **the role of private consultants acting as innovation intermediaries in TT projects**.

The purpose this interview is to collect and analyse the perceptions and experiences regarding the use of private consultants as innovation intermediaries in TT projects, as well as other more traditional (public) intermediaries (such as TTO and TIC). Several professionals, such as yourself, representing key player's institutions within the Portuguese NIS will be interviewed. Institutions such as research centres, universities, companies, public and governmental institutions, industrial associations, and private consultants.

Due to the ongoing COVID-19 pandemic restrictions, the interviews can be conducted in person or through alternative communication channels such as video conference or by phone call. **Interview's raw data such as recordings and transcriptions are to be used by the researcher for research purposes only. Key excerpts and notes can be used and made public only with express authorization/validation from the interviewee. All data will be used under total anonymity for both the interviewees and the organisations they represent/are part of.**

The interview is composed of 5 open-ended questions to allow for a more detailed and in-depth exploration of the topic and 1 assisted survey part in the end. The interview has an estimated duration of 45 minutes and will be conducted by the researcher himself in a semi-structured way.

### **Research context:**

TT is a critical aspect of innovation, and intermediaries play a crucial role in facilitating the transfer of technology between academia and industry. Private consultants have emerged as important intermediaries in recent years, and their role has been increasingly recognized as crucial to the success of TT projects. However, little research has been conducted on the role of these players as innovation intermediaries in the TT processes within NIS.

**NOTE: Please keep in mind that all the questions in this interview focus on the TT process within the Portuguese NIS and the role intermediary organisations play with key TT stakeholders such as academic/research institutions and companies.**

**1. What is your perception and experience with public/traditional intermediaries?**

Support guides: How familiar you are? Do you have previous experiences (good or bad)? Elaborate on your perceptions/opinion about this kind of intermediaries (e.g., TTO, TIC).

**2. What is your perception and experience with private intermediaries, namely private consultants?**

Support guides: How familiar you are? Do you have previous experiences (good or bad)? Elaborate on your perceptions/opinions about this kind of intermediaries.

**3. What are the key characteristics, skills and roles sought in consultants (value proposition)?**

Support guides: Many consultants are being involved in TT projects? What do they have to offer? (roles, specializations, resources, other?).

**4. Are private consultants' competition (threat) or complementary (opportunity) to public/traditional intermediaries?**

Support guides: How do they compare? How do they differ? How they relate within the NIS?

**5. Are there other factors, external to the private consultants, that might be contributing for their involvement in TT projects?**

Support guides: Why a private consultant might be chosen instead of a traditional intermediary? Are there external factors that can favour private consultants (e.g., project phase, TRL, sector, political, etc)

**6. (In your opinion,) do the NIS's key actors recognize the private consultant's role as an innovation intermediary? Is this recognition reflected in the innovation and TT support programs and incentives policies?**

Support guides: Are consultants generally seen as TT innovation intermediaries by other organisations? Do you think private consultants' role is recognized/taken into account at policy/decision-making levels?

**7. ASSISTED SURVEY: Which roles/specializations do you identify as being performed by private consultants as intermediaries?**

Support guides: I'm going to present you with a checklist of intermediary roles. I'll be checking if you consider that a private consultant play – totally on just in part – any of these roles/specializations.

| <b>Specializations</b>                            | <b>Description</b>  | <b>X</b> |
|---|---|----------|
| <b>Policy &amp; Strategy</b>                      | Support and lobby policymakers in the development and implementation of regional, sectorial, or national-wide innovation policy strategies, providing a connection to government and public entities in matters of innovation.  |          |
| <b>Mediation &amp; Mobilization</b>               | Create and coordinate networks and other strategic intermediation platforms, providing neutral grounds to foster collaboration between innovation system's stakeholders and potentiate the mobilization of its key resources.   |          |
| <b>Knowledge Diffusion &amp; Support</b>          | Act as a two-way communication channel between university and industry, providing a centralized point of contact to both knowledge diffusion and knowledge support.   |          |
| <b>Funding &amp; Finance</b>                      | The focus is to identify and bid to funding opportunities aligned with project needs, or in the due diligence and activities related to the strategic selection and sourcing of public or private financing schemes.  |          |
| <b>Technology Scouting &amp; Market Foresight</b> | Constantly monitor the technology state of the art evolution, scan and gather information to support innovation decisions and technology procurement. Playing as an input source of market opportunities through strategic foresight activities, such as identifying and diagnosing market trends, industry' needs and innovation challenges.   |          |
| <b>Design &amp; Idealization</b>                  | Support the conceptualization and generation of new project ideas, by assisting in the idealization process contributing with knowledge and creative support.   |          |
| <b>Brokering &amp; Gatekeeping</b>                | Brokering & Gatekeeping technology, R&D results, and intellectual property, arranging and negotiate technology deals between sources and interested recipients.   |          |
| <b>Project Management &amp; Assessment</b>        | Assisting with the design, set-up and management of projects properly aligned with defined goals and needs, interacting regularly with key stakeholders from project administration and execution control tasks. Also, since acting as neutral third parties, intermediaries can independently assess and evaluate technology transfer projects performance and its impacts.  |          |
| <b>Financial &amp; Technical Feasibility</b>      | Assisting with concept proofing, supplying qualified feasibility analysis, and testing, diagnosing, and evaluating ideas, models, and technologies' prototypes in order to validate and evaluate its potential.   |          |
| <b>Accreditation &amp; Quality</b>                | Support in accreditation and standards, providing assistance in technology regulation and arbitration due diligences and through quality processes.   |          |
| <b>Intellectual Property &amp; Rights</b>         | Support R&D and technology needs through legal strategies, representing and supporting bureaucratic processes to protect and value intellectual property, rights, and other innovation assets.  |          |
| <b>Implementation &amp; Knowledge Transfer</b>    | Be part of the technology transfer and implementation processes fostering the recipient absorptive capacity through knowledge transfer strategies such as the selection and training of specialised workforces.   |          |
| <b>Marketing &amp; Business Development</b>       | Bridge and help to sell ready-to-market technology innovations, by assisting in key business activities like marketing research and strategy and after by assisting in the commercialization process. Also, in the case of entrepreneurial technology transfer strategies, being in the form of spin-offs and/or start-ups, it adds up the need for business development support to create, accelerate and grow the ventures. |          |

## ANNEX II – SPSS OUTPUTS

### Descriptive Analysis of the Sample

|                                 |                                  | Count      | Column<br>N % | 95,0%<br>Lower CL<br>for Column<br>N % | 95,0%<br>Upper CL<br>for Column<br>N % |
|---------------------------------|----------------------------------|------------|---------------|--|--|
| <b>Sector/Technology</b>        | ICT                              | 206        | 94,1%         | 90,3%                                  | 96,6%                                  |
| <b>Domain</b>                   | Electronics and Computers        | 6          | 2,7%          | 1,2%                                   | 5,6%                                   |
|                                 | Mechanical                       | 4          | 1,8%          | 0,6%                                   | 4,3%                                   |
|                                 | Industrial                       | 3          | 1,4%          | 0,4%                                   | 3,6%                                   |
|                                 | Automation/Robotics              |            |               |  |  |
|                                 | <b>Total</b>                     | <b>219</b> | <b>100,0%</b> | .                                      | .                                      |
| <b>Type of Origin</b>           | University/TTO                   | 4          | 1,8%          | 0,6%                                   | 4,3%                                   |
| <b>Entity</b>                   | Research Centre / Tech Interface | 10         | 4,6%          | 2,4%                                   | 7,9%                                   |
|                                 | Recipient Company                | 128        | 58,4%         | 51,8%                                  | 64,8%                                  |
|                                 | Private Consultant               | 77         | 35,2%         | 29,1%                                  | 41,6%                                  |
|                                 | <b>Total</b>                     | <b>219</b> | <b>100,0%</b> | .                                      | .                                      |
| <b>Contact of the Source</b>    | University/TTO                   | 5          | 2,3%          | 0,9%                                   | 4,9%                                   |
|                                 | Research Centre / Tech Interface | 6          | 2,7%          | 1,2%                                   | 5,6%                                   |
|                                 | Recipient Company                | 5          | 2,3%          | 0,9%                                   | 4,9%                                   |
|                                 | Private Consultant               | 203        | 92,7%         | 88,7%                                  | 95,6%                                  |
|                                 | Total                            | 219        | 100,0%        | .                                      | .                                      |
| <b>Contact of the Recipient</b> | University/TTO                   | 0          | 0,0%          | .                                      | .                                      |
|                                 | Research Centre / Tech Interface | 0          | 0,0%          | .                                      | .                                      |
|                                 | Recipient Company                | 128        | 58,4%         | 51,8%                                  | 64,8%                                  |
|                                 | Private Consultant               | 91         | 41,6%         | 35,2%                                  | 48,2%                                  |
|                                 | <b>Total</b>                     | <b>219</b> | <b>100,0%</b> | .                                      | .                                      |
| <b>Year of the project</b>      | 2014                             | 5          | 2,3%          | 0,9%                                   | 4,9%                                   |
|                                 | 2015                             | 18         | 8,2%          | 5,1%                                   | 12,4%                                  |
|                                 | 2016                             | 43         | 19,6%         | 14,8%                                  | 25,3%                                  |
|                                 | 2017                             | 37         | 16,9%         | 12,4%                                  | 22,3%                                  |
|                                 | 2018                             | 58         | 26,5%         | 21,0%                                  | 32,6%                                  |
|                                 | 2019                             | 5          | 2,3%          | 0,9%                                   | 4,9%                                   |
|                                 | 2020                             | 52         | 23,7%         | 18,5%                                  | 29,7%                                  |
|                                 | 2021                             | 1          | 0,5%          | 0,0%                                   | 2,1%                                   |
|                                 | <b>Total</b>                     | <b>219</b> | <b>100,0%</b> | .                                      | .                                      |



|   |              | Count      | Column N %    | 95,0% Lower CL for Column N % | 95,0% Upper CL for Column N % |
|---|--------------|------------|---------------|-------------------------------|-------------------------------|
| <b>Existence of previous interaction</b>      | No           | 20         | 9,1%          | 5,9%                          | 13,5%                         |
|   | Yes          | 199        | 90,9%         | 86,5%                         | 94,1%                         |
|   | <b>Total</b> | <b>219</b> | <b>100,0%</b> | .                             | .                             |
| <b>Looking for Financing Options</b>          | No           | 9          | 4,1%          | 2,1%                          | 7,4%                          |
|   | Yes          | 210        | 95,9%         | 92,6%                         | 97,9%                         |
|   | <b>Total</b> | <b>219</b> | <b>100,0%</b> | .                             | .                             |
| <b>Looking for Partners/Contacts</b>          | No           | 154        | 70,3%         | 64,0%                         | 76,1%                         |
|   | Yes          | 65         | 29,7%         | 23,9%                         | 36,0%                         |
|   | <b>Total</b> | <b>219</b> | <b>100,0%</b> | .                             | .                             |
| <b>Looking for technical know-how</b>         | No           | 184        | 84,0%         | 78,7%                         | 88,4%                         |
|   | Yes          | 35         | 16,0%         | 11,6%                         | 21,3%                         |
|   | <b>Total</b> | <b>219</b> | <b>100,0%</b> | .                             | .                             |
| <b>Looking for Project Management Support</b> | No           | 143        | 65,3%         | 58,8%                         | 71,4%                         |
|   | Yes          | 76         | 34,7%         | 28,6%                         | 41,2%                         |
|   | <b>Total</b> | <b>219</b> | <b>100,0%</b> | .                             | .                             |
| <b>Came due to WoM or good References</b>     | No           | 117        | 53,4%         | 46,8%                         | 60,0%                         |
|   | Yes          | 102        | 46,6%         | 40,0%                         | 53,2%                         |
|   | <b>Total</b> | <b>219</b> | <b>100,0%</b> | .                             | .                             |

|   |  | Count | Column N % | 95,0% Lower CL for Column N % | 95,0% Upper CL for Column N % |
|---|--|-------|------------|-------------------------------|-------------------------------|
| <b>Initial TRL</b>  | 2  | 1     | 0,5%       | 0,0%                          | 2,1%                          |
|   | 3  | 46    | 21,0%      | 16,0%                         | 26,8%                         |
|   | 4  | 139   | 63,5%      | 56,9%                         | 69,6%                         |
|   | 5  | 22    | 10,0%      | 6,6%                          | 14,5%                         |
|   | 6  | 11    | 5,0%       | 2,7%                          | 8,5%                          |
|   | <b>Participation of another Private Intermediaries</b> | No    | 216        | 98,6%                         | 96,4%                         |
|   | Yes  | 3     | 1,4%       | 0,4%                          | 3,6%                          |
| <b>Participation of Other traditional / Public Intermediaries</b> | No   | 190   | 86,8%      | 81,8%                         | 90,8%                         |
|   | Yes  | 29    | 13,2%      | 9,2%                          | 18,2%                         |

## Descriptive Analysis to the Sample – Roles performed by the private consultancy firm

|   |     | Count | Column N % | 95,0% Lower<br>CL for Column<br>N % | 95,0% Upper<br>CL for Column<br>N % |
|---|-----|-------|------------|-------------------------------------|-------------------------------------|
| <b>Policy &amp; Strategy</b>                      | No  | 219   | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |
| <b>Mediation &amp; Mobilization</b>               | No  | 212   | 96,8%      | 93,8%                               | 98,6%                               |
|   | Yes | 7     | 3,2%       | 1,4%                                | 6,2%                                |
| <b>Knowledge Diffusion &amp; Support</b>          | No  | 219   | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |
| <b>Funding &amp; Finance</b>                      | No  | 7     | 3,2%       | 1,4%                                | 6,2%                                |
|   | Yes | 212   | 96,8%      | 93,8%                               | 98,6%                               |
| <b>Technology Scouting &amp; Market Foresight</b> | No  | 95    | 43,4%      | 36,9%                               | 50,0%                               |
|   | Yes | 124   | 56,6%      | 50,0%                               | 63,1%                               |
| <b>Design &amp; Idealization</b>                  | No  | 151   | 68,9%      | 62,6%                               | 74,8%                               |
|   | Yes | 68    | 31,1%      | 25,2%                               | 37,4%                               |
| <b>Brokering &amp; Gatekeeping</b>                | No  | 204   | 93,2%      | 89,2%                               | 95,9%                               |
|   | Yes | 15    | 6,8%       | 4,1%                                | 10,8%                               |
| <b>Project Management &amp; Assessment</b>        | No  | 25    | 11,4%      | 7,7%                                | 16,1%                               |
|   | Yes | 194   | 88,6%      | 83,9%                               | 92,3%                               |
| <b>Financial &amp; Technical Feasibility</b>      | No  | 177   | 80,8%      | 75,2%                               | 85,6%                               |
|   | Yes | 42    | 19,2%      | 14,4%                               | 24,8%                               |
| <b>Accreditation &amp; Quality</b>                | No  | 218   | 99,5%      | 97,9%                               | 100,0%                              |
|   | Yes | 1     | 0,5%       | 0,0%                                | 2,1%                                |
| <b>Intellectual Property &amp; Rights</b>         | No  | 215   | 98,2%      | 95,7%                               | 99,4%                               |
|   | Yes | 4     | 1,8%       | 0,6%                                | 4,3%                                |
| <b>Implementation &amp; Knowledge Transfer</b>    | No  | 219   | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |
| <b>Marketing &amp; Business Development</b>       | No  | 189   | 86,3%      | 81,3%                               | 90,4%                               |
|   | Yes | 30    | 13,7%      | 9,6%                                | 18,7%                               |

## Descriptive Analysis to the Sample – Roles performed by other traditional intermediaries

|   |     | Count | Column N % | 95,0% Lower<br>CL for Column<br>N % | 95,0% Upper<br>CL for Column<br>N % |
|---|-----|-------|------------|-------------------------------------|-------------------------------------|
| <b>Policy &amp; Strategy</b>                      | No  | 29    | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |
| <b>Mediation &amp; Mobilization</b>               | No  | 23    | 79,3%      | 62,2%                               | 90,9%                               |
|   | Yes | 6     | 20,7%      | 9,1%                                | 37,8%                               |
| <b>Knowledge Diffusion &amp; Support</b>          | No  | 24    | 82,8%      | 66,3%                               | 93,1%                               |
|   | Yes | 5     | 17,2%      | 6,9%                                | 33,7%                               |
| <b>Funding &amp; Finance</b>                      | No  | 7     | 24,1%      | 11,5%                               | 41,6%                               |
|   | Yes | 22    | 75,9%      | 58,4%                               | 88,5%                               |
| <b>Technology Scouting &amp; Market Foresight</b> | No  | 29    | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |
| <b>Design &amp; Idealization</b>                  | No  | 16    | 55,2%      | 37,3%                               | 72,1%                               |
|   | Yes | 13    | 44,8%      | 27,9%                               | 62,7%                               |
| <b>Brokering &amp; Gatekeeping</b>                | No  | 24    | 82,8%      | 66,3%                               | 93,1%                               |
|   | Yes | 5     | 17,2%      | 6,9%                                | 33,7%                               |
| <b>Project Management &amp; Assessment</b>        | No  | 7     | 24,1%      | 11,5%                               | 41,6%                               |
|   | Yes | 22    | 75,9%      | 58,4%                               | 88,5%                               |
| <b>Financial &amp; Technical Feasibility</b>      | No  | 21    | 72,4%      | 54,6%                               | 86,0%                               |
|   | Yes | 8     | 27,6%      | 14,0%                               | 45,4%                               |
| <b>Accreditation &amp; Quality</b>                | No  | 29    | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |
| <b>Intellectual Property &amp; Rights</b>         | No  | 25    | 86,2%      | 70,5%                               | 95,2%                               |
|   | Yes | 4     | 13,8%      | 4,8%                                | 29,5%                               |
| <b>Implementation &amp; Knowledge Transfer</b>    | No  | 24    | 82,8%      | 66,3%                               | 93,1%                               |
|   | Yes | 5     | 17,2%      | 6,9%                                | 33,7%                               |
| <b>Marketing &amp; Business Development</b>       | No  | 29    | 100,0%     | .                                   | .                                   |
|   | Yes | 0     | 0,0%       | .                                   | .                                   |

## Statistical Tests – Hypothesis 1

### *Case Processing Summary*

|  | <b>Cases</b> |         |                |         |              |         |
|--|--------------|---------|----------------|---------|--------------|---------|
|  | <b>Valid</b> |         | <b>Missing</b> |         | <b>Total</b> |         |
|  | N            | Percent | N              | Percent | N            | Percent |
| Type of Origin Entity * Policy & Strategy                      | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Mediation & Mobilization               | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Knowledge Diffusion & Support          | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Funding & Finance                      | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Technology Scouting & Market Foresight | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Design & Idealization                  | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Brokering & Gatekeeping                | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Project Management & Assesment         | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Financial & Technical Feasibility      | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Accreditation & Quality                | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Intellectual Property & Rights         | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Implementation & Knowledge Transfer    | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |
| Type of Origin Entity * Marketing & Business Development       | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |

**Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Policy & Strategy (Role)**

***Crosstab***

|                       |                                  |                                | <b>Policy &amp; Strategy</b> |              |
|-----------------------|----------------------------------|--------------------------------|------------------------------|--------------|
|                       |                                  |                                | <b>No</b>                    | <b>Total</b> |
| Type of Origin Entity | University/TTO                   | Count                          | 4                            | 4            |
|                       |                                  | % within Type of Origin Entity | 100,0%                       | 100,0%       |
|                       | Research Centre / Tech Interface | Count                          | 10                           | 10           |
|                       |                                  | % within Type of Origin Entity | 100,0%                       | 100,0%       |
|                       | Recipient Company                | Count                          | 128                          | 128          |
|                       |                                  | % within Type of Origin Entity | 100,0%                       | 100,0%       |
|                       | Private Consultant               | Count                          | 77                           | 77           |
|                       |                                  | % within Type of Origin Entity | 100,0%                       | 100,0%       |
| Total                 | Count                            |                                | 219                          | 219          |
|                       | % within Type of Origin Entity   |                                | 100,0%                       | 100,0%       |

***Chi-Square Tests***

|                    | Value          |
|--------------------|----------------|
| Pearson Chi-Square | . <sup>a</sup> |
| N of Valid Cases   | 219            |

**a. No statistics are computed because Policy & Strategy is a constant.**

## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Mediation & Mobilization (Role)

### *Crosstab*

|                       |                                  |                                | <b>Mediation &amp; Mobilization</b> |            |              |
|-----------------------|----------------------------------|--------------------------------|-------------------------------------|------------|--------------|
|                       |                                  |                                | <b>No</b>                           | <b>Yes</b> | <b>Total</b> |
| Type of Origin Entity | University/TTO                   | Count                          | 4                                   | 0          | 4            |
|                       |                                  | % within Type of Origin Entity | 100,0%                              | 0,0%       | 100,0%       |
|                       | Research Centre / Tech Interface | Count                          | 9                                   | 1          | 10           |
|                       |                                  | % within Type of Origin Entity | 90,0%                               | 10,0%      | 100,0%       |
| Recipient Company     |                                  | Count                          | 123                                 | 5          | 128          |
|                       |                                  | % within Type of Origin Entity | 96,1%                               | 3,9%       | 100,0%       |
| Private Consultant    |                                  | Count                          | 76                                  | 1          | 77           |
|                       |                                  | % within Type of Origin Entity | 98,7%                               | 1,3%       | 100,0%       |
| Total                 |                                  | Count                          | 212                                 | 7          | 219          |
|                       |                                  | % within Type of Origin Entity | 96,8%                               | 3,2%       | 100,0%       |

### *Chi-Square Tests*

|                              | Value              | df | Asymptotic Significance (2-sided) |
|------------------------------|--------------------|----|-----------------------------------|
| Pearson Chi-Square           | 2,733 <sup>a</sup> | 3  | ,435                              |
| Likelihood Ratio             | 2,574              | 3  | ,462                              |
| Linear-by-Linear Association | 1,314              | 1  | ,252                              |
| N of Valid Cases             | 219                |    |                                   |

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,13.

**Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Knowledge Diffusion & Support (Role)**

***Crosstab***

|                                  |                                | <b>Knowledge Diffusion<br/>&amp; Support</b> |              |
|----------------------------------|--------------------------------|--|--------------|
|                                  |                                | No   | <b>Total</b> |
| Type of Origin Entity            | University/TTO                 | 4  | 4            |
|                                  | Count                          | 100,0%                                       | 100,0%       |
|                                  |                                | Entity                                       |              |
| Research Centre / Tech Interface | Count                          | 10   | 10           |
|                                  | % within Type of Origin Entity | 100,0%                                       | 100,0%       |
|                                  |                                | Entity                                       |              |
| Recipient Company                | Count                          | 128  | 128          |
|                                  | % within Type of Origin Entity | 100,0%                                       | 100,0%       |
|                                  |                                | Entity                                       |              |
| Private Consultant               | Count                          | 77   | 77           |
|                                  | % within Type of Origin Entity | 100,0%                                       | 100,0%       |
|                                  |                                | Entity                                       |              |
| Total                            | Count                          | 219  | 219          |
|                                  | % within Type of Origin Entity | 100,0%                                       | 100,0%       |

***Chi-Square Tests***

|                    | Value |
|--------------------|-------|
| Pearson Chi-Square | .a    |
| N of Valid Cases   | 219   |

**a. No statistics are computed because Knowledge Diffusion & Support is a constant.**

## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Funding & Finance (Role)

### *Crosstab*

|                                  |                |                                | <b>Funding &amp; Finance</b> |            |              |
|----------------------------------|----------------|--------------------------------|------------------------------|------------|--------------|
|                                  |                |                                | <b>No</b>                    | <b>Yes</b> | <b>Total</b> |
| Type of Origin Entity            | University/TTO | Count                          | 1                            | 3          | 4            |
|                                  |                | % within Type of Origin Entity | 25,0%                        | 75,0%      | 100,0%       |
| Research Centre / Tech Interface |                | Count                          | 1                            | 9          | 10           |
|                                  |                | % within Type of Origin Entity | 10,0%                        | 90,0%      | 100,0%       |
| Recipient Company                |                | Count                          | 3                            | 125        | 128          |
|                                  |                | % within Type of Origin Entity | 2,3%                         | 97,7%      | 100,0%       |
| Private Consultant               |                | Count                          | 2                            | 75         | 77           |
|                                  |                | % within Type of Origin Entity | 2,6%                         | 97,4%      | 100,0%       |
| Total                            |                | Count                          | 7                            | 212        | 219          |
|                                  |                | % within Type of Origin Entity | 3,2%                         | 96,8%      | 100,0%       |

### *Chi-Square Tests*

|                              | Value              | df | Asymptotic Significance (2-sided) |
|------------------------------|--------------------|----|-----------------------------------|
| Pearson Chi-Square           | 8,032 <sup>a</sup> | 3  | ,045                              |
| Likelihood Ratio             | 3,978              | 3  | ,264                              |
| Linear-by-Linear Association | 3,076              | 1  | ,079                              |
| N of Valid Cases             | 219                |    |                                   |

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,13.



**Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Technology Scouting & Market Foresight (Role)**

***Crosstab***

|                                  |                | <b>Technology Scouting &amp; Market Foresight</b> |            |              |        |
|----------------------------------|----------------|---|------------|--------------|--------|
|                                  |                | <b>No</b>   | <b>Yes</b> | <b>Total</b> |        |
| Type of Origin Entity            | University/TTO | Count   | 1          | 3            | 4      |
|                                  |                | % within Type of Origin Entity                    | 25,0%      | 75,0%        | 100,0% |
| Research Centre / Tech Interface |                | Count   | 4          | 6            | 10     |
|                                  |                | % within Type of Origin Entity                    | 40,0%      | 60,0%        | 100,0% |
| Recipient Company                |                | Count   | 60         | 68           | 128    |
|                                  |                | % within Type of Origin Entity                    | 46,9%      | 53,1%        | 100,0% |
| Private Consultant               |                | Count   | 30         | 47           | 77     |
|                                  |                | % within Type of Origin Entity                    | 39,0%      | 61,0%        | 100,0% |
| Total                            |                | Count   | 95         | 124          | 219    |
|                                  |                | % within Type of Origin Entity                    | 43,4%      | 56,6%        | 100,0% |

***Chi-Square Tests***

|                              | Value              | df | Asymptotic Significance (2-sided) |
|------------------------------|--------------------|----|-----------------------------------|
| Pearson Chi-Square           | 1,845 <sup>a</sup> | 3  | ,605                              |
| Likelihood Ratio             | 1,882              | 3  | ,597                              |
| Linear-by-Linear Association | ,118               | 1  | ,731                              |
| N of Valid Cases             | 219                |    |                                   |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,74.

## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Design & Idealization (Role)

### *Crosstab*

|                                  |                | <b>Design &amp; Idealization</b> |            |              |        |
|----------------------------------|----------------|----------------------------------|------------|--------------|--------|
|                                  |                | <b>No</b>                        | <b>Yes</b> | <b>Total</b> |        |
| Type of Origin Entity            | University/TTO | Count                            | 2          | 2            | 4      |
|                                  |                | % within Type of Origin Entity   | 50,0%      | 50,0%        | 100,0% |
| Research Centre / Tech Interface |                | Count                            | 6          | 4            | 10     |
|                                  |                | % within Type of Origin Entity   | 60,0%      | 40,0%        | 100,0% |
| Recipient Company                |                | Count                            | 101        | 27           | 128    |
|                                  |                | % within Type of Origin Entity   | 78,9%      | 21,1%        | 100,0% |
| Private Consultant               |                | Count                            | 42         | 35           | 77     |
|                                  |                | % within Type of Origin Entity   | 54,5%      | 45,5%        | 100,0% |
| Total                            |                | Count                            | 151        | 68           | 219    |
|                                  |                | % within Type of Origin Entity   | 68,9%      | 31,1%        | 100,0% |

### *Chi-Square Tests*

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 14,434 <sup>a</sup> | 3  | ,002                              |
| Likelihood Ratio             | 14,339              | 3  | ,002                              |
| Linear-by-Linear Association | 4,022               | 1  | ,045                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is 1,24.

## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Brokering & Gatekeeping (Role)

### ***Crosstab***

|                                  |                                | <b>Brokering &amp; Gatekeeping</b> |            |              |
|----------------------------------|--------------------------------|------------------------------------|------------|--------------|
|                                  |                                | <b>No</b>                          | <b>Yes</b> | <b>Total</b> |
| Type of Origin Entity            | University/TTO                 | 2                                  | 2          | 4            |
|                                  | Count                          | 50,0%                              | 50,0%      | 100,0%       |
|                                  | % within Type of Origin Entity |                                    |            |              |
| Research Centre / Tech Interface | Count                          | 9                                  | 1          | 10           |
|                                  | % within Type of Origin Entity | 90,0%                              | 10,0%      | 100,0%       |
|                                  | % within Type of Origin Entity |                                    |            |              |
| Recipient Company                | Count                          | 122                                | 6          | 128          |
|                                  | % within Type of Origin Entity | 95,3%                              | 4,7%       | 100,0%       |
|                                  | % within Type of Origin Entity |                                    |            |              |
| Private Consultant               | Count                          | 71                                 | 6          | 77           |
|                                  | % within Type of Origin Entity | 92,2%                              | 7,8%       | 100,0%       |
|                                  | % within Type of Origin Entity |                                    |            |              |
| Total                            | Count                          | 204                                | 15         | 219          |
|                                  | % within Type of Origin Entity | 93,2%                              | 6,8%       | 100,0%       |
|                                  | % within Type of Origin Entity |                                    |            |              |

### ***Chi-Square Tests***

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 12,874 <sup>a</sup> | 3  | ,005                              |
| Likelihood Ratio             | 6,750               | 3  | ,080                              |
| Linear-by-Linear Association | 1,657               | 1  | ,198                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,27.

**Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Project Management & Assessment (Role)**

***Crosstab***

|                                  |                                | <b>Project Management &amp; Assessment</b> |            |              |        |
|----------------------------------|--------------------------------|--|------------|--------------|--------|
|                                  |                                | <b>No</b>                                  | <b>Yes</b> | <b>Total</b> |        |
| Type of Origin Entity            | University/TTO                 | Count                                      | 4          | 0            | 4      |
|                                  |                                | % within Type of Origin Entity             | 100,0%     | 0,0%         | 100,0% |
| Research Centre / Tech Interface | Count                          | 8  | 2          | 10           |        |
|                                  | % within Type of Origin Entity | 80,0%                                      | 20,0%      | 100,0%       |        |
| Recipient Company                | Count                          | 6  | 122        | 128          |        |
|                                  | % within Type of Origin Entity | 4,7%                                       | 95,3%      | 100,0%       |        |
| Private Consultant               | Count                          | 7  | 70         | 77           |        |
|                                  | % within Type of Origin Entity | 9,1%                                       | 90,9%      | 100,0%       |        |
| Total                            | Count                          | 25   | 194        | 219          |        |
|                                  | % within Type of Origin Entity | 11,4%                                      | 88,6%      | 100,0%       |        |

***Chi-Square Tests***

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 83,697 <sup>a</sup> | 3  | ,000                              |
| Likelihood Ratio             | 50,181              | 3  | ,000                              |
| Linear-by-Linear Association | 27,981              | 1  | ,000                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,46.

**Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Financial & Technical Feasibility (Role)**

***Crosstab***

|                                  |                | <b>Financial &amp; Technical Feasibility</b> |            |              |        |
|----------------------------------|----------------|--|------------|--------------|--------|
|                                  |                | <b>No</b>                                    | <b>Yes</b> | <b>Total</b> |        |
| Type of Origin Entity            | University/TTO | Count  | 2          | 2            | 4      |
|                                  |                | % within Type of Origin Entity               | 50,0%      | 50,0%        | 100,0% |
| Research Centre / Tech Interface |                | Count  | 6          | 4            | 10     |
|                                  |                | % within Type of Origin Entity               | 60,0%      | 40,0%        | 100,0% |
| Recipient Company                |                | Count  | 96         | 32           | 128    |
|                                  |                | % within Type of Origin Entity               | 75,0%      | 25,0%        | 100,0% |
| Private Consultant               |                | Count  | 73         | 4            | 77     |
|                                  |                | % within Type of Origin Entity               | 94,8%      | 5,2%         | 100,0% |
| Total                            |                | Count  | 177        | 42           | 219    |
|                                  |                | % within Type of Origin Entity               | 80,8%      | 19,2%        | 100,0% |

***Chi-Square Tests***

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 17,761 <sup>a</sup> | 3  | ,000                              |
| Likelihood Ratio             | 19,680              | 3  | ,000                              |
| Linear-by-Linear Association | 17,293              | 1  | ,000                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,77.

## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Accreditation & Quality (Role)

### *Crosstab*

|                                  |                | Accreditation & Quality        |        |       |        |
|----------------------------------|----------------|--------------------------------|--------|-------|--------|
|                                  |                | No                             | Yes    | Total |        |
| Type of Origin Entity            | University/TTO | Count                          | 3      | 1     | 4      |
|                                  |                | % within Type of Origin Entity | 75,0%  | 25,0% | 100,0% |
| Research Centre / Tech Interface |                | Count                          | 10     | 0     | 10     |
|                                  |                | % within Type of Origin Entity | 100,0% | 0,0%  | 100,0% |
| Recipient Company                |                | Count                          | 128    | 0     | 128    |
|                                  |                | % within Type of Origin Entity | 100,0% | 0,0%  | 100,0% |
| Private Consultant               |                | Count                          | 77     | 0     | 77     |
|                                  |                | % within Type of Origin Entity | 100,0% | 0,0%  | 100,0% |
| Total                            |                | Count                          | 218    | 1     | 219    |
|                                  |                | % within Type of Origin Entity | 99,5%  | 0,5%  | 100,0% |

### *Chi-Square Tests*

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 53,997 <sup>a</sup> | 3  | ,000                              |
| Likelihood Ratio             | 8,275               | 3  | ,041                              |
| Linear-by-Linear Association | 12,949              | 1  | ,000                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,02.

## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Intellectual Property & Rights (Role)

### *Crosstab*

|                                  |                | Intellectual Property & Rights |        |       |        |
|----------------------------------|----------------|--------------------------------|--------|-------|--------|
|                                  |                | No                             | Yes    | Total |        |
| Type of Origin Entity            | University/TTO | Count                          | 2      | 2     | 4      |
|                                  |                | % within Type of Origin Entity | 50,0%  | 50,0% | 100,0% |
| Research Centre / Tech Interface |                | Count                          | 10     | 0     | 10     |
|                                  |                | % within Type of Origin Entity | 100,0% | 0,0%  | 100,0% |
| Recipient Company                |                | Count                          | 128    | 0     | 128    |
|                                  |                | % within Type of Origin Entity | 100,0% | 0,0%  | 100,0% |
| Private Consultant               |                | Count                          | 75     | 2     | 77     |
|                                  |                | % within Type of Origin Entity | 97,4%  | 2,6%  | 100,0% |
| Total                            |                | Count                          | 215    | 4     | 219    |
|                                  |                | % within Type of Origin Entity | 98,2%  | 1,8%  | 100,0% |

### *Chi-Square Tests*

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 54,591 <sup>a</sup> | 3  | ,000                              |
| Likelihood Ratio             | 15,853              | 3  | ,001                              |
| Linear-by-Linear Association | 6,037               | 1  | ,014                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 5 cells (62,5%) have expected count less than 5. The minimum expected count is ,07.

**Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Implementation & Knowledge Transfer**

***Crosstab***

|                                  |                | <b>Implementation &amp; Knowledge Transfer</b> |           |              |
|----------------------------------|----------------|--|-----------|--------------|
|                                  |                |  | <b>No</b> | <b>Total</b> |
| Type of Origin Entity            | University/TTO | Count  | 4         | 4            |
|                                  |                | % within Type of Origin Entity                 | 100,0%    | 100,0%       |
| Research Centre / Tech Interface |                | Count  | 10        | 10           |
|                                  |                | % within Type of Origin Entity                 | 100,0%    | 100,0%       |
| Recipient Company                |                | Count  | 128       | 128          |
|                                  |                | % within Type of Origin Entity                 | 100,0%    | 100,0%       |
| Private Consultant               |                | Count  | 77        | 77           |
|                                  |                | % within Type of Origin Entity                 | 100,0%    | 100,0%       |
| Total                            |                | Count  | 219       | 219          |
|                                  |                | % within Type of Origin Entity                 | 100,0%    | 100,0%       |

***Chi-Square Tests***

|                    | Value          |
|--------------------|----------------|
| Pearson Chi-Square | . <sup>a</sup> |
| N of Valid Cases   | 219            |

**a. No statistics are computed because Implementation & Knowledge Transfer is a constant.**



## Statistical Tests – Hypothesis 1 - Type of Origin Entity \* Marketing & Business Development

### *Crosstab*

|                                  |                | Marketing & Business Development |       |       |        |
|----------------------------------|----------------|----------------------------------|-------|-------|--------|
|                                  |                | No                               | Yes   | Total |        |
| Type of Origin Entity            | University/TTO | Count                            | 2     | 2     | 4      |
|                                  |                | % within Type of Origin Entity   | 50,0% | 50,0% | 100,0% |
| Research Centre / Tech Interface |                | Count                            | 8     | 2     | 10     |
|                                  |                | % within Type of Origin Entity   | 80,0% | 20,0% | 100,0% |
| Recipient Company                |                | Count                            | 105   | 23    | 128    |
|                                  |                | % within Type of Origin Entity   | 82,0% | 18,0% | 100,0% |
| Private Consultant               |                | Count                            | 74    | 3     | 77     |
|                                  |                | % within Type of Origin Entity   | 96,1% | 3,9%  | 100,0% |
| Total                            |                | Count                            | 189   | 30    | 219    |
|                                  |                | % within Type of Origin Entity   | 86,3% | 13,7% | 100,0% |

### *Chi-Square Tests*

|                              | Value               | df | Asymptotic Significance (2-sided) |
|------------------------------|---------------------|----|-----------------------------------|
| Pearson Chi-Square           | 13,027 <sup>a</sup> | 3  | ,005                              |
| Likelihood Ratio             | 13,500              | 3  | ,004                              |
| Linear-by-Linear Association | 11,872              | 1  | ,001                              |
| N of Valid Cases             | 219                 |    |                                   |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,55.

## Statistical Tests – Hypothesis 2 – Previous interaction \* Type of Origin Entity

### *Case Processing Summary*

|   | Cases |         |         |         |       |         |
|---|-------|---------|---------|---------|-------|---------|
|   | Valid |         | Missing |         | Total |         |
|   | N     | Percent | N       | Percent | N     | Percent |
| Type of Origin Entity *<br>Existence of previous<br>interaction | 219   | 100,0%  | 0       | 0,0%    | 219   | 100,0%  |

### *Chi-Square Tests*

|                              | Value              | df | Asymptotic<br>Significance (2-<br>sided) |
|------------------------------|--------------------|----|--|
| Pearson Chi-Square           | 9,033 <sup>a</sup> | 3  | ,029                                     |
| Likelihood Ratio             | 8,989              | 3  | ,029                                     |
| Linear-by-Linear Association | 6,020              | 1  | ,014                                     |
| N of Valid Cases             | 219                |    |  |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,37.

***Type of Origin Entity \* Existence of previous interaction Crosstabulation***

|                                  |                | <b>Existence of previous interaction</b>   |            |              |        |
|----------------------------------|----------------|--|------------|--------------|--------|
|                                  |                | <b>No</b>                                  | <b>Yes</b> | <b>Total</b> |        |
| Type of Origin Entity            | University/TTO | Count                                      | 0          | 4            | 4      |
|                                  |                | % within Type of Origin Entity             | 0,0%       | 100,0%       | 100,0% |
|                                  |                | % within Existence of previous interaction | 0,0%       | 2,0%         | 1,8%   |
|                                  |                | % of Total                                 | 0,0%       | 1,8%         | 1,8%   |
| Research Centre / Tech Interface |                | Count                                      | 1          | 9            | 10     |
|                                  |                | % within Type of Origin Entity             | 10,0%      | 90,0%        | 100,0% |
|                                  |                | % within Existence of previous interaction | 5,0%       | 4,5%         | 4,6%   |
|                                  |                | % of Total                                 | 0,5%       | 4,1%         | 4,6%   |
| Recipient Company                |                | Count                                      | 6          | 122          | 128    |
|                                  |                | % within Type of Origin Entity             | 4,7%       | 95,3%        | 100,0% |
|                                  |                | % within Existence of previous interaction | 30,0%      | 61,3%        | 58,4%  |
|                                  |                | % of Total                                 | 2,7%       | 55,7%        | 58,4%  |
| Private Consultant               |                | Count                                      | 13         | 64           | 77     |
|                                  |                | % within Type of Origin Entity             | 16,9%      | 83,1%        | 100,0% |
|                                  |                | % within Existence of previous interaction | 65,0%      | 32,2%        | 35,2%  |
|                                  |                | % of Total                                 | 5,9%       | 29,2%        | 35,2%  |
| Total                            |                | Count                                      | 20         | 199          | 219    |
|                                  |                | % within Type of Origin Entity             | 9,1%       | 90,9%        | 100,0% |
|                                  |                | % within Existence of previous interaction | 100,0%     | 100,0%       | 100,0% |
|                                  |                | % of Total                                 | 9,1%       | 90,9%        | 100,0% |

**Statistical Tests – Hypothesis 3 – Type of Origin Entity \* Motivations**

***Case Processing Summary***

|  | <b>Cases</b> |         |                |         |              |         |
|--|--------------|---------|----------------|---------|--------------|---------|
|  | <b>Valid</b> |         | <b>Missing</b> |         | <b>Total</b> |         |
|  | N            | Percent | N              | Percent | N            | Percent |
| Type of Origin Entity *<br>Looking for Financing<br>Options          | 142          | 100,0%  | 0              | 0,0%    | 142          | 100,0%  |
| Type of Origin Entity *<br>Looking for<br>Partners/Contacts          | 142          | 100,0%  | 0              | 0,0%    | 142          | 100,0%  |
| Type of Origin Entity *<br>Looking for technical know-<br>how        | 142          | 100,0%  | 0              | 0,0%    | 142          | 100,0%  |
| Type of Origin Entity *<br>Looking for Project<br>Management Support | 142          | 100,0%  | 0              | 0,0%    | 142          | 100,0%  |
| Type of Origin Entity * Came<br>due to WoM or good<br>References     | 142          | 100,0%  | 0              | 0,0%    | 142          | 100,0%  |

### Statistical Tests – Hypothesis 3 – Type of Origin Entity \* Looking for Financing Options

#### ***Crosstab***

|   |  |  | <b>Looking for<br/>Financing Options</b> |            |              |
|---|--|--|--|------------|--------------|
|   |  |  | <b>No</b>                                | <b>Yes</b> | <b>Total</b> |
| Type of University/TTO<br>Origin Entity | Count                                  |  | 1  | 3          | 4            |
|   | % within Type of Origin Entity         |  | 25,0%                                    | 75,0%      | 100,0%       |
|   | % within Looking for Financing Options |  | 16,7%                                    | 2,2%       | 2,8%         |
|   | % of Total                             |  | 0,7%                                     | 2,1%       | 2,8%         |
| Research Centre<br>/ Tech Interface     | Count                                  |  | 3  | 7          | 10           |
|   | % within Type of Origin Entity         |  | 30,0%                                    | 70,0%      | 100,0%       |
|   | % within Looking for Financing Options |  | 50,0%                                    | 5,1%       | 7,0%         |
|   | % of Total                             |  | 2,1%                                     | 4,9%       | 7,0%         |
| Recipient<br>Company                    | Count                                  |  | 2  | 126        | 128          |
|   | % within Type of Origin Entity         |  | 1,6%                                     | 98,4%      | 100,0%       |
|   | % within Looking for Financing Options |  | 33,3%                                    | 92,6%      | 90,1%        |
|   | % of Total                             |  | 1,4%                                     | 88,7%      | 90,1%        |
| Total                                   | Count                                  |  | 6  | 136        | 142          |
|   | % within Type of Origin Entity         |  | 4,2%                                     | 95,8%      | 100,0%       |
|   | % within Looking for Financing Options |  | 100,0%                                   | 100,0%     | 100,0%       |
|   | % of Total                             |  | 4,2%                                     | 95,8%      | 100,0%       |

#### ***Chi-Square Tests***

|                              | Value               | df | Asymptotic<br>Significance (2-<br>sided) |
|------------------------------|---------------------|----|--|
| Pearson Chi-Square           | 22,925 <sup>a</sup> | 2  | ,000                                     |
| Likelihood Ratio             | 12,392              | 2  | ,002                                     |
| Linear-by-Linear Association | 18,593              | 1  | ,000                                     |
| N of Valid Cases             | 142                 |    |  |

a. 3 cells (50,0%) have expected count less than 5. The minimum expected count is ,17.

### Statistical Tests – Hypothesis 3 – Type of Origin Entity \* Looking for Partners/Contacts

#### ***Crosstab***

|   |  |  | <b>Looking for<br/>Partners/Contacts</b> |            |              |
|---|--|--|--|------------|--------------|
|   |  |  | <b>No</b>                                | <b>Yes</b> | <b>Total</b> |
| Type of University/TTO<br>Origin Entity | Count                                  |  | 2  | 2          | 4            |
|   | % within Type of Origin Entity         |  | 50,0%                                    | 50,0%      | 100,0%       |
|   | % within Looking for Partners/Contacts |  | 1,9%                                     | 5,3%       | 2,8%         |
|   | % of Total                             |  | 1,4%                                     | 1,4%       | 2,8%         |
| Research Centre / Tech Interface        | Count                                  |  | 7  | 3          | 10           |
|   | % within Type of Origin Entity         |  | 70,0%                                    | 30,0%      | 100,0%       |
|   | % within Looking for Partners/Contacts |  | 6,7%                                     | 7,9%       | 7,0%         |
|   | % of Total                             |  | 4,9%                                     | 2,1%       | 7,0%         |
| Recipient Company                       | Count                                  |  | 95                                       | 33         | 128          |
|   | % within Type of Origin Entity         |  | 74,2%                                    | 25,8%      | 100,0%       |
|   | % within Looking for Partners/Contacts |  | 91,3%                                    | 86,8%      | 90,1%        |
|   | % of Total                             |  | 66,9%                                    | 23,2%      | 90,1%        |
| Total                                   | Count                                  |  | 104                                      | 38         | 142          |
|   | % within Type of Origin Entity         |  | 73,2%                                    | 26,8%      | 100,0%       |
|   | % within Looking for Partners/Contacts |  | 100,0%                                   | 100,0%     | 100,0%       |
|   | % of Total                             |  | 73,2%                                    | 26,8%      | 100,0%       |

#### ***Chi-Square Tests***

|                              | Value              | df | Asymptotic<br>Significance (2-<br>sided) |
|------------------------------|--------------------|----|--|
| Pearson Chi-Square           | 1,218 <sup>a</sup> | 2  | ,544                                     |
| Likelihood Ratio             | 1,089              | 2  | ,580                                     |
| Linear-by-Linear Association | 1,018              | 1  | ,313                                     |
| N of Valid Cases             | 142                |    |  |

a. 3 cells (50,0%) have expected count less than 5. The minimum expected count is 1,07.

### Statistical Tests – Hypothesis 3 – Type of Origin Entity \* Looking for technical know-how

#### ***Crosstab***

|   |   | <b>Looking for technical know-how</b> |            |              |
|---|---|---------------------------------------|------------|--------------|
|   |   | <b>No</b>                             | <b>Yes</b> | <b>Total</b> |
| Type of University/TTO<br>Origin Entity | Count                                   | 4                                     | 0          | 4            |
|   | % within Type of Origin Entity          | 100,0%                                | 0,0%       | 100,0%       |
|   | % within Looking for technical know-how | 3,4%                                  | 0,0%       | 2,8%         |
|   | % of Total                              | 2,8%                                  | 0,0%       | 2,8%         |
| Research Centre /<br>Tech Interface     | Count                                   | 7                                     | 3          | 10           |
|   | % within Type of Origin Entity          | 70,0%                                 | 30,0%      | 100,0%       |
|   | % within Looking for technical know-how | 5,9%                                  | 13,0%      | 7,0%         |
|   | % of Total                              | 4,9%                                  | 2,1%       | 7,0%         |
| Recipient<br>Company                    | Count                                   | 108                                   | 20         | 128          |
|   | % within Type of Origin Entity          | 84,4%                                 | 15,6%      | 100,0%       |
|   | % within Looking for technical know-how | 90,8%                                 | 87,0%      | 90,1%        |
|   | % of Total                              | 76,1%                                 | 14,1%      | 90,1%        |
| Total                                   | Count                                   | 119                                   | 23         | 142          |
|   | % within Type of Origin Entity          | 83,8%                                 | 16,2%      | 100,0%       |
|   | % within Looking for technical know-how | 100,0%                                | 100,0%     | 100,0%       |
|   | % of Total                              | 83,8%                                 | 16,2%      | 100,0%       |

#### ***Chi-Square Tests***

|                              | Value              | df | Asymptotic<br>Significance (2-<br>sided) |
|------------------------------|--------------------|----|--|
| Pearson Chi-Square           | 2,208 <sup>a</sup> | 2  | ,332                                     |
| Likelihood Ratio             | 2,623              | 2  | ,269                                     |
| Linear-by-Linear Association | ,002               | 1  | ,963                                     |
| N of Valid Cases             | 142                |    |  |

a. 3 cells (50,0%) have expected count less than 5. The minimum expected count is ,65.

### Statistical Tests – Hypothesis 3 – Type of Origin Entity \* Looking for Project Management Support

#### *Crosstab*

|                       |                                  |   | <b>Looking for Project Management Support</b> |            |              |
|-----------------------|----------------------------------|---|---|------------|--------------|
|                       |                                  |   | <b>No</b>                                     | <b>Yes</b> | <b>Total</b> |
| Type of Origin Entity | University/TTO                   | Count   | 3   | 1          | 4            |
|                       |                                  | % within Type of Origin Entity                  | 75,0%   | 25,0%      | 100,0%       |
|                       |                                  | % within Looking for Project Management Support | 3,1%  | 2,2%       | 2,8%         |
|                       |                                  | % of Total                                      | 2,1%  | 0,7%       | 2,8%         |
|                       | Research Centre / Tech Interface | Count   | 6   | 4          | 10           |
|                       |                                  | % within Type of Origin Entity                  | 60,0%   | 40,0%      | 100,0%       |
|                       |                                  | % within Looking for Project Management Support | 6,3%  | 8,7%       | 7,0%         |
|                       |                                  | % of Total                                      | 4,2%  | 2,8%       | 7,0%         |
|                       | Recipient Company                | Count   | 87  | 41         | 128          |
|                       |                                  | % within Type of Origin Entity                  | 68,0%   | 32,0%      | 100,0%       |
|                       |                                  | % within Looking for Project Management Support | 90,6%   | 89,1%      | 90,1%        |
|                       |                                  | % of Total                                      | 61,3%   | 28,9%      | 90,1%        |
| Total                 |                                  | Count   | 96  | 46         | 142          |
|                       |                                  | % within Type of Origin Entity                  | 67,6%   | 32,4%      | 100,0%       |
|                       |                                  | % within Looking for Project Management Support | 100,0%  | 100,0%     | 100,0%       |
|                       |                                  | % of Total                                      | 67,6%   | 32,4%      | 100,0%       |

#### *Chi-Square Tests*

|                              | Value             | df | Asymptotic Significance (2-sided) |
|------------------------------|-------------------|----|-----------------------------------|
| Pearson Chi-Square           | ,372 <sup>a</sup> | 2  | ,830                              |
| Likelihood Ratio             | ,367              | 2  | ,832                              |
| Linear-by-Linear Association | ,005              | 1  | ,941                              |
| N of Valid Cases             | 142               |    |                                   |

a. 3 cells (50,0%) have expected count less than 5. The minimum expected count is 1,30.



**Statistical Tests – Hypothesis 3 – Type of Origin Entity \* Came due to WoM or good References**

***Crosstab***

|                                  |   |  | <b>Came due to WoM or<br/>good References</b> |            |              |
|----------------------------------|---|--|---|------------|--------------|
|                                  |   |  | <b>No</b>                                     | <b>Yes</b> | <b>Total</b> |
| Type of University/TTO           | Count                                       |  | 0   | 4          | 4            |
| Origin Entity                    | % within Type of Origin Entity              |  | 0,0%  | 100,0%     | 100,0%       |
|                                  | % within Came due to WoM or good References |  | 0,0%  | 5,0%       | 2,8%         |
|                                  | % of Total                                  |  | 0,0%  | 2,8%       | 2,8%         |
| Research Centre / Tech Interface | Count                                       |  | 3   | 7          | 10           |
|                                  | % within Type of Origin Entity              |  | 30,0%   | 70,0%      | 100,0%       |
|                                  | % within Came due to WoM or good References |  | 4,8%  | 8,8%       | 7,0%         |
|                                  | % of Total                                  |  | 2,1%  | 4,9%       | 7,0%         |
| Recipient Company                | Count                                       |  | 59  | 69         | 128          |
|                                  | % within Type of Origin Entity              |  | 46,1%   | 53,9%      | 100,0%       |
|                                  | % within Came due to WoM or good References |  | 95,2%   | 86,3%      | 90,1%        |
|                                  | % of Total                                  |  | 41,5%   | 48,6%      | 90,1%        |
| Total                            | Count                                       |  | 62  | 80         | 142          |
|                                  | % within Type of Origin Entity              |  | 43,7%   | 56,3%      | 100,0%       |
|                                  | % within Came due to WoM or good References |  | 100,0%  | 100,0%     | 100,0%       |
|                                  | % of Total                                  |  | 43,7%   | 56,3%      | 100,0%       |

***Chi-Square Tests***

|                              | Value              | df | Asymptotic<br>Significance (2-<br>sided) |
|------------------------------|--------------------|----|--|
| Pearson Chi-Square           | 4,167 <sup>a</sup> | 2  | ,125                                     |
| Likelihood Ratio             | 5,685              | 2  | ,058                                     |
| Linear-by-Linear Association | 4,018              | 1  | ,045                                     |
| N of Valid Cases             | 142                |    |  |

a. 3 cells (50,0%) have expected count less than 5. The minimum expected count is 1,75.

**Statistical Tests – Hypothesis 4 – Type of Origin Entity \* Participation of other public/traditional intermediaries**

***Case Processing Summary***

|   | <b>Cases</b> |         |                |         |              |         |
|---|--------------|---------|----------------|---------|--------------|---------|
|   | <b>Valid</b> |         | <b>Missing</b> |         | <b>Total</b> |         |
|   | N            | Percent | N              | Percent | N            | Percent |
| Type of Origin Entity *<br>Participation of Public<br>Intermediary(ies) | 219          | 100,0%  | 0              | 0,0%    | 219          | 100,0%  |

***Chi-Square Tests***

|                              | Value               | df | Asymptotic<br>Significance (2-<br>sided) |
|------------------------------|---------------------|----|--|
| Pearson Chi-Square           | 85,649 <sup>a</sup> | 3  | ,000                                     |
| Likelihood Ratio             | 56,836              | 3  | ,000                                     |
| Linear-by-Linear Association | 21,826              | 1  | ,000                                     |
| N of Valid Cases             | 219                 |    |  |

a. 3 cells (37,5%) have expected count less than 5. The minimum expected count is ,53.

***Type of Origin Entity \* Participation of Public Intermediary Crosstabulation***

|                                      |  | <b>Participation of Public Intermediary</b> |        | <b>Total</b> |
|--------------------------------------|--|---|--------|--------------|
|                                      |  | No  | Yes    |              |
| Type of Origin University/TTO Entity | Count  | 0   | 4      | 4            |
|                                      | % within Type of Origin Entity                     | 0,0%  | 100,0% | 100,0%       |
|                                      | % within Participation of Public Intermediary(ies) | 0,0%  | 13,8%  | 1,8%         |
|                                      | % of Total   | 0,0%  | 1,8%   | 1,8%         |
| Research Centre / Tech Interface     | Count  | 1   | 9      | 10           |
|                                      | % within Type of Origin Entity                     | 10,0%                                       | 90,0%  | 100,0%       |
|                                      | % within Participation of Public Intermediary(ies) | 0,5%  | 31,0%  | 4,6%         |
|                                      | % of Total   | 0,5%  | 4,1%   | 4,6%         |
| Recipient Company                    | Count  | 122   | 6      | 128          |
|                                      | % within Type of Origin Entity                     | 95,3%                                       | 4,7%   | 100,0%       |
|                                      | % within Participation of Public Intermediary(ies) | 64,2%                                       | 20,7%  | 58,4%        |
|                                      | % of Total   | 55,7%                                       | 2,7%   | 58,4%        |
| Private Consultant                   | Count  | 67  | 10     | 77           |
|                                      | % within Type of Origin Entity                     | 87,0%                                       | 13,0%  | 100,0%       |
|                                      | % within Participation of Public Intermediary(ies) | 35,3%                                       | 34,5%  | 35,2%        |
|                                      | % of Total   | 30,6%                                       | 4,6%   | 35,2%        |
| Total                                | Count  | 190   | 29     | 219          |
|                                      | % within Type of Origin Entity                     | 86,8%                                       | 13,2%  | 100,0%       |
|                                      | % within Participation of Public Intermediary(ies) | 100,0%                                      | 100,0% | 100,0%       |
|                                      | % of Total   | 86,8%                                       | 13,2%  | 100,0%       |

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Policy & Strategy**

**Warnings**

No measures of association are computed for the crosstabulation of Policy & Strategy (PC) \* Policy & Strategy (OTI). At least one variable in each 2-way table upon which measures of association are computed is a constant.

*Policy & Strategy (PC) \* Policy & Strategy (OTI) Crosstabulation*

|                        |    | Policy & Strategy (OTI)          |        |        |
|------------------------|----|----------------------------------|--------|--------|
|                        |    |                                  | No     | Total  |
| Policy & Strategy (PC) | No | Count                            | 29     | 29     |
|                        |    | % within Policy & Strategy (PC)  | 100,0% | 100,0% |
|                        |    | % within Policy & Strategy (OTI) | 100,0% | 100,0% |
|                        |    | % of Total                       | 100,0% | 100,0% |
| Total                  |    | Count                            | 29     | 29     |
|                        |    | % within Policy & Strategy (PC)  | 100,0% | 100,0% |
|                        |    | % within Policy & Strategy (OTI) | 100,0% | 100,0% |
|                        |    | % of Total                       | 100,0% | 100,0% |

**Chi-Square Tests**

|                     | Value          | df | Asymptotic Significance (2-sided) |
|---------------------|----------------|----|-----------------------------------|
| Pearson Chi-Square  | . <sup>a</sup> |    |                                   |
| McNemar-Bowker Test | .              | .  | . <sup>b</sup>                    |
| N of Valid Cases    | 29             |    |                                   |

a. No statistics are computed because Policy & Strategy (PC) and Policy & Strategy (OTI) are constants.

b. Computed only for a PxP table, where P must be greater than 1.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Mediation & Mobilization**

*Mediation & Mobilization (PC) \* Mediation & Mobilization (OTI) Crosstabulation*

|                               |    |   | Mediation & Mobilization (OTI) |        |        |
|-------------------------------|----|---|--------------------------------|--------|--------|
|                               |    |   | No                             | Yes    | Total  |
| Mediation & Mobilization (PC) | No | Count                                   | 22                             | 6      | 28     |
|                               |    | % within Mediation & Mobilization (PC)  | 78,6%                          | 21,4%  | 100,0% |
|                               |    | % within Mediation & Mobilization (OTI) | 95,7%                          | 100,0% | 96,6%  |
|                               |    | % of Total                              | 75,9%                          | 20,7%  | 96,6%  |
| Yes                           |    | Count                                   | 1                              | 0      | 1      |
|                               |    | % within Mediation & Mobilization (PC)  | 100,0%                         | 0,0%   | 100,0% |
|                               |    | % within Mediation & Mobilization (OTI) | 4,3%                           | 0,0%   | 3,4%   |
|                               |    | % of Total                              | 3,4%                           | 0,0%   | 3,4%   |
| Total                         |    | Count                                   | 23                             | 6      | 29     |
|                               |    | % within Mediation & Mobilization (PC)  | 79,3%                          | 20,7%  | 100,0% |
|                               |    | % within Mediation & Mobilization (OTI) | 100,0%                         | 100,0% | 100,0% |
|                               |    | % of Total                              | 79,3%                          | 20,7%  | 100,0% |

**Chi-Square Tests**

|                                    | Value             | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|------------------------------------|-------------------|----|-----------------------------------|----------------------|----------------------|
| Pearson Chi-Square                 | ,270 <sup>a</sup> | 1  | ,603                              |                      |                      |
| Continuity Correction <sup>b</sup> | ,000              | 1  | 1,000                             |                      |                      |
| Likelihood Ratio                   | ,473              | 1  | ,492                              |                      |                      |
| Fisher's Exact Test                |                   |    |                                   | 1,000                | ,793                 |
| Linear-by-Linear Association       | ,261              | 1  | ,610                              |                      |                      |
| McNemar Test                       |                   |    |                                   | ,125 <sup>c</sup>    |                      |
| N of Valid Cases                   | 29                |    |                                   |                      |                      |

a. 2 cells (50,0%) have expected count less than 5. The minimum expected count is ,21.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Knowledge Diffusion & Support**

**Warnings**

No measures of association are computed for the crosstabulation of Knowledge Diffusion & Support (PC) \* Knowledge Diffusion & Support (OTI). At least one variable in each 2-way table upon which measures of association are computed is a constant.

*Knowledge Diffusion & Support (PC) \* Knowledge Diffusion & Support (OTI) Crosstabulation*

|                                    |    |  |  | Knowledge Diffusion & Support (OTI) |        |        |
|------------------------------------|----|--|--|-------------------------------------|--------|--------|
|                                    |    |  |  | No                                  | Yes    | Total  |
| Knowledge Diffusion & Support (PC) | No | Count  |  | 24                                  | 5      | 29     |
|                                    |    | % within Knowledge Diffusion & Support (PC)  |  | 82,8%                               | 17,2%  | 100,0% |
|                                    |    | % within Knowledge Diffusion & Support (OTI) |  | 100,0%                              | 100,0% | 100,0% |
|                                    |    | % of Total                                   |  | 82,8%                               | 17,2%  | 100,0% |
| Total                              |    | Count  |  | 24                                  | 5      | 29     |
|                                    |    | % within Knowledge Diffusion & Support (PC)  |  | 82,8%                               | 17,2%  | 100,0% |
|                                    |    | % within Knowledge Diffusion & Support (OTI) |  | 100,0%                              | 100,0% | 100,0% |
|                                    |    | % of Total                                   |  | 82,8%                               | 17,2%  | 100,0% |

**Chi-Square Tests**

|                     | Value          | df | Asymptotic Significance (2-sided) |
|---------------------|----------------|----|-----------------------------------|
| Pearson Chi-Square  | . <sup>a</sup> |    |                                   |
| McNemar-Bowker Test | .              | .  | . <sup>b</sup>                    |
| N of Valid Cases    | 29             |    |                                   |

a. No statistics are computed because Knowledge Diffusion (PC) & Support (OTI) is a constant.

b. Computed only for a P x P table, where P must be greater than 1.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Funding & Finance**

*Funding & Finance (PC) \* Funding & Finance (OTI) Crosstabulation*

|                        |       |                                  | Funding & Finance (OTI) |        |        |
|------------------------|-------|----------------------------------|-------------------------|--------|--------|
|                        |       |                                  | No                      | Yes    | Total  |
| Funding & Finance (PC) | No    | Count                            | 0                       | 2      | 2      |
|                        |       | % within Funding & Finance (PC)  | 0,0%                    | 100,0% | 100,0% |
|                        |       | % within Funding & Finance (OTI) | 0,0%                    | 9,1%   | 6,9%   |
|                        |       | % of Total                       | 0,0%                    | 6,9%   | 6,9%   |
| Yes                    | Count | 7                                | 20                      | 27     |        |
|                        |       | % within Funding & Finance (PC)  | 25,9%                   | 74,1%  | 100,0% |
|                        |       | % within Funding & Finance (OTI) | 100,0%                  | 90,9%  | 93,1%  |
|                        |       | % of Total                       | 24,1%                   | 69,0%  | 93,1%  |
| Total                  | Count | 7                                | 22                      | 29     |        |
|                        |       | % within Funding & Finance (PC)  | 24,1%                   | 75,9%  | 100,0% |
|                        |       | % within Funding & Finance (OTI) | 100,0%                  | 100,0% | 100,0% |
|                        |       | % of Total                       | 24,1%                   | 75,9%  | 100,0% |

**Chi-Square Tests**

|                                    | Value             | df | Asymptotic<br>Significance (2-<br>sided) | Exact Sig. (2-<br>sided) | Exact Sig. (1-<br>sided) |
|------------------------------------|-------------------|----|--|--------------------------|--------------------------|
| Pearson Chi-Square                 | ,684 <sup>a</sup> | 1  | ,408                                     |                          |                          |
| Continuity Correction <sup>b</sup> | ,000              | 1  | 1,000                                    |                          |                          |
| Likelihood Ratio                   | 1,151             | 1  | ,283                                     |                          |                          |
| Fisher's Exact Test                |                   |    |  | 1,000                    | ,569                     |
| Linear-by-Linear<br>Association    | ,660              | 1  | ,417                                     |                          |                          |
| McNemar Test                       |                   |    |  | ,180 <sup>c</sup>        |                          |
| N of Valid Cases                   | 29                |    |  |                          |                          |

a. 2 cells (50,0%) have expected count less than 5. The minimum expected count is 48.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Technology Scouting & Market Foresight**

**Warnings**

No measures of association are computed for the crosstabulation of Technology Scouting (PC) & Market Foresight \* Technology Scouting & Market Foresight (OTI). At least one variable in each 2-way table upon which measures of association are computed is a constant.

*Technology Scouting & Market Foresight \* Technology Scouting & Market Foresight Crosstabulation*

|   |       | Technology Scouting & Market Foresight (OTI)          |        |        |
|---|-------|---|--------|--------|
|   |       |   | No     | Total  |
| Technology Scouting & Market Foresight (PC) | No    | Count   | 12     | 12     |
|   |       | % within Technology Scouting & Market Foresight (PC)  | 100,0% | 100,0% |
|   |       | % within Technology Scouting & Market Foresight (OTI) | 41,4%  | 41,4%  |
|   |       | % of Total  | 41,4%  | 41,4%  |
|   | Yes   | Count   | 17     | 17     |
|   |       | % within Technology Scouting & Market Foresight (PC)  | 100,0% | 100,0% |
|   |       | % within Technology Scouting & Market Foresight (OTI) | 58,6%  | 58,6%  |
|   |       | % of Total  | 58,6%  | 58,6%  |
|   | Total | Count   | 29     | 29     |
|   |       | % within Technology Scouting & Market Foresight (PC)  | 100,0% | 100,0% |
|   |       | % within Technology Scouting & Market Foresight (OTI) | 100,0% | 100,0% |
|   |       | % of Total  | 100,0% | 100,0% |

**Chi-Square Tests**

|                     | Value          | df | Asymptotic Significance (2-sided) |
|---------------------|----------------|----|-----------------------------------|
| Pearson Chi-Square  | . <sup>a</sup> |    |                                   |
| McNemar-Bowker Test | .              | .  | . <sup>b</sup>                    |
| N of Valid Cases    | 29             |    |                                   |

a. No statistics are computed because Technology Scouting & Market Foresight is a constant.

b. Computed only for a PxP table, where P must be greater than 1.



**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Design & Idealization**

*Design & Idealization (PC) \* Design & Idealization (OTI) Crosstabulation*

|                            |    |                                      | Design & Idealization (OTI) |        |        |
|----------------------------|----|--------------------------------------|-----------------------------|--------|--------|
|                            |    |                                      | No                          | Yes    | Total  |
| Design & Idealization (PC) | No | Count                                | 5                           | 10     | 15     |
|                            |    | % within Design & Idealization (PC)  | 33,3%                       | 66,7%  | 100,0% |
|                            |    | % within Design & Idealization (OTI) | 31,3%                       | 76,9%  | 51,7%  |
|                            |    | % of Total                           | 17,2%                       | 34,5%  | 51,7%  |
| Yes                        |    | Count                                | 11                          | 3      | 14     |
|                            |    | % within Design & Idealization (PC)  | 78,6%                       | 21,4%  | 100,0% |
|                            |    | % within Design & Idealization (OTI) | 68,8%                       | 23,1%  | 48,3%  |
|                            |    | % of Total                           | 37,9%                       | 10,3%  | 48,3%  |
| Total                      |    | Count                                | 16                          | 13     | 29     |
|                            |    | % within Design & Idealization (PC)  | 55,2%                       | 44,8%  | 100,0% |
|                            |    | % within Design & Idealization (OTI) | 100,0%                      | 100,0% | 100,0% |
|                            |    | % of Total                           | 55,2%                       | 44,8%  | 100,0% |

**Chi-Square Tests**

|                                    | Value              | df | Asymptotic<br>Significance (2-<br>sided) | Exact Sig. (2-<br>sided) | Exact Sig. (1-<br>sided) |
|------------------------------------|--------------------|----|--|--------------------------|--------------------------|
| Pearson Chi-Square                 | 5,992 <sup>a</sup> | 1  | ,014                                     |                          |                          |
| Continuity Correction <sup>b</sup> | 4,302              | 1  | ,038                                     |                          |                          |
| Likelihood Ratio                   | 6,248              | 1  | ,012                                     |                          |                          |
| Fisher's Exact Test                |                    |    |  | ,025                     | ,018                     |
| Linear-by-Linear<br>Association    | 5,785              | 1  | ,016                                     |                          |                          |
| McNemar Test                       |                    |    |  | 1,000 <sup>c</sup>       |                          |
| N of Valid Cases                   | 29                 |    |  |                          |                          |

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 6,28.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Brokering & Gatekeeping**

*Brokering & Gatekeeping (PC) \* Brokering & Gatekeeping (OTI) Crosstabulation*

|                              |    | Brokering & Gatekeeping (OTI)          |        |        |        |
|------------------------------|----|--|--------|--------|--------|
|                              |    | No                                     | Yes    | Total  |        |
| Brokering & Gatekeeping (PC) | No | Count                                  | 20     | 4      | 24     |
|                              |    | % within Brokering & Gatekeeping (PC)  | 83,3%  | 16,7%  | 100,0% |
|                              |    | % within Brokering & Gatekeeping (OTI) | 83,3%  | 80,0%  | 82,8%  |
|                              |    | % of Total                             | 69,0%  | 13,8%  | 82,8%  |
| Yes                          |    | Count                                  | 4      | 1      | 5      |
|                              |    | % within Brokering & Gatekeeping (PC)  | 80,0%  | 20,0%  | 100,0% |
|                              |    | % within Brokering & Gatekeeping (OTI) | 16,7%  | 20,0%  | 17,2%  |
|                              |    | % of Total                             | 13,8%  | 3,4%   | 17,2%  |
| Total                        |    | Count                                  | 24     | 5      | 29     |
|                              |    | % within Brokering & Gatekeeping (PC)  | 82,8%  | 17,2%  | 100,0% |
|                              |    | % within Brokering & Gatekeeping (OTI) | 100,0% | 100,0% | 100,0% |
|                              |    | % of Total                             | 82,8%  | 17,2%  | 100,0% |

**Chi-Square Tests**

|                                    | Value             | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|------------------------------------|-------------------|----|-----------------------------------|----------------------|----------------------|
| Pearson Chi-Square                 | ,032 <sup>a</sup> | 1  | ,858                              |                      |                      |
| Continuity Correction <sup>b</sup> | ,000              | 1  | 1,000                             |                      |                      |
| Likelihood Ratio                   | ,031              | 1  | ,860                              |                      |                      |
| Fisher's Exact Test                |                   |    |                                   | 1,000                | ,642                 |
| Linear-by-Linear Association       | ,031              | 1  | ,860                              |                      |                      |
| McNemar Test                       |                   |    |                                   | 1,000 <sup>c</sup>   |                      |
| N of Valid Cases                   | 29                |    |                                   |                      |                      |

a. 3 cells (75,0%) have expected count less than 5. The minimum expected count is ,86.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Project Management & Assessment**

*Project Management & Assessment (PC) \* Project Management & Assessment (OTI) Crosstabulation*

|                                      |       | Project Management & Assessment (OTI)          |        |        |        |
|--------------------------------------|-------|--|--------|--------|--------|
|                                      |       | No   | Yes    | Total  |        |
| Project Management & Assessment (PC) | No    | Count  | 2      | 13     | 15     |
|                                      |       | % within Project Management & Assessment (PC)  | 13,3%  | 86,7%  | 100,0% |
|                                      |       | % within Project Management & Assessment (OTI) | 28,6%  | 59,1%  | 51,7%  |
|                                      |       | % of Total                                     | 6,9%   | 44,8%  | 51,7%  |
| Yes                                  | Count | 5  | 9      | 14     |        |
|                                      |       | % within Project Management & Assessment (PC)  | 35,7%  | 64,3%  | 100,0% |
|                                      |       | % within Project Management & Assessment (OTI) | 71,4%  | 40,9%  | 48,3%  |
|                                      |       | % of Total                                     | 17,2%  | 31,0%  | 48,3%  |
| Total                                | Count | 7  | 22     | 29     |        |
|                                      |       | % within Project Management & Assessment (PC)  | 24,1%  | 75,9%  | 100,0% |
|                                      |       | % within Project Management & Assessment (OTI) | 100,0% | 100,0% | 100,0% |
|                                      |       | % of Total                                     | 24,1%  | 75,9%  | 100,0% |

**Chi-Square Tests**

|                                    | Value              | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|------------------------------------|--------------------|----|-----------------------------------|----------------------|----------------------|
| Pearson Chi-Square                 | 1,981 <sup>a</sup> | 1  | ,159                              |                      |                      |
| Continuity Correction <sup>b</sup> | ,947               | 1  | ,330                              |                      |                      |
| Likelihood Ratio                   | 2,025              | 1  | ,155                              |                      |                      |
| Fisher's Exact Test                |                    |    |                                   | ,215                 | ,166                 |
| Linear-by-Linear Association       | 1,913              | 1  | ,167                              |                      |                      |
| McNemar Test                       |                    |    |                                   | ,096 <sup>c</sup>    |                      |
| N of Valid Cases                   | 29                 |    |                                   |                      |                      |

a. 2 cells (50,0%) have expected count less than 5. The minimum expected count is 3,38.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Financial & Technical Feasibility**

*Financial & Technical Feasibility (PC) \* Financial & Technical Feasibility (OTI) Crosstabulation*

|  |  | Financial & Technical Feasibility (OTI)          |        |        |        |
|--|--|--|--------|--------|--------|
|  |  | No   | Yes    | Total  |        |
| Financial & Technical Feasibility (PC) | No   | Count  | 14     | 8      | 22     |
|  |  | % within Financial & Technical Feasibility (PC)  | 63,6%  | 36,4%  | 100,0% |
|  |  | % within Financial & Technical Feasibility (OTI) | 66,7%  | 100,0% | 75,9%  |
|  |  | % of Total                                       | 48,3%  | 27,6%  | 75,9%  |
|  | Yes  | Count  | 7      | 0      | 7      |
|  |  | % within Financial & Technical Feasibility (PC)  | 100,0% | 0,0%   | 100,0% |
|  |  | % within Financial & Technical Feasibility (OTI) | 33,3%  | 0,0%   | 24,1%  |
|  |  | % of Total                                       | 24,1%  | 0,0%   | 24,1%  |
|  | Total  | Count  | 21     | 8      | 29     |
|  | % within Financial & Technical Feasibility (PC)  | 72,4%  | 27,6%  | 100,0% |        |
|  | % within Financial & Technical Feasibility (OTI) | 100,0%   | 100,0% | 100,0% |        |
|  | % of Total                                       | 72,4%  | 27,6%  | 100,0% |        |

**Chi-Square Tests**

|                                    | Value              | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|------------------------------------|--------------------|----|-----------------------------------|----------------------|----------------------|
| Pearson Chi-Square                 | 3,515 <sup>a</sup> | 1  | ,061                              |                      |                      |
| Continuity Correction <sup>b</sup> | 1,930              | 1  | ,165                              |                      |                      |
| Likelihood Ratio                   | 5,321              | 1  | ,021                              |                      |                      |
| Fisher's Exact Test                |                    |    |                                   | ,142                 | ,075                 |
| Linear-by-Linear Association       | 3,394              | 1  | ,065                              |                      |                      |
| McNemar Test                       |                    |    |                                   | 1,000 <sup>c</sup>   |                      |
| N of Valid Cases                   | 29                 |    |                                   |                      |                      |

a. 1 cells (25,0%) have expected count less than 5. The minimum expected count is 1,93.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Accreditation & Quality**

**Warnings**

No measures of association are computed for the crosstabulation of Accreditation & Quality (PC) \* Accreditation & Quality (OTI). At least one variable in each 2-way table upon which measures of association are computed is a constant.

*Accreditation & Quality (PC) \* Accreditation & Quality (OTI) Crosstabulation*

|                                    |  | Accreditation & Quality (OTI) |        |
|------------------------------------|--|-------------------------------|--------|
|                                    |  | No                            | Total  |
| Accreditation & No<br>Quality (PC) | Count                                  | 28                            | 28     |
|                                    | % within Accreditation & Quality (PC)  | 100,0%                        | 100,0% |
|                                    | % within Accreditation & Quality (OTI) | 96,6%                         | 96,6%  |
|                                    | % of Total                             | 96,6%                         | 96,6%  |
| Yes                                | Count                                  | 1                             | 1      |
|                                    | % within Accreditation & Quality (PC)  | 100,0%                        | 100,0% |
|                                    | % within Accreditation & Quality (OTI) | 3,4%                          | 3,4%   |
|                                    | % of Total                             | 3,4%                          | 3,4%   |
| Total                              | Count                                  | 29                            | 29     |
|                                    | % within Accreditation & Quality (PC)  | 100,0%                        | 100,0% |
|                                    | % within Accreditation & Quality (OTI) | 100,0%                        | 100,0% |
|                                    | % of Total                             | 100,0%                        | 100,0% |

**Chi-Square Tests**

|                     | Value          | df | Asymptotic<br>Significance (2-<br>sided) |
|---------------------|----------------|----|--|
| Pearson Chi-Square  | . <sup>a</sup> |    |  |
| McNemar-Bowker Test | .              | .  | . <sup>b</sup>                           |
| N of Valid Cases    | 29             |    |  |

a. No statistics are computed because Accreditation & Quality is a constant.

b. Computed only for a PxP table, where P must be greater than 1.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Intellectual Property & Rights**

*Intellectual Property & Rights (PC) \* Intellectual Property & Rights (OTI) Crosstabulation*

|                                     |   |   | Intellectual Property & Rights (OTI) |        |        |
|-------------------------------------|---|---|--------------------------------------|--------|--------|
|                                     |   |   | No                                   | Yes    | Total  |
| Intellectual Property & Rights (PC) | No  | Count   | 24                                   | 3      | 27     |
|                                     |   | % within Intellectual Property & Rights (PC)  | 88,9%                                | 11,1%  | 100,0% |
|                                     |   | % within Intellectual Property & Rights (OTI) | 96,0%                                | 75,0%  | 93,1%  |
|                                     |   | % of Total                                    | 82,8%                                | 10,3%  | 93,1%  |
|                                     | Yes   | Count   | 1                                    | 1      | 2      |
|                                     |   | % within Intellectual Property & Rights (PC)  | 50,0%                                | 50,0%  | 100,0% |
|                                     |   | % within Intellectual Property & Rights (OTI) | 4,0%                                 | 25,0%  | 6,9%   |
|                                     |   | % of Total                                    | 3,4%                                 | 3,4%   | 6,9%   |
|                                     |   | Total   | Count                                | 25     | 4      |
|                                     | % within Intellectual Property & Rights (PC)  | 86,2%   | 13,8%                                | 100,0% |        |
|                                     | % within Intellectual Property & Rights (OTI) | 100,0%  | 100,0%                               | 100,0% |        |
|                                     | % of Total                                    | 86,2%   | 13,8%                                | 100,0% |        |

**Chi-Square Tests**

|                                    | Value              | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|------------------------------------|--------------------|----|-----------------------------------|----------------------|----------------------|
| Pearson Chi-Square                 | 2,368 <sup>a</sup> | 1  | ,124                              |                      |                      |
| Continuity Correction <sup>b</sup> | ,227               | 1  | ,634                              |                      |                      |
| Likelihood Ratio                   | 1,659              | 1  | ,198                              |                      |                      |
| Fisher's Exact Test                |                    |    |                                   | ,261                 | ,261                 |
| Linear-by-Linear Association       | 2,287              | 1  | ,130                              |                      |                      |
| McNemar Test                       |                    |    |                                   | ,625 <sup>c</sup>    |                      |
| N of Valid Cases                   | 29                 |    |                                   |                      |                      |

a. 3 cells (75,0%) have expected count less than 5. The minimum expected count is ,28.

b. Computed only for a 2x2 table

c. Binomial distribution used.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Implementation & Knowledge Transfer**

**Warnings**

No measures of association are computed for the crosstabulation of Implementation & Knowledge Transfer (PC) \* Implementation & Knowledge Transfer (OTI). At least one variable in each 2-way table upon which measures of association are computed is a constant.

*Implementation & Knowledge Transfer \* Implementation & Knowledge Transfer (OTI) Crosstabulation*

|  |  | Implementation & Knowledge Transfer (OTI) |        |        |
|--|--|---|--------|--------|
|  |  | No  | Yes    | Total  |
| Implementation & Knowledge Transfer (PC) | Count  | 24  | 5      | 29     |
|  | % within Implementation & Knowledge Transfer (PC)  | 82,8%                                     | 17,2%  | 100,0% |
|  | % within Implementation & Knowledge Transfer (OTI) | 100,0%                                    | 100,0% | 100,0% |
|  | % of Total   | 82,8%                                     | 17,2%  | 100,0% |
| Total                                    | Count  | 24  | 5      | 29     |
|  | % within Implementation & Knowledge Transfer (PC)  | 82,8%                                     | 17,2%  | 100,0% |
|  | % within Implementation & Knowledge Transfer (OTI) | 100,0%                                    | 100,0% | 100,0% |
|  | % of Total   | 82,8%                                     | 17,2%  | 100,0% |

**Chi-Square Tests**

|                     | Value          | df | Asymptotic Significance (2-sided) |
|---------------------|----------------|----|-----------------------------------|
| Pearson Chi-Square  | . <sup>a</sup> |    |                                   |
| McNemar-Bowker Test | .              | .  | . <sup>b</sup>                    |
| N of Valid Cases    | 29             |    |                                   |

a. No statistics are computed because Implementation & Knowledge Transfer is a constant.

b. Computed only for a PxP table, where P must be greater than 1.

**Statistical Tests – Hypothesis 5 – Private Consultant (PC) \* Other Traditional Intermediary (OTI) - Marketing & Business Development**

**Warnings**

No measures of association are computed for the crosstabulation of Marketing & Business Development (PC) \* Marketing & Business Development (OTI). At least one variable in each 2-way table upon which measures of association are computed is a constant.

*Marketing & Business Development (PC) \* Marketing & Business Development (OTI) Crosstabulation*

|                                       |       | Marketing & Business Development (OTI)          |   |        |        |
|---------------------------------------|-------|---|---|--------|--------|
|                                       |       | No  | Total   |        |        |
| Marketing & Business Development (PC) | No    | Count   | 25  | 25     |        |
|                                       |       | % within Marketing & Business Development (PC)  | 100,0%  | 100,0% |        |
|                                       | Yes   |   | % within Marketing & Business Development (OTI) | 86,2%  | 86,2%  |
|                                       |       |   | % of Total                                      | 86,2%  | 86,2%  |
|                                       |       | Count   | 4   | 4      |        |
|                                       |       | % within Marketing & Business Development (PC)  | 100,0%  | 100,0% |        |
|                                       |       | % within Marketing & Business Development (OTI) | 13,8%   | 13,8%  |        |
|                                       |       | % of Total                                      | 13,8%   | 13,8%  |        |
|                                       | Total | Count   | 29  | 29     |        |
|                                       |       |   | % within Marketing & Business Development (PC)  | 100,0% | 100,0% |
|                                       |       | % within Marketing & Business Development (OTI) | 100,0%  | 100,0% |        |
|                                       |       | % of Total                                      | 100,0%  | 100,0% |        |

**Chi-Square Tests**

|                     | Value          | df | Asymptotic Significance (2-sided) |
|---------------------|----------------|----|-----------------------------------|
| Pearson Chi-Square  | . <sup>a</sup> |    |                                   |
| McNemar-Bowker Test | .              | .  | . <sup>b</sup>                    |
| N of Valid Cases    | 29             |    |                                   |

a. No statistics are computed because Marketing & Business Development is a constant.

b. Computed only for a PxP table, where P must be greater than 1.