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Présentée et soutenue par:

Prince Gilbert FIALOR

Le Mardi 09 Decembre 2025

TITRE :

**FROM INTERMEDIATION TO ORCHESTRATION:
COLLABORATIVE STRATEGIES OF RESEARCH AND
TECHNOLOGY ORGANIZATIONS AND SMALL MEDIUM-
SIZED ENTERPRISE IN INNOVATION ECOSYSTEMS**

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“The university does not intend to approve or disapprove the particular opinions of the author.”

I dedicate this work to my mother (Miss Gladys Priscilla NYINASE), my father (WO1 Godwin FIALOR), my beloved wife (Debora Afua Amoaah NYAMEKYE), and my loved ones for their invaluable support in the major personal achievement that this doctoral dissertation represents.

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INFORMATION

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Co-authorship

This PhD dissertation consists of three essays, two of which (Essay 1 and Essay 2) were orientated by my dissertation supervisors: they gave me guidelines monthly to deepen the contributions of each essay. The writing was made by me, including the modifications needed during the revise and resubmit opportunities. We obtained a first review round in a top-journal. I am a single author for the third essay, which must be submitted in a top-journal as well. I would like to thank my supervisors for their valuable comments orientating my research.

Data availability

To ensure data transparency and availability but also to best guarantee the anonymity of the people we interviewed for this dissertation, we ensure evidence of data sharing: more precisely, the data (both primary and secondary data) of the three essays are available upon reasonable request, and but also made available through the data structures we provide in the essays and their respective appendices. However, the whole dataset of the primary data, interview recordings and transcriptions, collected during this dissertation work cannot be shared for confidentiality reasons as agreed with interviewees. Nevertheless, we relied as much as possible on the data transparency and replicability criteria developed by Aguinis and Solarino (2019) to be as transparent as possible regarding my research and the transferability of its results.

AI Tools

To ensure research transparency, I would like to mention that I used AI tools to help me in the writing of this PhD dissertation for two main tasks. First, I used AI tools to support data translation from French

to English, to best translate and capture the meaning of the verbatims mentioned in my dissertation. Secondly, I used these tools for gathering existing knowledge and reformulating my own ideas and explanations to make them clearer for the reader, especially in the literature review section, and for defining key terms. I list below the tools I used, how and for which task, with examples of prompts, responses and the final text written by myself:

DeepL

Tasks: For translating quotes from my semi-structured interviews. Usually, I kept the text as it was generated. For verbatims translations:

Example 1 :

Prompt: *“Concrètement, cela nous a permis, par exemple, d'établir un devis pour une entreprise”*

Response (from DeepL): *“What we've got out of it in concrete terms is that, for example, we've been able to put together a costing for a company.” (p.54)*

Example 2 :

Prompt: *“Ils nous ont permis à trouver le laboratoire... parce que nous ne pouvions pas connaître toutes les capacités...”*

Response (from DeepL): *“They helped us find the lab... because we couldn't know all the capabilities...” (p.53)*

Chat GPT-4o

Tasks: 1) For synthesizing and summarizing ideas from my chapters, especially in the literature review sections; 2) for simplifying my English writing style.

1) For synthesizing and summarizing:

Example 1:

Prompt: *“Please break this sentence into two, and kindly rewrite it in simple terms for a reader who is not an expert of the field to understand: “Informal observations and ethnographic notes were taken*

during four years of embedded presence, capturing interactional dynamics and informal processes of negotiation, sensemaking, and alignment.”

Response (from ChatGPT): *“Over a period of four years, I closely observed the everyday activities of the program from within. During this time, I took detailed notes on how people worked together, made sense of challenges, built shared understanding, and reached informal agreements.”*

Final text written by me: *“Over a four-year period, I closely observed the everyday activities of Opensive from within, taking notes on how stakeholders worked together, made sense of problems, co-created shared understanding, and reached informal agreements. These multiple data collection approach enabled triangulation across diverse sources (Lincoln & Guba, 1985), strengthening the validity and depth of the study.” (p.119)*

2) For simplifying my English writing:

Example 2:

Prompt: *“I adopt dynamic capabilities as a theoretical lens to investigate how research and technology organizations (RTOs) adapt and position themselves to capture more value from collaboration with their clients. Critically analyze this section and identify the weaknesses in my writing. More specifically, examine the coherence and unity in the text and its fit with academic language appropriate for publication in an ABS ranked 3 journals. Here is the section that I wrote:”*

“The value generated by RTOs, when collaborating with clients, forms a vital repository of knowledge and opportunities for learning and adaption. Teece et al., (1997) introduced dynamic capabilities as the ability of a firm to adapt, integrate, and reconfigure internal and external competences in response to environmental changes. His later work (see Teece, 2007) refined this theory, formalizing it into a theoretical framework that captures sensing, seizing, and transforming as central to modern day dynamic managerial capabilities...”

Response (From ChatGPT): “Thank you for sharing this section. It's a strong starting point with a clear focus on using the dynamic capabilities framework to understand value appropriation by RTOs. To elevate it to ABS 3 journal standards, I'll provide a critical analysis of your draft:

Area	Observation
Clarity and Structure	The argument is coherent, but the paragraph is overly long and dense. Breaking it into shorter, thematically focused paragraphs will enhance readability and impact.
Theoretical Precision	The use of Teece (1997, 2007) is appropriate, but phrases like “Basically, these capabilities...” should be avoided in formal writing.
Conceptual Linkage	The connection between value appropriation and dynamic capabilities is made, but it can be more sharply defined—particularly how appropriation mechanisms enable rather than result from dynamic capabilities.
Scholarly Tone	Phrasing can be more polished. For example, replace “we thus use this lens...” with more formal academic framing.
Contribution	You assert that dynamic capabilities help RTOs capture value, but don't fully highlight the originality or gap your paper addresses. This can be made explicit.

“Here is a rewritten version of your draft: The value co-created by Research and Technology Organizations (RTOs) in collaboration with clients constitutes not only a source of technological advancement but also a dynamic repository of organizational learning. Yet, the extent to which RTOs can appropriate this value—rather than merely generate it—hinges on their ability to continuously adapt and strategically position themselves within evolving innovation ecosystems. To unpack this adaptive process, we draw on the dynamic capabilities’ framework (Teece, Pisano, & Shuen, 1997; Teece, 2007), which conceptualizes firms’ ability to sense opportunities, seize them effectively, and transform internal structures and routines in response to environmental change...”

Final text written by me: “Dynamic capabilities theory provides an important lens for analyzing how organizations adapt to change, innovate, and sustain competitive advantage in uncertain environments (Teece et al., 1997; Teece, 2007). Central to this framework is the firm’s capacity to sense emerging opportunities and threats, seize them through timely resource mobilization, and transform internal structures and competences in response to evolving conditions. These dynamic capabilities are not static endowments but are developed and refined over time through processes of learning, collaboration, and

feedback. In the context of RTOs, dynamic capabilities are particularly critical given their intermediary position between scientific research and industrial application. Collaborative activities enable RTOs to develop a dynamic repository of organizational knowledge, comprising routines, insights, and reflexive learning processes, that underpins the development of dynamic capabilities over time... ” (p.78)

Example 3:

Prompt: “Kindly rewrite this, in simple terms, for a reader who is not an expert in the field innovation ecosystems understand: “Given the complexity of innovation ecosystems, marked by distributed agency, evolving goals, and socio-technical uncertainty, a case study design enables in-depth, contextualized exploration of orchestration mechanisms””

Response (From ChatGPT): “Because innovation ecosystems involve many different actors, changing goals, and uncertain conditions, using a case study approach allows for a deep, detailed understanding of how coordination and direction are achieved in practice.”

Final text written by me: “Innovation ecosystems are often made up of many different actors, changing objectives, and uncertain conditions. Using a case study approach was necessary to facilitate a deep and detailed investigation into how coordination and direction are achieved in practice (Yin, 2018). Thus, in this study, I focused on activities at the intersection of ecosystem orchestration, embedding directionality, and methodological intermediation. This focus supports a positioning of my case study as an opportunity for theory-building (Siggelkow, 2007)” (p.118)

To ensure the trustworthiness of all AI generated text, I manually checked and selected all sources, and the coherence of AI generated texts, which is marginal in this dissertation. Therefore, I rewrote and reformulated all AI generated texts to best reflect my own findings and opinions, and thus to make my own contribution throughout this PhD dissertation. The dissertation is not an AI generated manuscript. The academic contribution results from my personal work and thinking that I have developed on my academic journey and intellectual exercise that this PhD constitutes.

LIST OF THE PHD DISSERTATION WORKS

- **Essay 1 (2nd Chapter):** Fialor, P.G., Lo, A., Laviolette, E.M. Adaptive Intermediation: How Research and Technology Organizations Evolve Strategically to Support Small and Medium-Sized Enterprise Innovation. Submitted to The Journal of Technology Transfer

Previous versions of study 1 were presented in 2022 at International Council for Small Business (ICSB) Congress, Research Group on Collaborative Spaces (RGCS) Symposium, and in 2023 and 2024 at European Academy of Management (EURAM) Conference, and 2024 R&D Management Conference.

- **Essay 2 (3rd Chapter):** Fialor, P.G., Laviolette, E.M., Lo, A. Generating Internal Value in Research and Technology Organizations from Collaborative Innovation. Submitted to R&D Management Journal

Previous versions were presented in 2024 at Innovation and Product Development Management Conference (IPDMC) Doctoral Colloquium, Research Group on Collaborative Spaces (RGCS) Symposium, and in 2025 at European Academy of Management (EURAM) Conference.

- **Essay 3 (4th Chapter):** Fialor, P.G. Reframing the role of RTOs: From Intermediaries to Ecosystem Shapers: The Role of Research and Technology Organizations in Directing Innovation Trajectories. To be submitted to Technovation.

Previous versions were accepted for presentation at 17e Congrès International Francophone en Entrepreneuriat et PME (organized by the Association Internationale de Recherche en Entrepreneuriat et PME - AIRPME) but was not presented due to visa restrictions.

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<https://www.tbs-education.fr/professeurs-recherche/recherche/recherche-partenariale/projets-de-recherche-en-cours/rio-pme/ameliorer-collaboration-pme-organismes-recherche-technologique/>

GLOSSARY

CEA	Commissariat à l’Energie Atomique et aux Energies Alternatives (The French Atomic Energy and Alternative Energies Commission)
CEA Tech	Technological Research Department at CEA
SATT	Société d’Accélération du Transfert de Technologies
Y.SPOT	CEA Tech’s new open innovation tool (an open lab implemented as part of the open innovation strategy at CEA)
Opensive	An exploratory innovation support program, by CEA, targetted at fostering innovation for SMEs
RTOs	Research and Technology Organizations
SMEs	Small and Medium-sized Enterprises
CIFEPME	Congrès International Francophone en Entrepreneuriat et PME (International Francophone Congress on Entrepreneurship and SMEs)
R&D	Research and Development
EURAM	European Academy of Management
EARTO	European Association of Research and Technology Organizations
TBS Education	Toulouse Business School
Open Labs	Open Laboratories
IP	Intellectual property
AD’OCC	L’Agence de Développement Economique, d’Innovation et de soutien à l’emploi (Economic Development Agency of the Occitanie / Pyrénées-Méditerranée Region that supports businesses in creating jobs)
POC	Proof-of-Concept
Mines Albi	IMT Mines Albi, Grande Ecole d’Ingénieurs Généralistes (MT Mines Albi, General Engineering School)
CHU	Centre Hospitalier Universitaire (University Hospital)
TRL	Technology Readiness Level
ICSB	International Council for Small Business

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1. INTRODUCTION TO RESEARCH ON INNOVATION

INTERMEDIATION AND ECOSYSTEMS

In the past two decades, research on innovation has shifted from linear approaches to knowledge transfer towards a relational and systemic understanding of innovation. Innovation is now understood as a relational and systemic process, where different stakeholders, including firms, universities, governments, and intermediary organizations work together and collaboratively evolve around shared technologies and markets (Adner & Kapoor, 2010; Autio, 2022). Innovation is hence increasingly framed as an interactive, multi-stakeholder process embedded in innovation ecosystems. In these ecosystems, no single stakeholder controls the innovation process. Instead, coordination and alignment emerge through shared control, negotiated goals, and adaptive collaboration.

In these contexts, innovation intermediaries play a crucial role such as reducing uncertainty by building bridges across different knowledge domains, stakeholders, and institutional logics (Howells, 2006). These intermediaries broker relationships, facilitate access to resources, and translate expertise into usable frameworks to enable knowledge flow. In response, innovation intermediation (Kodama, 2008; Sieg et al., 2010) emerged as an important concept and a key theoretical lens for explaining how fragmented and networked innovation environments become more productive (Klerkx & Leeuwis, 2009; Dalziel & Parjanen, 2011).

Innovation management literature emphasizes the transactional and bridging functions of intermediation, like matchmaking between firms and research providers, transfer of technical knowledge, and the provision of access to infrastructure. These functions are important but capture only part of what intermediaries actually do, especially in dynamic and uncertain innovation contexts. A growing body of research (Agogu   et al., 2013; De Silva et al., 2018; Diener et al., 2020; Noviaristanti et al., 2023; Zhang & Liu, 2024) suggests that intermediaries also perform *interpretive* and *strategic* functions. They do not just connect stakeholders but help them make sense of emerging technologies, frame problems and opportunities, and orient collaborations in directions that anticipate future challenges and opportunities (Agogu   et al., 2013; Kuhlmann & Rip, 2018).

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This interpretive role is particularly crucial in ecosystems that face grand societal problems like sustainability, public health, and digital transformation, and where innovation goals are not predetermined but must be collectively imagined, framed, and aligned (Schot & Steinmueller, 2018; Mazzucato, 2018). In such ecosystems, intermediaries contribute to directionality (Bergek et al., 2023; Parks, 2022), ensuring that innovation efforts move toward broader societal goals and not only reproduce market-driven innovation trajectories. However, these contributions require capabilities that go beyond transactional brokerage to include sensemaking, framing, and orchestration. How such capabilities are developed and adapted by intermediaries, particularly Research and Technology Organizations (RTOs), constitute a critical gap in literature on innovation intermediation.

Building on these perspectives, this doctoral dissertation work examines how RTOs, often public or hybrid (public-private) intermediaries with strong scientific and applied capabilities, extend the concept of innovation intermediation. RTOs do not just play traditional functions of technology transfer and brokerage but engage in strategic ecosystem orchestration. They configure collaborative pathways under uncertainty, embedding methodological tools that shape how problems are defined, and aligning innovation activities with long-term societal objectives. Through this work, we advance the notion that RTOs can no longer be adequately understood as passive service providers or neutral intermediaries. RTOs are evolving into *institutional orchestrators* (as is later discussed in this work), stakeholders that configure the conditions under which innovation ecosystems are shaped, align, and respond to societal challenges.

This dissertation examines the case of the French Alternative Energies and Atomic Energy Commission (CEA) and its open lab Y.SPOT, and demonstrates how RTOs combine intermediation, capability building, and ecosystem governance to balance three interrelated objectives: (1) generating value for resource-constrained actors like small and medium-sized enterprises (SMEs), (2) ensuring internal sustainability through adaptive learning and value capture, and (3) embedding directionality into innovation trajectories to align them with societal goals. By carrying out this work, we contribute new theoretical insights to literature on innovation intermediation, dynamic capabilities, and ecosystem

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governance. Particularly, we introduce the concepts of *adaptive intermediation*, *non-market capability routines*, and reframe RTOs as *institutional orchestrators* that embed directionality in ecosystems.

This work enabled us to also examine the expanded role of RTOs and contribute to a comprehensive understanding of innovation intermediation. We show that innovation intermediation is not just a transactional activity, focused on services and connections, but also an *interpretive* and *strategic* practice. Intermediaries such as RTOs play a key role in helping ecosystem stakeholders make sense of uncertainty, reframe problems, and align their efforts toward broader societal and strategic goals. This makes intermediation central to the governance and direction of innovation ecosystems. In essence, we explored “*how RTOs adapt to balance external impact, internal sustainability, and societal directionality, thereby evolving from intermediaries into institutional orchestrators of innovation ecosystems*”.

This dissertation is structured around five chapters, with the first and current chapter presenting an introduction to the key literature that underpins and sets the stage for the next three chapters. Chapters 2, 3 and 4 present the three essays that form the core of this doctoral work while the fifth chapter offers some conclusions from the research. We present the contents of each chapter below.

The rest of chapter 1 of this dissertation starts by getting acquainted with RTOs. We sketch the role of RTOs and present their relevance as innovation intermediaries in the innovation ecosystem. Then, we proceed to offer a brief motivation for conducting this research in a second part. In a third part, we present institutional perspectives on RTOs, highlighting what it means to argue that RTOs evolve institutionally which constitute a critical oversight in the literature. From this point, we argue that further investigations regarding the role of RTOs as *institutional orchestrators* are, in particular, needed. The fourth section builds on these insights and presents our research objectives, scope, and questions. The fifth part states our positioning as researchers and briefly summarizes the methods used in the essays. The first chapter closes with an overview of the three essays presented in this dissertation.

The second, third, and fourth chapters constitute the three essays that make up the core of this dissertation. The first essay (chapter 2) explores how RTOs generate external value for SMEs in the

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upstream phases of innovation, emphasizing *brokering* and *framing* as critical practices for *adaptive intermediation*. The second essay (chapter 3) analyzes how RTOs capture internal value from collaborations through *prospecting* and *feedbacking*, thereby sustaining organizational learning and relevance. In the third essay (chapter 4), a work carried out solely by the dissertation's author, explored how RTOs orchestrate ecosystems through innovation support programs, embedding directionality into collaborative projects to align them with societal missions. Together, these essays contribute to reframing RTOs as *institutional orchestrators*: organizations that actively shape innovation trajectories by configuring ideas, aligning diverse stakeholders, and embedding directionality into collaborative practices.

After summarizing the three essays, the fifth chapter discusses the overall findings of this dissertation, highlights practical implications derived, and offers avenues for future research on the role of RTOs as innovation intermediaries. With this dissertation, we hope to bring new insights on innovation intermediation, contributing to our understanding of the role of RTOs in innovation ecosystem governance. We thus focus on RTOs as *institutional orchestrators*, an important aspect of the role of these intermediaries that have received little attention in the current literature despite their relevance in innovation ecosystems and studies.

1.1. GETTING ACQUAINTED WITH RESEARCH AND TECHNOLOGY ORGANIZATIONS (RTOs)

In an era marked by growing pressure on public budgets and heightened expectations for research to generate societal value, the role of RTOs in innovation ecosystems is undergoing a crucial transformation. RTOs are historically recognized for their contributions to applied research, R&D services, and technology transfer (Gillier & Schweitzer, 2021; Arnold et al. 2010) but are now tasked with far more dynamic, integrative, and strategic roles. According to the European Association of Research and Technology Organizations (EARTO), RTOs are defined as “*organizations which as their predominant activity provide research and development, technology and innovation services to enterprises, governments and other clients...*” (EURAB 2005).

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However, the expectations placed on RTOs have shifted and intensified. RTOs are no longer perceived solely as providers of applied research and technical services. Instead, they are expected to act as intermediaries, enablers, and, more ambitiously, orchestrators of collaborative innovation that aligns with broader socio-economic goals (Sheikheldin, 2021; Uribe-Echeberria et al., 2019). Consequently, RTOs are now required to demonstrate broader contributions to innovation-led growth, regional resilience, and public value creation (Giannopoulou et al., 2019; Readman et al. 2015). Governments and funding agencies expect them to play a more active role in innovation ecosystems, beyond translating scientific knowledge into usable technology, to address mission-oriented goals such as energy transitions and public health, and many more.

This shift reflects broader changes in the way innovation is understood and governed. It highlights a more fundamental transformation in the governance of innovation ecosystems, where success depends less on the transfer of knowledge and technology from the lab to the market, and more on the ability to coordinate multiple stakeholders (including firms, universities, policymakers, etc.) around shared challenges and emerging opportunities. In other words, the technology-push strategies of RTOs are giving way to ecosystem approaches that emphasize cross-sector collaboration, stakeholder alignment, and collaborative sensemaking under conditions of uncertainty (see Sheikheldin, 2021; De Silva et al., 2018; Rincón Díaz & Albors Garrigós, 2017). As such, RTOs are expected to expand their role from technology service providers to ecosystem enablers and orchestrators.

This requires RTOs to take on more strategic (Bandarian, 2018) and integrative roles such as facilitating cross-sector collaboration, building capacity for upstream innovation, shaping how problems are defined, and embedding directionality into innovation efforts. Within this new paradigm, RTOs are no longer perceived as passive intermediaries between academia and industry, but as central actors capable of connecting stakeholders, shaping agendas, and embedding directionality into innovation processes. Thus, RTOs are increasingly being positioned to guide what is explored, how innovation problems are framed, and what innovations are prioritized.

In Europe, RTOs such as France's CEA and Germany's Fraunhofer-Gesellschaft already play a key role in this transformation. Each year, these organizations provide services to thousands of firms,

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ranging from large corporations to SMEs, and contribute to a wide array of sectors, from energy and aerospace to health and digital technologies. Despite their growing importance, RTOs remain under-theorized in academic literature, particularly regarding their strategic evolution, internal learning processes, and capacity to shape innovation ecosystems from within. Most existing studies (Siegel et al., 2023; Gillier & Schweitzer, 2021; Bandarian, 2018; Goduscheit & Knudsen, 2015; Readman et al., 2015; Albors-Garrigós et al., 2014; Barge-Gil & Modrego, 2011; Arnold et al. 2010; etc.) focus on their downstream functions, such as contributions to late-stage product development, R&D, technology transfer, or technical problem-solving.

Others (Sheikheldin, 2021; Suominen et al., 2021; Giannopoulou et al., 2019; Uribe-Echeberria et al., 2019; Barge-Gil et al., 2011; etc.) pay more attention to their distinctiveness and similarities to other public research organizations like universities. Much less is known about how RTOs engage in upstream exploratory innovation, particularly with SMEs. SMEs are widely considered vital to economic growth (Messeni Petruzzelli et al., 2022) yet often lack the necessary absorptive capacity, resources, and maturity to effectively collaborate with RTOs (Hilkenmeier et al., 2021; Kurdve et al., 2020; Albors-Garrigós et al., 2010). However, traditional RTO strategies and engagement processes (often designed around structured, technology-driven projects) are often not well suited to meet the realities and needs of SMEs (Siegel et al., 2023; Gillier & Schweitzer, 2021; Readman et al., 2015; Albors-Garrigós et al., 2014; Albors-Garrigós et al., 2010). This creates a misalignment between RTOs and SMEs, especially in relation to their innovation objectives, needs, capabilities, etc.

1.2. INSTITUTIONAL PERSPECTIVES ON RTOs IN INNOVATION ECOSYSTEMS

Innovation does not unfold in a vacuum of technical possibility or market competition. It is deeply embedded in institutional environments defined by rules, norms, and shared cognitive frames that shape how organizations understand problems, identify opportunities, and coordinate action (Scott, 2014; DiMaggio & Powell, 1983). Institutional perspectives emphasize that organizations are not only economic actors but institutionalized entities who derive legitimacy by conforming to or strategically

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shaping the expectations of their environments. This perspective is particularly relevant for public RTOs, whose roles and missions are intertwined with evolving policy agendas, societal expectations, and the governance of innovation ecosystems.

Traditionally, RTOs derive their legitimacy from an innovation logic that positions them as providers of applied research, R&D, and technology transfer (Arnold et al., 2007; Howells, 2006). However, as policy agendas shift towards grand societal challenges, new institutional logics are emerging, focusing on framing problems, orchestrating ecosystems, and addressing these challenges. This places new expectations on RTOs to deliver technical solutions but also act as intermediate, enable, and orchestrate who frames problems in the upstream phases of innovation, mobilize multi-stakeholder collaborations, and guide innovation toward shared objectives (Mazzucato, 2018; Kuhlmann & Rip, 2018; Borrás & Edler, 2020). This shift marks a transformation in how RTOs gain legitimacy. Their impacts are no longer measured solely on their knowledge transfer activities but increasingly on their capacity to structure and steer collaborative innovation.

Additionally, institutional theory highlights that organizations are not passive recipients of institutional pressures. Through institutional work, they can actively shape new norms, practices, and expectations (Battilana et al., 2009). In the case of RTOs, this work involves designing *open labs*, *deploying exploratory methods* such as design thinking and C-K theory, and *curating spaces* for cross-sector collaborations. These practices do not simply support technological projects; they reconfigure the very conditions under which innovation unfolds, embedding new ways of defining problems and aligning heterogeneous stakeholders. From this perspective, RTOs act as institutional entrepreneurs (Battilana et al., 2009) or entrepreneurship instruments (Khelfaoui & Bernier, 2023), constructing new “rules of the game” in the innovation ecosystem.

Emerging studies on innovation governance also underscores the tentative and experimental character of directionality in complex socio-technical systems (Kuhlmann et al., 2019). Rather than enforcing rigid control, governance increasingly relies on iterative experimentation, feedback loops, and recalibration. RTOs are central to this *tentative governance* model because they can test new methods, facilitate collective learning, and embed “*directionality*”, the alignment of innovation with societal

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missions, into everyday innovation practices (Schot & Steinmueller, 2018; Borrás & Edler, 2020). By introducing exploratory programs (like the one explored in essay 3), RTOs move beyond providing technical services to actively shaping innovation trajectories, institutionalizing governance practices that combine flexibility with purpose.

The institutional perspective also lends to our understanding of how RTOs develop and sustain internal capabilities. While dynamic capabilities theory typically emphasizes market-driven sensing, seizing, and transforming (Teece, 2007), RTOs develop such capabilities through non-market routines that are embedded in public mandates and ecosystem responsibilities. Practices such as *prospecting* (sensing opportunities through ecosystem engagement) and *feedbacking* (learning from collaborations to adapt internal strategies), revealed in essay 2, illustrate how RTOs translate external collaborations into internal value for adaptation (De Silva et al., 2018). These routines are not purely competitive but institutionally anchored, reflecting the need to balance public missions with organizational relevance.

To say that RTOs evolve institutionally is to argue that the transformation of their roles is not just operational but structural and normative. RTOs evolve by shifting from technology-push approaches towards functions that are legitimized by new institutional logics, for instance, acting as *institutional orchestrators* that help orchestrate the conditions under which innovation occurs. This involves aligning stakeholders around cocreated problems, embedding directionality in collaborative projects, and reconfiguring ecosystem structures through new collaboration mechanisms. Over time, these changes become institutionalized in routines, programs, and shared expectations, redefining not only the roles of RTOs but also the governance of innovation ecosystems.

Drawing on these arguments, the institutional perspective provides an important lens for analyzing how RTOs (like CEA) navigate and shape dynamic innovation ecosystems. It highlights that RTOs' evolution is not just technological and strategic but institutional. They adapt to and reconfigure the rules, norms, and logics that structure collaborative innovation.

1.3. MOTIVATION FOR THE DISSERTATION

This dissertation project was motivated by three interrelated observations that highlighted persistent gaps between the promise of RTOs and their operational realities, as we had already begun to discuss. This is particularly in relation to SMEs, internal value generation, and the growing demand for mission-oriented innovation. Firstly, while SMEs are widely identified as engines of innovation, employment, and economic resilience, they mostly operate under resources-constrained conditions and organizational limitations (Bertello et al., 2022; Messeni Petruzzelli et al., 2022) that impede their ability to engage in structured innovation processes. Their limited absorptive capacity, defined as the ability to recognize, assimilate, and apply external knowledge (Hilkenmeier et al., 2021; Kurdve et al., 2020; Spithoven et al., 2011), makes it even more difficult for them to collaborate with RTOs in the early, exploratory phases of innovation.

Yet this is precisely the phase where intervention and support are most needed, where problems are ill-defined, exploration is high-risk, and innovation pathways are most uncertain. Despite this, most RTO strategies have traditionally focused on serving large firms through demand-led, downstream innovation services such as prototyping, testing, and technical validation (Bandarian, 2018; Rincón-Díaz & Albors-Garrigós, 2013; Albors-Garrigós et al., 2010). These traditional service offerings are not well adapted to SMEs' needs, particularly those operating outside the core industrial sectors often prioritized by RTOs. Consequently, SMEs are mostly underserved by RTOs (Siegel et al., 2023; Goduscheit & Knudsen, 2015; Albors-Garrigós et al., 2014), not because they lack potential, but because they are not structurally aligned, and there exist a mismatch, with RTOs' dominant engagement processes and service delivery.

Secondly, RTOs themselves are under increasing pressure to demonstrate public value (Intarakumnerd & Goto, 2018; Barge-Gil & Modrego, 2011), not only through the direct impact they create for their partners, but through their own organizational transformation and strategic evolution (Noviaristanti et al., 2023; De Silva et al., 2018; Leitner, 2005). As we earlier stated, in the context of the current innovation and business landscapes, characterized by limited public funding and growing performance expectations, it is no longer sufficient for RTOs to act as passive knowledge agents (De

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Silva et al., 2018) and technology service providers (Gillier & Schweitzer, 2021). They must evolve into learning organizations that can capture insight, develop capabilities, and realign their strategies based on the outcomes of their collaborative innovation efforts. However, empirical studies that explore how RTOs capture value from their collaborative efforts, particularly in early-stage, co-creative environments, are rare.

Most research (Gillier & Schweitzer, 2021; Giannopoulou et al., 2019; Uribe-Echeberria et al., 2019; Barlatier et al., 2017) focuses on value creation for firms while neglecting the internal dynamics through which RTOs capture knowledge, adapt routines, and develop organizational direction from collaborative innovation. This gap is particularly vital in upstream phases of innovation, where the potential directions for impactful innovation can be explored, and probably “elevate value” of innovative projects with SMEs while considering their specificity. This is also a phase where returns are more intangible, and RTOs must act as cognitive partners rather than just technical solution providers.

Thirdly, contemporary innovation policy increasingly moves toward a mission-oriented approaches (Fastenrath et al., 2023). Private organizations are adding this to their mission statement, but a critical observation reveals that such missions were traditionally devoted to public organizations like RTOs. This means that RTOs could capitalize on what they have long practiced, align themselves with this trend, and gain an advantage. This calls for RTOs to reposition themselves in innovation ecosystems to address pressing societal challenges such as climate change, public health, environmental sustainability, etc. These challenges require coordinated action across sectors, new forms of problem framing, and infrastructure that enables exploratory innovation with public value in mind.

Therefore, RTOs are uniquely positioned to act as ecosystem orchestrators; organizations capable of connecting stakeholders, aligning interests, embedding directionality into ecosystems, and translating high-level policy missions into concrete collaborative projects. Yet, academic literature has not yet sufficiently examined the conditions under which RTOs can effectively assume this role. Neither has the literature explored how RTOs design the necessary intermediary infrastructures (i.e., open labs and innovation support programs) that allow them to perform this orchestration role across different stakeholders, sectors, and timelines. For instance, the rise of open labs, collaborative platforms designed

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to convene diverse stakeholders for collaborative innovation (Fritzsche, 2020; Fritzsche et al., 2020; Schmidt & Brinks, 2017), adds a new layer of complexity and opportunity to this discussion. Open labs promise to lower barriers to entry for SMEs, facilitate cross-sector knowledge recombination, and enable exploratory work that aligns with public missions (Mérindol & Versailles, 2022; Hu & Fritzsche, 2021; Moretti, 2019). Nevertheless, we know little about how RTOs design, manage, and leverage such spaces as their roles shift.

These gaps are not inconsequential. They emphasize the need for a deeper and more nuanced understanding of how RTOs support innovation, generate internal value, and contribute to shaping mission-oriented innovation ecosystems. As mostly publicly funded, and increasingly operating in competitive environments, RTOs must develop internal capabilities to learn, adapt, and transform. Understanding how they generate internal value, whether in the form of strategic learning, capability development, knowledge assets, or new collaborative partnerships, is crucial to examining their long-term survival and ecosystem impact. Yet, these questions remain unanswered, and we draw on them to address the gaps in literature by investigating not only what RTOs do, but how they evolve as intermediaries and orchestrators of innovation.

Specifically, the dissertation explores more closely how RTOs adapt their practices and roles to evolve from service providers into institutional orchestrators that generate external value, secure internal sustainability, and steer innovation ecosystems toward societal missions. We therefore organize the research around the strategic adaptation of RTOs in innovation ecosystems, with a focus on collaboration with SMEs for value co-creation.

1.4. OBJECTIVES, SCOPE, AND RESEARCH QUESTIONS

In this section, we present this dissertation's overarching research question and articulate how the three essays address specific sub-questions that allow to provide initial answers. Then we briefly give an account of the essays' main findings to illustrate how the research objectives translate in research outputs.

1.4.1. Research objectives

This dissertation addressed the gaps in literature earlier discussed by investigating how RTOs, specifically CEA, adapt their processes, practices, and tools to generate value for their external partners, but also internally for their own transformation and their innovation ecosystems. The objective was to move beyond narrow conceptions of RTOs as technical service providers that dominate the literature. More specifically, we examined the role of RTOs as dynamic and adaptive organizations capable of shaping innovation trajectories and orchestrating ecosystem-level changes. To achieve this, we grounded the research in an in-depth, longitudinal case study of CEA and its Y. SPOT open lab (dual-purpose innovation lab embedded within the Occitanie region of France).

Y.SPOT is not a traditional CEA R&D lab. It was initially designed as a space for experimentation, co-creation, and open collaborative innovation with ecosystem stakeholders, including SMEs, universities, policymakers, and researchers. Unlike traditional labs at CEA, which often focus on downstream product development, technology transfer, and technical problem-solving, Y. SPOT functions at the upstream end of the innovation process, where ideas are still forming, needs are unclear, and possibilities are open. This makes it an ideal case study for exploring how RTOs can support exploratory innovation and embed themselves within regional innovation ecosystems in more flexible, responsive, and directional ways.

At Y.SPOT, we specifically focused on *Opendive*, a flagship exploratory innovation support program developed by CEA. Originally launched as a post-Covid 19 innovation support initiative to help SMEs diversify beyond traditional industrial sectors (e.g., aeronautics), *Opendive* has since evolved into a methodological platform for collaborative exploration. It offers structured tools, such as design thinking, C-K theory, and collaborative problem framing workshops, and offers neutral engagement spaces that allow stakeholders to step outside their traditional sectors of operations and imagine cross-sector solutions. *Opendive* thus serves as a physical manifestation of the emerging orchestration role envisioned for RTOs, foster collaborations with existing stakeholders, but also actively cultivate innovation directions, collaborative problem definitions, and purpose-driven innovation trajectories.

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The case of Y.SPOT and *Opendive* illustrates a broader organizational shift. RTOs like CEA are increasingly being tasked to design and implement collaborative spaces that can bridge cross-sector boundaries, foster early-stage exploration, and align stakeholder interests around societal goals. These spaces represent a significant departure from traditional innovation spaces, especially in the context of RTOs. They do not focus solely on technology transfer or market readiness but prioritize relational capacity, cognitive openness, and iterative learning. They are places where diverse stakeholders, many of whom may lack prior connections, can converge to explore future-oriented challenges and form new collaborative pathways. By this, these spaces become vehicles through which RTOs enact their evolving role as ecosystem orchestrators.

Despite their growing prominence in innovation policy and organizational practice, open labs, and the innovation support programs they offer, remain under-studied in innovation intermediary research, particularly in the context of RTOs. While literature has addressed the role of intermediaries in knowledge brokering and technology transfer, it has rarely examined how RTOs deliberately design and govern such open labs to shape innovation processes, direct the evolution of innovation ecosystems, and embed societal relevance into collaborative innovation outcomes. How RTOs use methodological tools, how they facilitate trust and alignment among different stakeholders, and how they balance openness with coherence, are questions that remain largely unaddressed.

This research contributes to filling these gaps. By studying the operational logic, strategic intent, and practical dynamics of Y. SPOT and *Opendive*, the dissertation provides rich empirical insights into how RTOs can move from service offerings to ecosystem orchestration. This is vital to understand how these intermediary organizations can go from responding to innovation-led demands to shaping innovation ecosystem direction. We draw on this work to also offer a conceptual lens through which open labs can be understood not as passive enablers of innovation, but as organizational mechanisms through which RTOs activate new roles, experiment with new forms of value creation, and reconfigure their relationship to firms and society.

1.4.2. Research questions

Considering these objectives, we designed this doctoral dissertation with an overarching research question that breaks into three distinct, but interrelated questions addressed in each of the three essays:

How do RTOs adapt to balance external impact, internal sustainability, and societal directionality, thereby evolving from intermediaries into institutional orchestrators of innovation ecosystems?

This question reflects the dual challenge facing RTOs today, how to remain relevant as innovation services providers while also responding to broader societal demands for transformation. To address it, the dissertation unfolds through three interrelated sub-questions that build cumulatively:

1. How do public RTOs adapt their strategies to better support the upstream innovation needs of SMEs? (Essay 1)
2. How do RTOs appropriate internal value from collaborative innovation to shape their sustainability and alignment? (Essay 2)
3. How do RTOs shape the direction of innovation ecosystems through open labs and exploratory support programs? (Essay 3)

The first essay investigates external value generation by RTOs towards often marginalized innovation ecosystem stakeholders like SMEs, mainly focusing on the intermediary mechanisms that necessitate such value generation. The second essay turns inward, to explore internal value generation in RTOs through collaboration, highlighting dynamic capabilities that enable strategic learning and long-term survival. The third essay, however, shifts towards the ecosystem level, exploring the orchestration role of RTOs through open labs and innovation support programs that embed directionality to align collaborations with broader societal missions. Together, these essays provide cohesive insights into the practices of RTOs and simultaneously advance the theoretical understanding of innovation intermediation, dynamic capabilities, and ecosystem governance by reframing RTOs as *institutional orchestrators* capable of steering innovation ecosystems.

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1.5. THE THREE ESSAYS

We address the research questions through three empirical studies, each of which builds upon insights from the others, conceptually and methodologically. This dissertation could have been presented as a monograph, yet the evolution of the practices we studied and the research positioning we chose offers a much more logical argument and flow as a corpus of three different but interrelated essays. Notwithstanding, when examined as a whole, the essays form an elaborate inquiry into how RTOs evolve from being transactional service providers to adaptive *institutional orchestrators* capable of directing collaborative innovation and shaping ecosystem dynamics. According to Chiambaretto (2012), monograph dissertations have the advantage of being the traditional format in management sciences. They are well circumscribed, internally consistent, and allow doctoral students to demonstrate their individual research skills, often through long and solitary inquiry.

Yet, as Chiambaretto also notes, the growing importance of publication records for academic careers has increased the appeal of article-based dissertations. This format offers pragmatic advantages as it trains students to produce the most desirable research output, prepares them for the realities of academic publishing, and fosters collaborative competencies through co-authorship. It is nevertheless important to highlight that article-based dissertations are not without weaknesses, including the potential lack of coherence between papers (which we try to reduce in this work) and questions about the doctoral student's individual contribution. In this dissertation, we have adopted the article-based format, guided by a pragmatist orientation. The three essays address distinct but interrelated research questions, and the coherence between them is reinforced through a common empirical field and integrative work.

To address concerns over authorship, the third essay is entirely authored by the author of this dissertation, and explicit clarification of co-author contributions is provided for the other papers. This introductory chapter further highlights the unifying argument and theoretical integration across the three studies.

1.5.1. Research paradigm: Ontology, epistemology, and methodology

The philosophical positioning of this dissertation reflects the research questions raised earlier. We address in this work how RTOs, specifically CEA, adapt their strategies, practices, and tools to: (1) support upstream innovation for SMEs, (2) generate internal value from collaboration, and (3) orchestrate the trajectory of innovation ecosystems toward broader societal missions. These questions are exploratory, processual, and context-dependent. They cannot be answered through hypothesis-testing that is not in touch with lived practices. Instead, we required an inquiry approach that prioritized stakeholder meanings, interactions, and evolving practices. Accordingly, we adopted an interpretivist epistemology with a pragmatic orientation, supported by an abductive and longitudinal case study design, to uncover how orchestration is enacted in practice by RTOs and how it generates both theoretical and practical insights.

Positioning research philosophically requires clarifying its ontological, epistemological, and methodological assumptions. These dimensions together constitute a paradigm, shaping how phenomena are framed, how knowledge is generated, and how inquiry is conducted (Guba & Lincoln, 1994; Jackson et al., 2015). Ontology concerns the nature of reality. Positivist traditions typically assume a realist ontology in which an objective reality exists independent of human action, while interpretivist traditions adopt a relativist stance, treating reality as socially constructed and contextually embedded (Morgan & Smircich, 1980). This dissertation aligns with the latter, assuming that innovation ecosystems are emergent socio-technical configurations created and recreated through the practices, meanings, and negotiations of stakeholders.

Epistemology refers to the nature of knowledge and the relationship between the researcher and what is being researched. Positivist epistemologies prioritize prediction, measurement, and causal explanation, whereas interpretivist epistemologies emphasize situated understanding, sensemaking, and meaning construction (Orlikowski & Baroudi, 1991; Bansal & Corley, 2011). In this work, we treat knowledge as co-created through engagement with organizational practices. This orientation supports the use of qualitative methods, interviews, observations, and document analysis, to explore how stakeholders at CEA and in SMEs make sense of and orchestrate innovation. Methodology, however,

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connects ontological and epistemological positions with practical approaches of inquiry. For positivists, this often entails experiments or large-scale surveys. For interpretivists, case-based, ethnographic, and processual approaches are more consistent (Langley, 1999; Eisenhardt, 1989). In carrying out this work, we adopted a longitudinal, embedded case study design of CEA, its Y.SPOT open lab, and the *Opensive* innovation support program enacted in this lab, to capture the evolution of practices over time.

Taken together, these assumptions position our work within an interpretivist paradigm with a pragmatic orientation. Pragmatism complements the interpretivist stance by emphasizing the usefulness of knowledge for problem-solving and practice (Morgan, 2014). We developed concepts such as *adaptive intermediation* and *directionality embedding* to refine theory but also to improve the design of RTO innovation support programs and policymaking. This stance supported methodological pluralism, drawing on interviews, participant observation, and internal documents, which was necessary for us to go beyond a single definitive reality towards capturing multiple perspectives and generating richer, practice-relevant insights (Jick, 1979; Gioia et al., 2013).

Finally, we adopted an abductive reasoning strategy in this dissertation. We iteratively moved between theory and data to progressively define and refine our constructs and concepts. Thus, instead of testing hypotheses derived from a critical analysis of literature, we built concepts drawing on empirical data, consistent with abductive and process-oriented approaches to theory development (Dubois & Gadde, 2002; Van de Ven & Poole, 1995). This approach reflects the broader shift in management and innovation studies toward research that blends interpretive depth with practical relevance, particularly for understanding complex, emergent, and multi-stakeholder phenomena such as innovation ecosystems (Autio, 2022; Kuhlmann et al., 2019).

1.5.2. Research positioning

Research does not revolve only around data collection but also involves thinking carefully about the kind of knowledge we are producing. As Van de Ven (2007, p. 36) puts it: “It is better to choose a philosophy of science than to inherit one by default.” In other words, researchers should consciously reflect on the assumptions guiding their work, rather than simply adopting them without question. These

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assumptions matter because they shape both the way a research study is carried out and the kind of results it produces. From such understanding, two central issues become critical to highlight. First, the epistemology, or how knowledge is understood and justified; and second, the approach to theory development, or how we use research to build and refine concepts (Saunders et al., 2009).

1.5.2.1. Epistemological approach

We adopt an interpretivist foundation with a pragmatic orientation to conduct this doctoral work. At its core of this dissertation, the research seeks to understand how stakeholders inside an RTO (CEA) and its collaborating partners (particularly SMEs) make sense of, negotiate, and enact “orchestration” in practice. We therefore treat knowledge as socially constructed and context-dependent, which necessitated an emphasis on close, situated inquiry and rich description. By choosing this foundation, we lean towards the perspective that realities in innovation ecosystems are not a static, objective entities “out there”; instead, these realities are socially constructed through the meanings and practices of stakeholders (Burrell & Morgan, 1979; 2019; Lincoln & Guba, 1985). For instance, we observed (through this work) that when SME managers and CEA experts collaborate, they don’t simply execute predefined technical tasks.

Rather, they engage in framing, negotiating, and redefining what counts as an “innovation problem” or a “feasible opportunity.” This interpretivist perspective assumes that understanding these situated processes of sensemaking is key to explaining how orchestration actually works in practice (Weick et al., 2005). Thus, methods we used, which included in-depth interviews, participant observation, and thick descriptions (Geertz, 1973) were essential, because they captured not only outcomes but the lived experience of stakeholders within the ecosystem. This positioning allowed us to explore how concepts like framing and co-orientation emerge in the day-to-day activities of these stakeholders and not imposing them as categories outside of the empirical work.

Concurrently, we approached the dissertation from a pragmatic orientation and tried to go beyond interpreting meanings towards asking how insights from our work can be useful for improving practice. Pragmatism emphasizes problem-solving, actionable knowledge, and real-world applicability (Morgan,

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2014). In our case studies, concepts like *adaptive intermediation* or *directionality embedding* were not abstract themes for the sake of theorizing. They were refined with an eye to how they help RTOs design better programs (i.e., Y.SPOT, *Opendive*, etc.) and how policymakers can support them. This pragmatic orientation also legitimizes methodological pluralism (Creswell & Plano Clark, 2017): using multiple qualitative data collection approaches to explore the role of RTOs from different angles. The objective was to develop deeper and more relevant insights for both theory and practice.

We therefore drew on interviews, observations, and documents together, not to validate a single truth, but to generate richer insights that can inform theory and practice simultaneously. Pragmatism complements our methods by foregrounding usefulness and problem-solving. We developed concepts and refined them as and when they help explain and improve the design of intermediary programs and collaborative practices in real settings (in our case, at CEA). This dual positioning legitimizes iterative analysis, moving between empirical insights and theoretical frameworks while supporting the different methods we employed to answer our research questions. This positioning reflects established distinctions among dimensions of philosophical paradigms (ontology, epistemology, methodology, etc.) and aligns with existing management research that combines interpretive understanding with practical inference for complex emergent phenomena.

Together, this interpretivist and pragmatist philosophy fosters our abductive reasoning strategy, iterating between theory and empirical evidence to refine constructs such as *adaptive intermediation*, *institutional orchestration*, and *directionality embedding*. This aligns with the methodological demands of studying complex, uncertain, and multi-stakeholder environments where coordination and direction emerge through practice (Dubois & Gadde, 2002; Eisenhardt, 1989). In line with this, the dissertation embraces abductive reasoning, working back and forth between data and theory to progressively refine constructs (e.g., “adaptive intermediation,” “directionality embedding”) in light of what the field reveals, rather than testing a priori hypotheses detached from context. Your own methodological notes explicitly motivate this iterative, practice-proximate reasoning for studying a leading RTO.

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1.5.2.2. *Approach to theory development*

We adopt an abductive, process-oriented approach to theory development. This approach is often suited to studying complex, emerging, and multi-stakeholder phenomena such as innovation intermediation and ecosystem orchestration. Unlike deductive approaches (which test hypotheses derived from pre-existing theories) or purely inductive methods (that often focuses on building theory solely from data), abduction supports iteration between empirical material and conceptual frameworks. We consistently compared and contrasted our empirical observations from the field with established theories of innovation intermediation, dynamic capabilities, and ecosystem governance, which mostly led to refining theoretical constructs (Dubois & Gadde, 2002, 2014). This abductive logic is key to capturing the evolving and situated practices of RTOs as they redefine their roles within innovation ecosystems.

Three features define the abductive, process-oriented approach we employed in this dissertation work. First, process theorizing. We explore how intermediary practices unfold and change over time in contrast to treating intermediation as a static, linear, function (e.g., technology transfer, brokering). This longitudinal orientation enables theorizing of dynamic practices such as *brokering* (connecting actors and resources), *framing* (shaping how problems and opportunities are understood), *prospecting* (scanning for new opportunities), and *feedbacking* (feeding experiential learning back into organizational routines). Building on Langley (1999) and Van de Ven and Poole (1995), the analysis we carried out in this work highlights the temporal and iterative nature of these practices, showing how they interact to support both SME innovation and RTO internal adaptation.

Second, ecosystem orchestration as structured design. Drawing on ecosystem research, this dissertation conceptualizes orchestration beyond coordination towards understanding it as a deliberate design of roles, interfaces, and collaborative mechanisms that align diverse stakeholders around shared goals (Adner & Kapoor, 2010; Jacobides et al., 2018; Autio, 2022). This way, orchestration is no longer seen as an emerging by-product of ecosystem activity but as a set of purposeful interventions enacted through programs, tools, and spaces. This perspective enables us to identify how RTOs, through their

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innovation support programs, configure collaboration platforms that grounds exploratory work while promoting cross-sector alignment and directional innovation.

Thirdly, institutional embedding. Beyond firm- and program-level perspectives, our work engages with the institutional dimension of orchestration. *Directionality* is understood as something embedded in day-to-day practices, methodologies, and relational infrastructures and not just as a high-level policy mandate (Kuhlmann, Stegmaier, & Konrad, 2019; Mazzucato, 2018; Schot & Steinmueller, 2018). By examining how RTOs integrate methodological scaffolding (e.g., design thinking, C-K theory) and relational brokerage (e.g., partnerships with hospitals, universities, SMEs), this dissertation shows how new forms of collaboration are grounded and aligned with public missions. This institutional perspective situates RTOs as active agents in shaping norms, expectations, and collaboration logics within innovation ecosystems.

These features support the development of mid-range theory (Merton, 1968): explanations that are abstract enough to inform broader debates on intermediation and orchestration yet grounded in the empirical case of CEA and its open lab, Y.SPOT. By focusing on the interplay of dynamic mechanisms, structured ecosystem design, and institutional embedding, we demonstrate how RTOs are evolving from linear, technology-push organizations into *institutional orchestrators*, balancing external support for SMEs, internal value generation, and alignment with societal missions.

Having delineated our research design, we now turn to clarifying our research positioning, our methods, data collection and data analysis procedures in the next section.

1.5.3. Research method, guiding principles, and field work

1.5.3.1. Guiding Principles

The methodological design we deployed in this research work is anchored in three guiding principles, ensuring coherence with our research questions and the interpretivist and pragmatist paradigm. First, we deployed an embedded longitudinal case study of the Commissariat à l'énergie atomique et aux énergies alternatives (CEA), focusing specifically on its Y.SPOT labs and *Opensive* program as sub-units of analysis. A single-case design was appropriate given the theoretical richness of

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CEA as a leading European RTO, and the empirical opportunity to study ecosystem orchestration (Eisenhardt, 1989; Siggelkow, 2007). The longitudinal dimension (spanning 2021 to 2025) captures how orchestration practices, such as brokering and framing, unfolded and evolved over time, rather than appearing as static or one-off intervention. This temporal depth is crucial for addressing the research questions on adaptation, learning, and directionality in innovation ecosystems.

Secondly, we adopted triangulation and reflexivity to enhance credibility and minimize bias in the dissertation. The research integrates multiple data sources, including interviews, participant observations, internal documents, and project materials. Triangulation enables both within-method and across-method corroboration of findings (Jick, 1979; Gibbert et al., 2008). Equally important is reflexivity as one of the authors was stationed within the RTO investigated to facilitate data collection. This researcher's embedded role in *Opensive* activities created both opportunities for access to sources of data but at the same time posed risks of bias. We addressed these issues through peer debriefs with both academic and industrial supervisors, validation of accounts with key informants, and systematic notes that document and critically reflect on the embedded researcher's influence on the field (Bansal & Corley, 2011). This reflexive orientation aligns with interpretivist epistemology, acknowledging that knowledge is co-constructed and not just objectively discovered.

We also used a mechanism-seeking approach, which involves looking beyond describing events to explain the step-by-step processes through which outcomes emerge. In practice, this involves tracing how interactions between stakeholders, methods, and contexts gradually generates outcomes such as SME co-orientation or the embedding of directionality (Hedström & Ylikoski, 2010). Analytically, we implemented this through a blend of inductive and deductive coding process. Deductive codes derived from literature (e.g., intermediation, orchestration, dynamic capabilities) provided theoretical anchors, while inductive openness allowed new practices (e.g., prospecting, feedbacking) to surface from data. This approach supports mid-range theory refinement by systematically connecting observed practices with broader constructs (Langley, 1999; Gioia, Corley, & Hamilton, 2013).

We present the fieldwork we used for the three essays in the following paragraphs.

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1.5.3.2. The fieldwork

We selected CEA, one of Europe's leading RTOs, as our embedded case study setting. The choice of CEA was purposive, grounded in its dual role as a national provider of R&D services and a key actor within the European and French innovation landscape. Specifically, we focused on CEA Tech, the technology research division at CEA, due to its extensive involvement in collaborative innovation with a broad spectrum of stakeholders, including SMEs, corporations, universities, and public institutions. CEA's relevance stems from its evolving strategy to extend operations into underserved regions of France, including Occitanie, Nouvelle-Aquitaine, and Auvergne-Rhône-Alpes. These regional expansions offered a compelling context to examine how an established RTO reconfigures its capabilities and internal processes to respond to new and underserved innovation ecosystems. Furthermore, CEA's historical emphasis on specific industries such as defense and energy left it relatively closed to industrial diffusion until the early 2000s, making its current transition to more inclusive innovation services offerings particularly interesting to examine.

CEA represents a relevant case for addressing the research questions we raised. We purposively accessed the fieldwork at CEA Tech while conducting a pilot study to evaluate the role and impact of Y.SPOT, new open lab, in CEA's open innovation strategy. Initially, the topic of the design and implementation of this lab to support CEA's openness to industrial and regional stakeholders formed the basis of the inquiry. Hence, in December 2020, contacted the director of CEA's Y.SPOT Occitanie by mail to discuss avenues for exploring the role and impact of the lab in the Occitanie innovation system. After a few rounds of interview, we found that the Y.SPOT in Occitanie, located in Labège, had a specific orientation towards promoting innovation for SMEs whereas a second Y.SPOT at Grenoble in the Auvergne-Rhone-Alpes region had an orientation towards corporations and large firms.

Y.SPOT Occitanie presented a unique context to study how RTOs support innovation for SMEs. An initial review of literature on RTOs, carried between January 2021 and June 2022 as part of a master degree dissertation developed by the author of this dissertation, revealed that RTOs traditionally support innovation for large firms and corporations through their open innovation labs. This is not the case for RTOs and SMEs. The findings suggested that RTOs often do not consider the specificities of SMEs

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when designing their innovation support programs and strategies. SMEs on the other hand do not consider RTOs as key innovation support infrastructures, particularly in the early stages of innovation. We observe that SMEs often perceive RTOs as far removed from their sectors. From this perspective, the Y.SPOT in Occitanie, with its SME orientation, presented an interesting context for examining the evolution of the role of RTOs, especially towards innovation ecosystem stakeholders that are far removed from their sectors of application.

At this point, we took the chance and asked to initiate a formal collaboration to investigate the design, implementation, and impact of CEA's Y.SPOT in Occitanie which now constitutes the basis of this dissertation. Following further rounds of interviews and analysis, and a presentation of initial insights into proposed key questions, methods, and potential outcomes in December 2021, we reached an informal agreement for a collaborative research between CEA and TBS Education, pending internal approval by CEA. In February 2022, a TBS-CEA formal collaborative agreement was reached to carry out an independent study of the evolution and impact of CEA through Y.SPOT which co-sponsored a PhD researcher (this dissertation's author) within the framework of the TSM-TBS Doctoral Program. The essay presented in the second chapter of this dissertation constitutes the first outcome of the field work conducted within this agreement and elaborates on the methods and strategies deployed to kickstart the project.

Following the evolution of the activities of CEA, Y.SPOT, and *Opendive* (the program designed to support innovation for SMEs), the essay presented in the third chapter of this research work to a new view to examine the impact of Y.SPOT's activities on the internal dynamics and activities at CEA. Data collection and field work evolved based on findings and discoveries from workshops, site visits, meetings etc. The dissertation author was 40% stationed at CEA Tech (specifically Y.SPOT) in Labège, and 60% at TBS Education to foster the iterative and pragmatic paradigms that form the research positioning of this dissertation. Consequently, the field work formally spanned February 2022 and January 2025 (3 years) with iterative movement between field work and academic responsibilities. The dissertation work itself however exceeded this timeframe.

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The context that precedes the design and implementation of Y.SPOT Occitanie is particularly influenced by the impact of Covid19 on SMEs in Occitanie and support from the regional authorities interested in fostering innovation for firms in sectors heavily hit by the pandemic. Following this concern, an innovation support program (*Opensive*) was collaboratively designed with key stakeholders including Toulouse Tech Transfer (SATT), Toulouse University Innovation Center (PUI), CEA, and regional authorities. The evolution of this program within Y.SPOT also presented another dimension of fieldwork to further explore how CEA orchestrates innovation trajectories that are aligned with public missions; this formed the basis for the essay presented in the fourth chapter of this work.

The field work was supervised and directed by cross-sector team made up of two key members at CEA and three researchers from TBS Education. This team met on a bi-monthly basis to review, analyze, discuss, and verify accounts collected in the field. Additionally, a bi-weekly meeting was held by the three co-authors involved in the development of this dissertation to iterative data from the field with theoretical and conceptual frameworks and accounts from literature. This iterative process led to the development and publication of a practitioner-oriented article on TBS Education's website and the dissemination of the practical findings of the project on other networks such as LinkedIn.

From the kick-off meeting held in February 2022 to when we left the field in January 2025, members of the supervisory team had to reach multiple consensuses on what should be done, who would be in charge of implementation, when to implement, and a number of details that were initially overlooked. Navigating dissensions among differing interests and visions and, as such, shaping the contours of what would be the collaborative framework for the project required considerable effort and time from the actors. We left the field after the contractual agreement for carrying out the doctoral work and analysis of CEA Y.SPOT ended in January 2025. At this point, the author of this dissertation took a step back from the field to focus on organizing field notes, interview and observational data, and documentary information to kick-start the writing process. Figures 1.1 and 1.2 below present the timelines for the fieldwork and the doctoral dissertation project.

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1.5.3.3. *Data Collection*

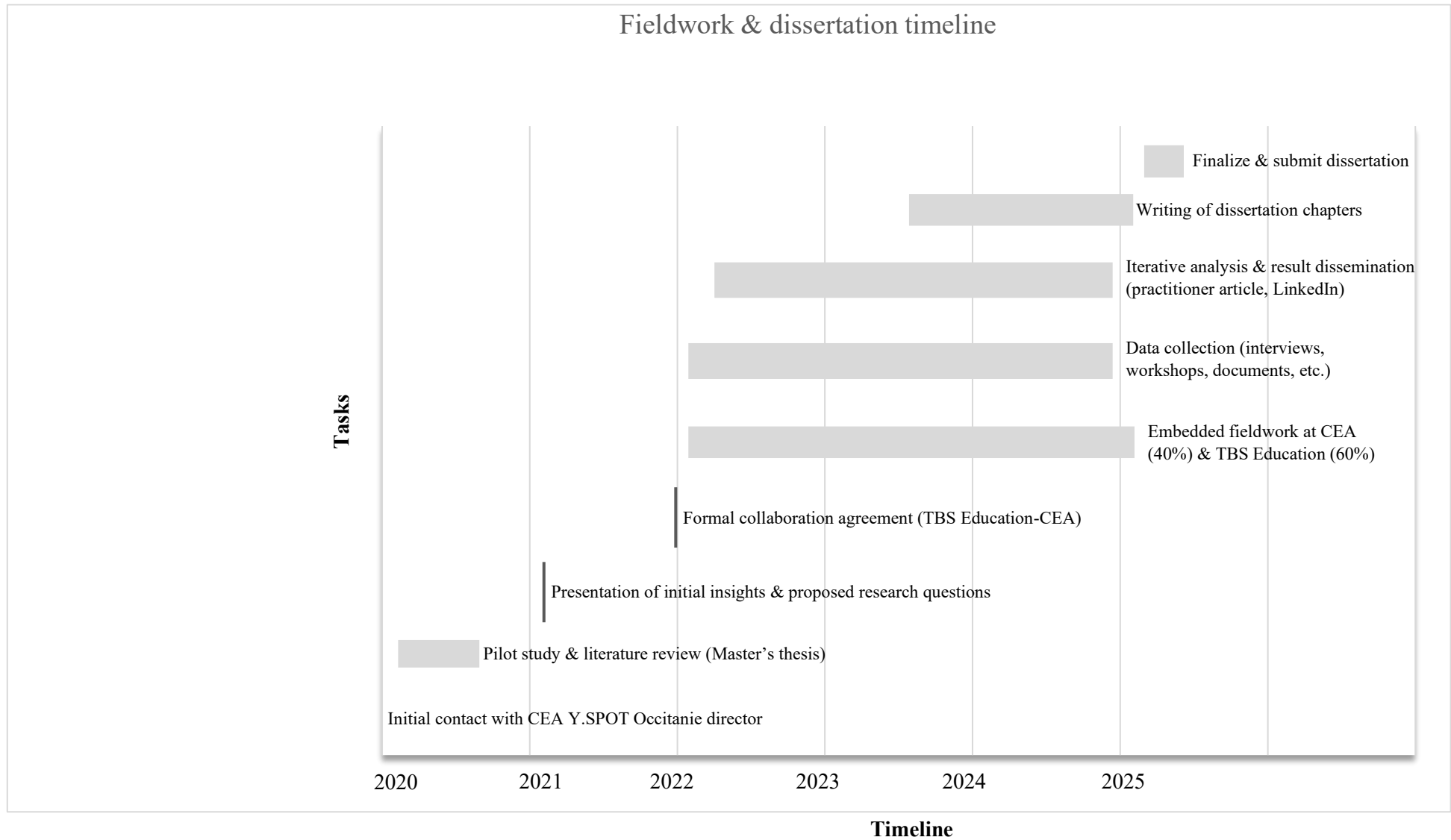
Data collection combined semi-structured interviews, participant observation, and documentary analysis to build a comprehensive view of orchestration practices at CEA. Approximately 138 semi-structured interviews were conducted with CEA staff, SME managers, innovation facilitators, and public stakeholders, ensuring diversity of perspectives across the ecosystem. Interview protocols were designed to elicit both retrospective accounts of collaboration and forward-looking reflections on innovation trajectories. We complemented accounts from interview data with participant observation by providing real-time insights into workshops, design sprints, and steering meetings. This immersion enabled the observation of informal dynamics, such as negotiation, sensemaking, and alignment, that are often absent from formal reporting. Finally, we included internal documents and program artefacts (briefs, workshop guides, reports, templates) in our data which offered insights into the methodological and institutional logics that underpinned *Opendive's* design and execution. Together, these data sources provide a robust basis for triangulation and temporal analysis

1.5.3.4. *Data Analysis*

Data analysis proceeded iteratively and abductively, going between data and theory. We analyzed data through thematic coding methods using NVivo software, following the Gioia methodology for rigorous qualitative analysis (Gioia et al., 2013). We used In vivo coding to capture first-order codes, especially informants' terms and practices (e.g., "scouting opportunities," "reframing problems"), to preserve closeness to informants' statements. We then gathered second-order themes around ideas such as exploratory orchestration, methodological intermediation, and SME co-orientation. Aggregate dimensions (e.g., adaptive intermediation, directionality embedding) were then constructed to link empirical findings with theoretical debates on intermediation, capabilities, and ecosystem governance. We also carried out triangulation across our data sources to enhance credibility and undertook validation interviews with key informants to reduce confirmation bias. We also deployed process exploration techniques (George & Bennett, 2005) to highlight how practices evolved across time and at different ecosystem-levels, thereby linking micro-level interactions with meso-level orchestration dynamics.

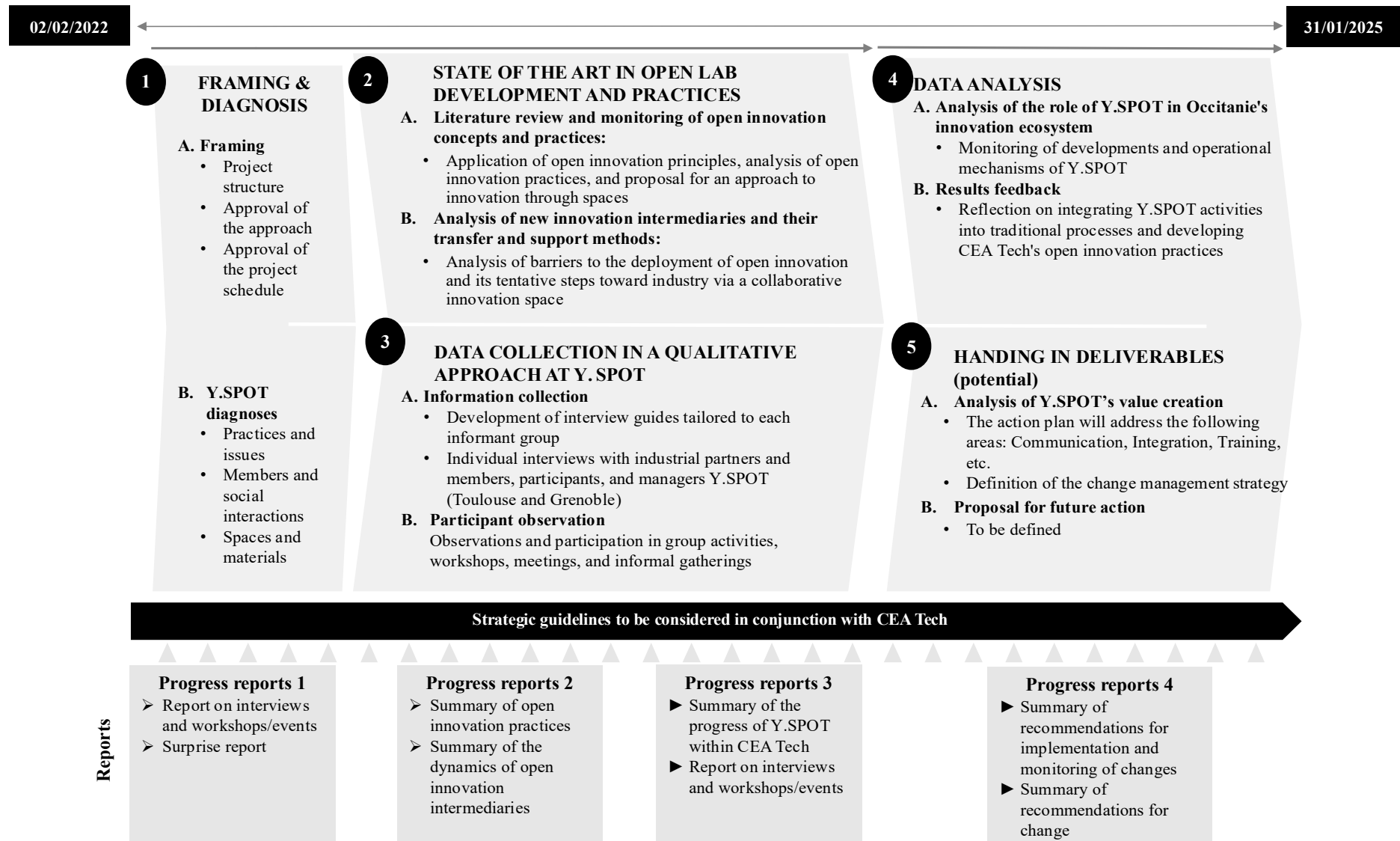
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Figure 1. 1: Dissertation writing and submission timeline



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Figure 1. 2: Field work timeline and activities



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This analytic strategy ensured rigor and allowed our work to reveal new theoretical constructs grounded in practice. Table 1.1 presents insights into our methodological approach, aligning the questions we address in this dissertation work, our research design choices, sources of data, and analytical approach.

Table 1. 1: Methodological Justification

Research Question	Design Choices	Data Sources	Analysis Approach	Quality Criteria
RQ1: How do public RTOs adapt their strategies to better support the upstream innovation needs of SMEs ?	Longitudinal single-case design with embedded units (Y.SPOT, SME collaborations) (Eisenhardt, 1989; Siggelkow, 2007).	46 semi-structured interviews; participant observation of SME projects; internal lab documents.	Thematic coding (deductive: intermediation, framing; inductive: emergent SME practices) (Gioia et al., 2013).	Triangulation across data types; chain of evidence; reflexive memos (Gibbert, Ruigrok & Wicki, 2008; Jick, 1979).
RQ2: How do RTOs appropriate internal value from collaborative innovation to shape their sustainability and alignment?	Abductive theory-building to surface mechanisms not visible in prior typologies (Dubois & Gadde, 2002; Eisenhardt & Graebner, 2007).	41 semi-structured interviews; reflective workshops; strategic reports and project briefs.	Process coding to capture routines; mechanism-seeking analysis linking practices to dynamic capabilities (Langley, 1999).	Validity through verification of accounts with CEA staff; credibility through progressive focusing (Golden-Biddle & Locke, 1993).
RQ3: How do RTOs shape the direction of innovation ecosystems through open labs and exploratory support programs?	Interpretive, practice-oriented inquiry into orchestration as designed governance (Kuhlmann et al., 2019; Autio, 2022).	51 semi-structured interviews (CEA facilitators, SME partners, public actors); ethnographic notes from <i>Opensive</i> workshops.	Iterative coding (deductive: directionality, orchestration; inductive: emergent practices); process tracing of ecosystem alignment.	Transferability through rich description (Bansal & Corley, 2011); trustworthiness through peer debriefs and data triangulation.

1.5.4. Main findings

The three essays each address a different but interrelated dimension of how RTOs adapt to contemporary innovation ecosystems. Together, they reveal how RTOs navigate the dual challenge of fostering innovation for external partners, particularly resource-constrained SMEs, while also sustaining their own strategic relevance and shaping the broader trajectory of innovation ecosystems.

The first essay examines the relationship between RTOs and SMEs in the early stages of innovation, where uncertainty is greatest and support is often most needed. It shows that RTOs play an indispensable role in enabling upstream innovation for SMEs by acting as intermediaries that go beyond technical problem-solving. Specifically, practices of *brokering* (connecting SMEs to knowledge and partners) and *framing* (helping re-define problems and opportunities) allow SMEs to access resources, articulate latent needs, and explore novel innovation trajectories they could not pursue alone.

The second essay focuses on the RTO's own capacity to remain viable and adaptive in a shifting environment. It finds that RTOs generate internal value through dynamic capabilities enacted in collaborative projects. The practices of *prospecting* (scanning for opportunities and emergent trends) and *feedbacking* (translating lessons from projects into organizational learning) enable RTOs to adjust their strategies, capture value from collaborations, and sustain their long-term role in the innovation ecosystem, beyond immediate outputs.

The third essay situates RTOs at the level of ecosystem governance, showing how they can evolve into *institutional orchestrators*. Through exploratory programs such as *Opendive*, RTOs deploy methodological tools (e.g., design thinking, C-K theory) and relational infrastructures (e.g., cross-sector partnerships, open labs) to foster collaboration across boundaries and embed directionality, orienting innovation towards broader societal goals. This highlights RTOs as not just service providers but as cultivators of ecosystem conditions that align multiple stakeholders and shape innovation trajectories.

Collectively, these essays demonstrate that RTOs are evolving from linear technology services providers into institutional orchestrators. They combine external support for SMEs, internal value generation through dynamic capabilities, and ecosystem-level orchestration aligned with societal

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missions. Thus, RTOs do not only facilitate the flow of knowledge but actively shape the future direction of innovation ecosystems.

1.6. OVERVIEW OF THE THREE ESSAYS

1.6.1. Essay 1: Adapting RTO Strategies Towards SMEs

Authors: Prince Gilbert FIALOR, Amadou LÔ, & Eric Michaël LAVIOLETTE

Status: Submitted to The Journal of Technology Transfer

Previous versions of study 1 were presented in 2022 at International Council for Small Business (ICSB) Congress, Research Group on Collaborative Spaces (RGCS) Symposium, and in 2023 and 2024 at European Academy of Management (EURAM) Conference, and 2024 R&D Management Conference.

Overview:

The first essay investigates the external role of RTOs, more specifically, how they support SMEs in the early, upstream phases of innovation. This innovation phase is often marked by uncertainty, ambiguity, and limited internal innovation capacity on the part of SMEs. We conducted an analysis of 46 semi-structured interviews from both CEA and SME informants, 32 project documents, and 14 months observations, carried out on 6 CEA-SME collaborative projects to explore how public RTOs adapt their strategies to better support the upstream innovation needs of SMEs. Drawing on this empirical evidence from Y. SPOT, we examined how RTOs employ target practices, such as brokering and framing, to reduce relational and cognitive barriers to collaborative innovation for SMEs. The findings identified how RTOs create exploratory scaffolding that enables SMEs to engage in problem redefinition, opportunity discovery, and collaborative exploration. The study shows that RTOs generate external value by offering technological services, but also by creating the necessary conditions that allow SMEs to unlock latent innovation potentials that they would otherwise not be able to access on their own. This essay thus highlights how RTOs generate external value by enabling SMEs to explore unmet needs, redefine problems, and navigate uncertain innovation landscapes.

1.6.2. Essay 2: Generating Internal Value in RTOs

Authors: Prince Gilbert FIALOR, Eric Michaël LAVIOLETTE, & Amadou LÔ

Status: Submitted to R&D Management Journal

Previous versions were presented in 2024 at Innovation and Product Development Management Conference (IPDMC) Doctoral Colloquium, Research Group on Collaborative Spaces (RGCS) Symposium, and in 2025 at European Academy of Management (EURAM) Conference.

Overview:

In the second essay, we shifted attention towards investigating how RTOs capture and generate internal value from collaborative engagements. More specifically, we explored how RTOs themselves learn from and adapt to collaborations with SMEs and other innovation ecosystem stakeholders. We investigated how CEA capture and internalize lessons, insights, and capabilities developed through upstream collaborative engagements. We analyzed 41 semi-structured interviews, 20 confidential project materials, and information from 14-month participant observations, complemented by insights from data used in the first study. Using the concept of dynamic capabilities, we identified two key processes: prospecting (involving the search for and sensing of emerging strategic opportunities) and feedbacking (the systematic use of reflection and learning to inform internal processes and structural alignment). These processes feed the identification of strategic opportunities and organizational learning in RTOs. They enable RTOs to generate internal value, beyond financial and reputational value, in terms of organizational transformation, responsiveness, and adaptability. This study addresses a critical gap in the literature, showing that value generation is not unidirectional. While RTOs support their partners, they also co-evolve, adapting their roles, methods, and positioning in response to changing ecosystem dynamics. Our conclusion from this study is that value generation within RTOs is iterative and strategic, embedded in organizational learning and essential to the evolving role and impact of RTOs in innovation ecosystems.

1.6.3. Essay 3: From Intermediaries to Ecosystem Shapers: The Role of RTOs in Directing Innovation Trajectories

Authors: Prince Gilbert FIALOR

Status: To be submitted to Technovation

Previous versions were accepted for presentation at 17e Congrès International Francophone en Entrepreneuriat et PME (organized by the Association Internationale de Recherche en Entrepreneuriat et PME - AIRPME) but was not presented due to visa restrictions.

Overview:

In the third essay, I adopt an ecosystem perspective to examine how RTOs orchestrate innovation trajectories through purposively designed innovation support programs like *Opensive*. Drawing on an analysis of 51 semi-structured interviews, 12 project documents, and a longitudinal analysis observational, interview, and project documents gathered over a 3-year participant observation period at CEA, I explore how RTOs move beyond bilateral collaboration and service provision to actively shape the architecture and directionality of innovation ecosystems. Through the design and implementation of exploratory programs that combine methodological tools (e.g., C-K theory, design thinking) with neutral relational spaces, RTOs like CEA facilitate cross-sector collaboration, enable alignment around mission-driven goals, and catalyze new forms of collaborative exploration. This orchestration is not top-down or prescriptive, it emerges through iterative facilitation, sensemaking, and stakeholder alignment. I hence introduce the notion of embedded directionality, which refers to the ability of RTOs to guide innovation through infrastructure, processes, and partnerships that invite future-oriented thinking and collective action, and not just through public policy mandates. This implies that RTOs can embed directionality in collaborative innovation by steering innovation toward public missions and long-term goals through methodological tools and neutral collaborative spaces.

This last essay is the result of a solo work of the dissertation author.

1.6.4. Overview of chapter 5: Conclusions and recommendations

In chapter 5, we discuss the general practical and theoretical implications of the research (for RTOs, the industry and the policy makers). In this chapter, we propose avenues for further research. Finally, in Appendix A of this dissertation, we provide an anonymized description of our case studies, and a short presentation of participating interviewees and their profiles. In Appendix B, we present the interview guides used in conducting data collection across the different studies and include extract of observation notes collected and analyzed for this dissertation. Ultimately, this dissertation advances the argument that RTOs such as CEA are not just knowledge and technology transfer agents. RTOs are active participants in defining what is explored, how it is framed, and what futures are made possible through innovation.

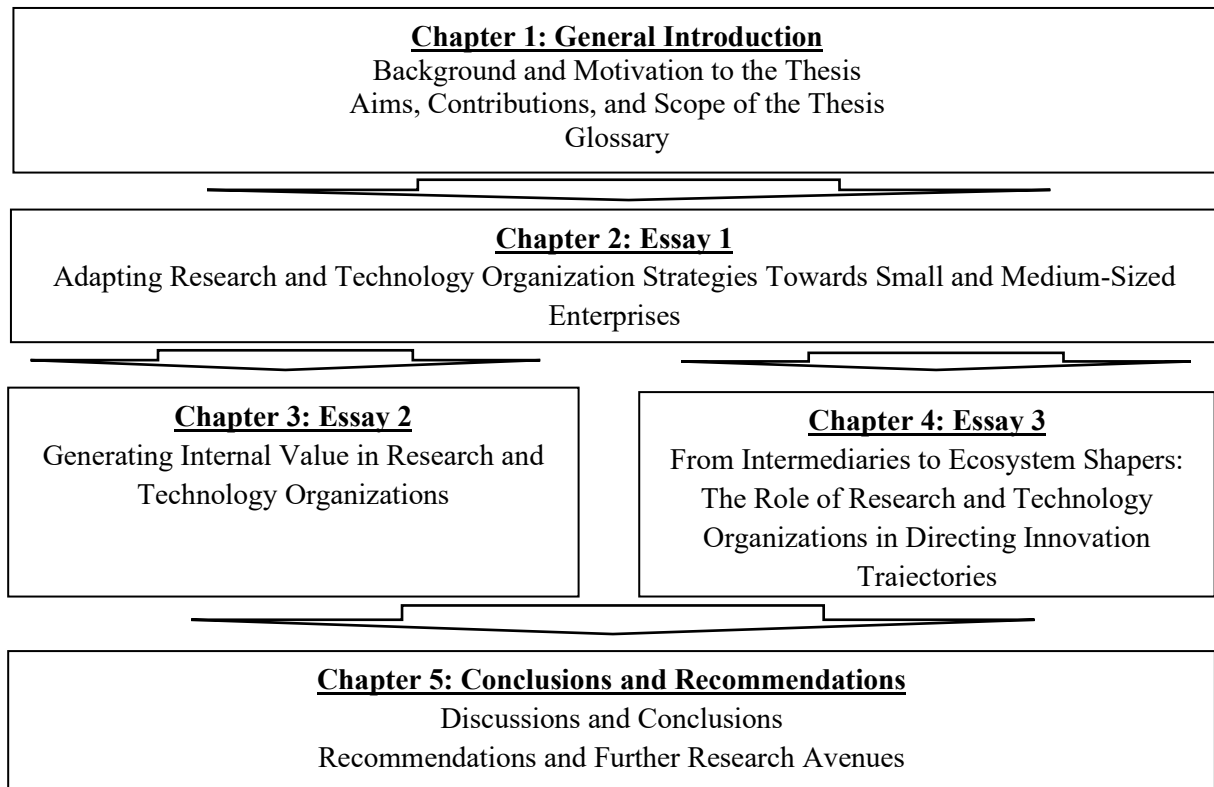
By focusing on adaptive intermediation, internal learning, and ecosystem orchestration, this dissertation reconceptualizes RTOs as strategic actors with a central role in shaping the direction, inclusivity, and purpose of innovation itself. Practically, the findings of this dissertation offer insights for RTO managers, innovation policymakers, and SMEs themselves on how to design and implement more inclusive, flexible, and future-oriented forms of collaboration. The case of CEA's Y. SPOT and *Opendive* illustrates how exploratory innovation programs can foster cross-sector learning, strategic alignment, and innovation that matters for both firms and society. This dissertation therefore presents RTOs not only as service providers, but as agents of transformation in complex and uncertain innovation environments, they are organizations capable of enabling innovation and orchestrating the direction of futures innovation ecosystems.

1.7. STRUCTURE OF THE DISSERTATION

The dissertation opens with an initial presentation of the general background and motivations for carrying out this three-article research work. I then proceed to provide an overview of the aims, scope, and research questions, followed by the structure and overview of the three studies that make up the body of the dissertation. I continue to present some contributions of the dissertation before adding a section to thoroughly define the key terms used in this dissertation in the glossary section. The rest of the manuscript is divided into four main parts as is presented Figure 1.1 below.

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Figure 1. 3: Dissertation Structure



1.8. CONTRIBUTIONS

By investigating how RTOs balance the dual imperative of external impact (supporting SME innovation and societal missions) and internal sustainability (adapting their own structures and strategies to maintain strategic relevance), this dissertation contributes to a richer understanding of the evolving role of RTOs in contemporary innovation ecosystems. Conceptually, the findings of the dissertation offer new insights into the complex interplay between organizational capability, the practice of intermediation, and ecosystem orchestration. It develops the notion of *adaptive intermediation*, a form of intermediation that is not only transactional or technical, but cognitive, relational, and future-oriented. The findings also contribute to innovation ecosystem theory by showing how orchestration can be enacted through designed infrastructures (open labs), embedded methodologies (exploratory programs), and curated partnerships (ecosystem alignment).

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Finally, it challenges the dominant static notions of RTOs as reactive, bureaucratic or rigid organizations, and reframes them as institutional orchestrators (hybrid actors capable of shaping both the flow and direction of innovation). Thus, RTOs, at least in the case of CEA, emerge as hybrid, reflexive, and forward-looking organizations that intermediate between technical opportunities and societal needs. Taken together, the three studies of this dissertation contribute a more holistic and practice-oriented understanding of how the role of RTOs are evolving. Moreover, the findings directly respond to emerging calls in literature for empirically grounded, and theoretically robust, accounts of how RTOs contribute to shaping innovation ecosystems; especially through the configuration of relationships, enabling exploration, and embedding societal missions into innovation pathways.

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Zhang, C., & Liu, N. (2024). Innovation intermediaries: A review, bibliometric analysis, and research agenda. *The Journal of Technology Transfer*, 49(3), 1113–1143.

**CHAPTER 2 - ADAPTIVE INTERMEDIATION: HOW
RESEARCH AND TECHNOLOGY ORGANIZATIONS
EVOLVE STRATEGICALLY TO SUPPORT SMALL
AND MEDIUM-SIZED ENTERPRISE INNOVATION
(ESSAY 1)**

ABSTRACT

Purpose: This study develops the concept of adaptive intermediation to explain how public Research and Technology Organizations (RTOs) support small and medium-sized enterprises (SMEs) in early, upstream phases of innovation where needs are uncertain and underdeveloped. We address the persistent mismatch between traditional RTO strategies, often optimized for large firms, and the resource-constrained, exploratory innovation processes of SMEs.

Research Design: Drawing on a qualitative multiple-case study of six SME collaborations with the French RTO Commissariat à l'énergie atomique et aux énergies alternatives (CEA) through its Y.SPOT labs, we analyzed 46 semi-structured interviews, project observations, and documentation. We applied the idea journey framework to capture how RTOs enable SMEs to articulate, develop, and legitimize innovative ideas under conditions of uncertainty.

Findings: We show that adaptive intermediation is enacted through two interdependent practices: *brokering*, which aligns actors and resources, and *framing*, which structures and legitimizes SME ideas. These practices allow RTOs to flexibly guide SMEs through idea generation, elaboration, championing, and implementation, shaping innovation trajectories rather than imposing predefined solutions.

Practical Implications: For RTO managers, we highlight the need to invest in relational, interpretive, and temporal capabilities and not only technological infrastructure. Adaptive tools such as ambition profiling and design sprints, coupled with governance arrangements that legitimize exploration, are vital for strengthening SME innovation journeys.

Theoretical Implications: We advance the concept of adaptive intermediation, a capability that combines relational, temporal, and sensemaking practices. It enriches understanding of how RTOs create value by shaping early-stage innovation pathways with SMEs, beyond technology transfer.

Originality/Value: This study positions adaptive intermediation as a distinctive intermediary capability, advancing theoretical debates on intermediation and dynamic capabilities. It provides a process-oriented view of how RTOs evolve from technology transfer agents into institutional orchestrators of SME-inclusive innovation ecosystems.

2. INTRODUCTION

Research and Technology Organizations (RTOs) are widely recognized as key infrastructures in regional innovation ecosystems, particularly for enabling technological advancement and value creation (Zhang & Liu, 2024; Hilkenmeier et al., 2021; Arnold et al., 2010). Their contributions to large firms through applied research, technology transfer, and downstream commercialization activities are well documented (Giannopoulou et al., 2019; Barge-Gil & Modrego, 2011). However, their ability to support small and medium-sized enterprises (SMEs), the backbone of most economies, remains significantly underexplored and under-utilized. While SMEs represent the majority of firms and hold critical potential for regional growth, they face structural disadvantages in innovation. SMEs lack R&D departments, dedicated innovation funding, and often the cognitive and strategic resources to anticipate and pursue new opportunities (Tödtling & Kaufmann, 2002; Barrett et al., 2021). These deficits are most prominent in the upstream phase of innovation, where needs are ambiguous, ideas are fragile, and market opportunities are still undefined. Without targeted support at this stage, promising ideas stall before reaching maturity, contributing to the “valley of death” (Ellwood et al., 2022) that disproportionately affect SMEs.

In principle, RTOs are uniquely positioned to address this gap. Unlike universities (who focus on basic research) and private consultants (offering transactional and often costly services), RTOs combine technological expertise, applied research infrastructure, and public legitimacy to act as neutral intermediaries and strategic partners (Kurdve et al., 2020; Radicic et al., 2019; Albors-Garrigós et al., 2014). Their mandate to serve industry and society gives them both the legitimacy and the resources to engage SMEs in collaborative exploration. Despite this, RTO-SME collaborations remain limited in scope and impact (Goduscheit & Knudsen, 2015). SMEs consistently benefit less from RTOs than large firms and often do not prioritize RTOs as relevant partners for early-stage innovation (Hilkenmeier et al., 2021; Giannopoulou et al., 2019). Structural rigidities within RTOs, misaligned objectives, and SMEs’ limited absorptive capacity worsen this disconnect (Readman et al., 2015; Khelifaoui & Bernier, 2023; Bandarian, 2018).

An important reason is that many RTO strategies still emphasize downstream activities such as technology demonstration, R&D services, and intellectual property (IP) licensing. These strategies assume that firms are already equipped to absorb, adapt, and deploy technological knowledge. For most SMEs, however, the real challenge lies upstream, at idea generation, problem framing, and opportunity recognition phases. Infrastructural arrangements such as technology showrooms, often pursued by RTOs, may inspire SMEs (Gillier & Schweitzer, 2021), but without guidance in structuring and legitimizing ideas early on in the innovation process, such inspiration rarely translates into sustained collaboration or tangible innovation outcomes.

Previous research has extensively studied RTO strategies and contributions in innovation ecosystems (Siegel et al., 2023; Gillier & Schweitzer, 2021; Sheikheldin, 2021; Giannopoulou et al., 2019; Bandarian, 2018; Readman et al., 2015; Barge-Gil & Modrego, 2011; Arnold et al., 2010) yet relatively pays less attention to how RTOs adapt strategies to foster effective innovation partnerships with SMEs. Most existing literature examines RTOs' technical roles, such as problem-solving or technology transfer (Siegel et al., 2023; Gillier & Schweitzer, 2021; Goduscheit & Knudsen, 2015; Barge-Gil & Modrego, 2011; Leitner, 2005), rather than their strategic responsiveness to shifting client profiles and collaborative demands. This is important aspect of the literature, which is often overlooked, considering the increasing diversification of regional innovation ecosystems and the growing demand for inclusive, SME-oriented support is what we address in this study.

This study therefore explores how RTOs can adapt their strategies and practices to foster more meaningful partnerships with SMEs, particularly in upstream innovation. We argue that strategic support for SMEs requires more than scientific and technical excellence, it requires adaptive intermediation, intermediary practices that are relational, interpretive, and flexible enough to scaffold SMEs' fragile innovation journeys. We therefore draw on qualitative data from multiple SME collaborations with the French public RTO, Commissariat à l'énergie atomique et aux énergies alternatives (CEA). Specifically, we focus on CEA's Y.SPOT labs embedded within the technological research department, to examine the concrete practices, processes, and challenges involved in how a leading European RTO adapts its strategy to address the upstream innovation needs of SMEs. We

therefore pose and address the research question: *How do public RTOs adapt their strategies to better support the upstream innovation needs of SMEs?*

2.1.LITERATURE REVIEW

2.1.1. RTOs in innovation ecosystems: Role and challenges

RTOs are key components of regional innovation ecosystems, serving as intermediaries between scientific research and industrial application (Zhang & Liu, 2024; Noviaristanti et al., 2023). Established as mission-driven, non-profit institutions, RTOs are tasked with transferring knowledge, enabling technology development, and supporting firms through applied research, prototyping, and technology diffusion (Readman et al., 2015; Berger & Hofer, 2011; Leijten, 2007). Their intermediation role includes technology scouting, road mapping, and the orchestration of collaborative innovation networks (Suominen et al., 2021). While RTOs have successfully supported innovation in large firms, who typically possess robust internal R&D infrastructures and strategic alignment, evidence from extant literature suggests that they are less effective in supporting SMEs (Giannopoulou et al., 2019; Barge-Gil & Modrego, 2011).

SMEs often lack the absorptive capacity, strategic foresight, and financial resources needed to engage on the same level with RTOs (Goduscheit & Knudsen, 2015). RTOs' structured collaboration models typically designed around long-term contracts, IP agreements, and technology demonstrations, often fail to meet the more immediate and flexible needs of SMEs. Consequently, some studies have questioned whether current RTO strategies are adequately tailored to SME-specific contexts, particularly in the early, upstream stages of innovation, where market exploration, ideation, and opportunity recognition are critical (Bertello et al., 2022; Barrett et al., 2021).

2.1.2. Challenges in RTO-SME Collaboration

The literature identifies two broad categories of challenges affecting RTO-SME collaboration: (1) misalignment in strategy and structure, and (2) capability and resource asymmetries between RTOs and

SMEs. Firstly, RTOs often employ standardized, large-firm-oriented collaborative engagement models that assume a high degree of technological readiness and absorptive capacity on the part of their partners (Bandarian, 2018; Readman et al., 2015). These models are usually not well-suited for SMEs that require hands-on, exploratory, and iterative support. For example, Gillier and Schweitzer (2021) show that while technology showrooms are effective in stimulating collaboration for firms with internal R&D capacity, they are less effective for SMEs, because SMEs often need immediate problem-solving and context-specific technical support.

Additionally, RTOs' administrative structures and long-term project timelines often discourage SME participation (Albors-Garrigós et al., 2010; Olazaran et al., 2009). SMEs mostly face internal challenges, such as limited absorptive capacity, which hinders their ability to recognize, assimilate, and apply external knowledge (Scuotto et al., 2017; Goduscheit & Knudsen, 2015). Unlike large firms, SMEs typically lack dedicated innovation personnel, spaces, and formal R&D departments (Messeni Petruzzelli & Murgia, 2021; Tödtling & Kaufmann, 2002). This limits their ability to co-develop, internalize, and sustain collaborations with RTOs, especially collaborations that involve advanced and complex technologies (Limaj & Bernroider, 2019).

Further compounding these issues is the fact that RTO strategies often target technologically mature sectors and regions with existing innovation infrastructures, resulting in the marginalization of SMEs in less developed ecosystems (Goduscheit & Knudsen, 2015). Case studies from Spain and Denmark show that SMEs in traditional sectors often struggle to meet the administrative and technical requirements of RTO engagements, leading to the underutilization of RTO services (Roessl et al., 2010; Aström et al., 2008) to promote SME innovation capabilities.

2.1.3. Rethinking RTO strategy: Towards adaptive innovation support for SMEs

SMEs are often recognized as key drivers of regional innovation and economic transformation, yet their collaboration with RTOs is still limited and largely not understood (Audretsch et al., 2012; Tödtling & Kaufmann, 2002). Unlike large firms, SMEs typically engage in informal, opportunity-driven, and

exploratory innovation processes, often shaped by immediate operational and market pressures and not just structured R&D trajectories (Hervás-Oliver et al., 2012; Barrett et al., 2021). However, most RTO support mechanisms continue to assume linear, resource-intensive, and long-term innovation processes that are mostly inaccessible to SMEs (Barge-Gil & Modrego, 2011; Giannopoulou et al., 2019). This mismatch highlights a growing consensus that the one-size-fits-all innovation support strategies of RTOs are no longer enough to foster innovation for ecosystem stakeholders, especially SMEs. Instead, RTOs must develop more adaptive and SME-sensitive approaches that recognize the constraints, rhythms, and innovation behaviors of smaller firms (Uribe-Echeberria et al., 2019; Knockaert & Spithoven, 2014).

Recent studies have started to emphasize the potential of intermediary processes that move beyond traditional technology transfer, including tailored support services, rapid prototyping, and low-barrier entry points into collaboration (Gillier & Schweitzer, 2021; Uribe-Echeberria et al., 2019; Goduscheit & Knudsen, 2015). Yet, there persists the issue of the underexplored perspective of RTOs, particularly how these organizations adapt to engage SMEs in the early upstream phases of innovation where innovation needs are uncertain and underdeveloped. While previous studies acknowledge the barriers to RTO-SME collaboration (Giannopoulou et al., 2019; Albors-Garrigós et al., 2014), the literature has not systematically examined how RTOs adapt their strategies, practices, and capabilities to align with SME-specific innovation trajectories.

Addressing this gap is vital, as upstream collaboration can unlock SMEs' growth potential and strengthen their role in innovation ecosystems (Intarakumnerd & Goto, 2018; Gillier & Schweitzer, 2021). We address this specific gap in this study by responding to the question: *How do public RTOs adapt their strategies to better support the upstream innovation needs of SMEs?*

2.2. METHODOLOGY

We investigated how public RTOs adapt their strategies to support upstream innovation needs of SMEs, by adopting a qualitative, multiple-case study design (Goffin et al., 2019; Yin, 2014; Eisenhardt & Graebner, 2007). This design is particularly appropriate when the objective of a research endeavor is to

develop in-depth understanding of underexplored phenomena embedded in real-world situations. In our case, it was relevant to explore the organizational practices enabling RTOs to effectively collaborate with SMEs. Our objective was to theorize from the practices we discover, by tracing how strategic adaptation occurs through actual collaborative innovation projects. We thus selected the CEA, and specifically its Y. SPOT initiative in the Occitanie region, as our focal case. Y. SPOT was designed as a collaborative innovation lab to facilitate engagement with SMEs and help them explore technologies, markets, and innovation strategies. A comparative pilot study with the Grenoble site confirmed that Y. SPOT Occitanie had the clearest strategic focus on SMEs, aligning with our research objectives.

2.2.1. Case selection

We selected six (6) collaborative innovation projects across two main sectors: health and aeronautics (three in each). These sectors are regionally strategic, technologically dynamic, and subject to strong regulatory and market pressures, at least within the Occitanie region where we situated our study. We followed the principles of theoretical sampling (Eisenhardt, 1989) in our case selection, allowing for variation in SME experience with CEA, business objectives, and innovation maturity. The SMEs we selected either (i) sought to diversify but lacked strategic clarity or (ii) pursued specific technological solutions requiring upstream support. Table 2.1 below presents the six SME cases selected for in-depth analysis, along with three additional SMEs that contributed contextual insights. Each case is characterized by a sector, innovation goal, and the primary strategy of engagement with CEA's Y. SPOT innovation platform. The table also summarizes the number of interviews conducted and the types of secondary data used. The cases reflect variation in SME needs, prior experience with RTOs, and innovation contexts which supported theoretical sampling and enabled comparative analysis of RTO adaptation practices across different collaboration types.

Table 2. 1: Overview of Selected SME Cases and CEA engagement strategy

Case ID	Sector	SME Profile	Innovation Objective	RTO Engagement strategy	Int. No.	Secondary Data
SME 1	Health	Outsourced Biology services	Tech solution for decentralized diagnostics	Technology scoping & applied prototyping	7	Observations, project documents; SME website

SME 2	Aeronautic	Elastomer components	Market diversification based on existing capabilities	Ecosystem scanning & opportunity mapping	6	Documents, SME site, unstructured follow-ups
SME 3	Aeronautic	Bonding technology	Explore new applications of core technology	Technology reinterpretation & market fit testing	6	Observations, site visits, informal talks
SME 4	Aeronautic	Drone development	Train AI for automated inventory data collection	Data-driven solution design & AI testing	5	Emails, calls, project documents
SME 5	Health	Community health apps	Early detection of sports-related disorders	Sensor design support & application framing	6	Project documents, SME site, follow-ups
SME 6	Health	Connected medical devices	Develop new hydration monitoring sensor	Co-design, testing, & tech blueprinting	7	Project documents, interviews, SME website
Others	Other Sectors	Waterjet & agri-tech firms	Product innovation & diversification	Initial engagement mapping & diagnostic scoping	9	Public materials, follow-up emails

2.2.2. Data collection

We collected data using a combination of semi-structured interviews, field observations, and project documentation, conducted over a 12-month period. To facilitate making sense of the data, we used “creative biographies” (Butzin & Widmaier, 2016) to reconstruct each project’s progression from idea inception to implementation. We focused on projects that had progressed beyond early-stage ideation, for instance, with signed contracts, confirmed funding, or validated technical concepts. In total, we conducted 46 interviews with CEA project managers, SME CEOs and R&D directors/managers, researchers, and business developers. We supplemented these interviews with observations, reports from meetings, and informal discussions between CEA and SME stakeholders. All interviews were transcribed and anonymized, and those that were recorded in languages, i.e., French, other English were transcribed with AI assistance tools like DeepL and ChatGPT-4.0 to assist in the sensemaking process.

By comparing accounts across informants and data sources, we constructed an intersubjective narrative of each collaboration.

2.2.3. Data analysis

We applied a thematic analysis (Braun & Clarke, 2012), guided by the idea journey framework (Perry-Smith & Mannucci, 2017), which traces the evolution of an idea through four phases: generation, elaboration, championing, and implementation. This framework enabled us to map how CEA's practices addressed SME needs across different stages of innovation. We coded the activities we observed and linked them to each stage of the idea journey framework. We also accounted for uncertainties in participation and scope over time (Ibert et al., 2018), which led us to develop the conceptual dimension of the idea journey which we categorized as "idea strategizing": the practice of helping SMEs structure and progress their innovation pathways. Table 2.2 summarizes the key practices observed across the cases.

This table draws on the idea journey framework developed by Perry-Smith and Mannucci (2017), which describes how innovative ideas evolve from initial conception to final implementation. The journey consists of four interconnected phases. (1) Idea generation: The early stage where novel ideas are conceived or stimulated, often through brainstorming, dialogue, or exposure to new stimuli. (2) Idea elaboration: The development and refinement of initial ideas, including feasibility analysis, technical detailing, and aligning with business or user needs. (3) Idea championing: Gaining support and buy-in for the idea, often involving internal advocacy, pitching to decision-makers, or aligning with strategic goals. (4) Idea implementation: Translating the developed idea into practice through prototyping, testing, formal projects, or technology deployment.

In this study, we added an additional phase, Strategizing, to capture the early preparatory work that SMEs undertook with CEA, including problem scoping, articulation of needs, and the alignment of innovation objectives. This phase emerged inductively from the data and reflects the practical realities of supporting upstream innovation for SMEs.

Table 2. 2: Practices carried out for each collaborative project in different phases of the idea journey

Firm	Strategizing	Generation	Elaboration	Championing	Implementation	Patterns
SME 1	Innovation objective definition	Co-ideation with CEA experts	Technology roadmap development	Internal validation workshop	R&D project and fundraising	Classic linear progression; internal alignment a key enabler
SME 2	Needs assessment; ecosystem scan	Co-ideation & ecosystem mapping	Value proposition & products roadmap design	In-house validation	Functional exploration & R&D launch	Emphasis on early market exploration
SME 3	Resource audit; market study	Ecosystem mapping & exploration	Business/service blueprinting	Strategic fit review	Partner/funding search	High iteration during elaboration phase
SME 4	Consortium building	Tech scouting & brick identification	Design fiction & algorithm design	Funding pitch	Prototyping, testing & iteration	Complex stakeholder coordination
SME 5	Market & innovation readiness	Co-ideation & co-conception with industry experts	Barrier identification & application design	Partner search	Extended exploration	Strong focus on reconfiguring firm offering
SME 6	User needs exploration	Stakeholder interviews	Co-design & roadmap	Funding pitch	Ambitious R&D program	Strong user-centered approach

Our choice of a qualitative case study offered a more suitable, compared to similar approaches like ethnography or large-scale quantitative studies, given our focus on multiple bounded collaborations across organizations rather than internal organizational practices and culture. As we sought to uncover the nuanced, evolving, and context-specific practices that shape RTO–SME collaborations, the multiple case study approach presented a more reliable method. For instance, while ethnography offers a deep immersion in real-world contexts and to capture deep understanding, it was unsuitable for a conducting this multiple case study of collaborations that spanned multiple organizations. Additionally, we needed to use a process, interview and document-based approach, which allowed us to trace how innovative ideas emerged, were supported, and evolved across projects. This offered a richer understanding of how RTO strategies are enacted and adapted in practice.

2.3. FINDINGS

This section presents the empirical findings of our study on how CEA, through its Y.SPOT innovation lab, adapts its practices to support upstream innovation for SMEs. Two interdependent practices emerged from our analysis: *brokering* and *framing*. *Brokering* refers to the relational and strategic work of connecting SMEs with actors, technologies, and opportunities, enabling them to expand their innovation space and collaboratively shape ideas. *Framing* on the other hand involves the interpretive work of structuring and legitimizing these emerging ideas, helping SMEs and CEA laboratories to align around shared problem definitions and value propositions. Importantly, these practices directly fit into the early phases of the idea journey as proposed by Perry-Smith and Mannucci (2017). *Brokering* supports SMEs in idea generation and elaboration by linking them to external expertise and resources, while *framing* enables elaboration and championing by translating vague ideas into credible narratives that can attract commitment. Together, these practices constitute what we conceptualize as adaptive intermediation, which is the intermediary work that is relational, interpretive, and flexible enough to help SMEs navigate the uncertainties of upstream innovation work. Table 2.3 synthesizes the key intermediary practices implemented by CEA Y.SPOT across the idea journey of the SMEs we studied. These practices (guided support, ecosystem mapping, collaborative ideation, value proposition framing, and project formalization) show how CEA adapts its traditional role as an RTO to better accompany SMEs when their ideas are still fragile and underdeveloped.

2.3.1. Brokering: Matching, aligning, and mobilizing for upstream innovation

Brokering encompasses the practices through which CEA initiates and configures collaboration with SMEs, particularly in environments where innovation needs are emergent or loosely defined.

2.3.1.1. Guided support as relational brokerage

A core brokering practice is guided support, in which business developers and project managers at Y.SPOT work closely with SMEs to collaboratively define innovation pathways. These engagements are not simply transactional but involve iterative exploration and strategic dialogue. One aspect of this type

of support is what CEA teams termed “*ambition profiling*”: a process of exploring and clarifying SMEs’ innovation objectives, strategic direction, and expectations. This initial step helps align intentions and capabilities between SMEs and CEA.

“Some firms don’t have the full picture. They have fragments. We try to help them piece it together, technically and strategically.” (Informant 15, Designer, CEA)

“They came with an idea. We helped shape it into something they could pitch, test, and eventually fund.” (Informant 9, Innovation Project Manager, CEA)

Guided support as relational brokerage involves more than advising or directing SMEs, it reflects a sustained and collaborative process through which CEA actively co-develops the early contours of innovation. This practice recognizes that many SMEs do not approach RTOs with fully formed problems or clear technological needs; instead, their ideas are often tentative, fragmented, or disconnected from actionable innovation pathways. In response, CEA business developers engage SMEs through structured yet flexible interactions, such as ambition profiling, to uncover not only what the SMEs want to achieve, but also what they are capable of pursuing with support. This process is relational in nature: it requires trust, dialogue, and iterative clarification.

By working side-by-side with SMEs in identifying latent opportunities and aligning internal and external resources, CEA transforms what could be a one-off service interaction into a co-learning process. Road-mapping and strategic alignment sessions, for instance, are not just tools for project scoping, they are mechanisms for building shared understanding and laying the groundwork for future exploration. In doing so, CEA repositions itself from a technical provider to a strategic partner, one that brokers relationships, translates ambition into action, and helps SMEs traverse the ambiguity that characterizes early-stage innovation.

2.3.1.2. Mapping ecosystems and technologies

CEA’s brokering also includes mapping external ecosystems to align SME innovation goals with real opportunities and constraints. This involves translating technical concepts into potential market and user sectors and identifying viable application domains across different markets.

“Sometimes it’s not the technology that needs work, but the business model or the ecosystem fit... We help them reframe the problem.” (Informant 6, Director, CEA)

In one case from the aeronautics sector, an SME sought to apply bonding technologies in new areas but lacked insights into where this could add value. CEA mobilized experts from that domain to examine potential applications in adjacent sectors and framed a collaborative innovation roadmap.

“We didn’t know what to do with what we had. CEA helped us explore where it might go, and what kind of funding makes sense.” (Informant 3, Health Practitioner/Device Development Manager, Other SMEs)

Mapping ecosystems and technologies extends the role of brokering beyond organizational matchmaking to a more interpretive and strategic function. It involves helping SMEs make sense of where their ideas and capabilities could find relevance, across markets, sectors, and regulatory environments. This practice becomes particularly critical when SMEs approach innovation with limited foresight and market clarity. Instead of assuming that the value of a technology is self-evident, CEA brokers help SMEs reinterpret both problems and opportunities by situating them within a broader innovation landscape. This mapping work often includes identifying related markets, facilitating interactions with new user groups, and aligning innovation potential with funding mechanisms and industrial demand.

It also involves translating highly technical capabilities into business-relevant language that resonates with investors, policymakers, and partners. By doing this, CEA supports SMEs in realigning their innovation objectives with feasible applications and ecosystem conditions, often repositioning ideas that might otherwise stall due to uncertainty or lack of strategic direction. In this sense, mapping becomes a cognitive and strategic tool for reframing innovation trajectories, allowing SMEs to engage not just with a technology, but with an evolving opportunity identification. Thus, brokering goes beyond matchmaking between firms and technologies to include strategic translation, reconfiguring the perceived relevance of CEA’s technological base to fit SME trajectories.

2.3.1.3. Temporal brokerage and problem structuring

Brokering also unfolds across time as Y. SPOT helps coordinate diverse actors over time while shaping a shared understanding of a complex problem. On one hand, Y. SPOT acts as a go-between to connect CEA and SME stakeholders as they operate on different timelines (e.g., short-term vs. long-term goals) and were often non-aligned in terms of priorities and readiness. On the other, it clarifies opportunities,

cocreating and defining innovation problems and pathways with SMEs. In the early stages of the collaborative projects, business developers helped SMEs make sense of ambiguous ideas. In later stages, they guided resource alignment and helped firms secure funding. In some cases, brokering included reframing problems when SME goals were overly broad or misaligned with RTO expertise. A project manager noted:

“We must steer them gently. Sometimes they think they need one thing, but we realize the real value is elsewhere.” (Informant 11, Technology Prospection Advisor, CEA)

Temporal brokerage and problem structuring involves helping SMEs make sense of not just what they are trying to innovate, but when and how to advance it. CEA experts do this by guiding firms through the complex, often non-linear process of developing early-stage ideas, especially when the innovation trajectory is unclear.

While traditionally they will push predefined solutions, CEA brokers help SMEs prioritize their decisions, determining which parts of an idea to explore first, which capabilities to mobilize, and when to pursue formal development or funding. This guidance often entails reframing SMEs’ initial expectations, particularly when firms overestimate the readiness of their ideas or underestimate the complexity of implementation. By orchestrating collaboration, introducing structured milestones, engaging in co-design sessions, and offering deliverables at different phases of the innovation process, CEA ensures that innovation unfolds in a manageable, strategically timed way.

This practice not only protects limited SME resources but also increases the chances of successful project alignment and commitment from both sides. This way, temporal brokerage becomes a key form of adaptive support, allowing RTOs to balance SMEs’ urgency with the ecosystem’s demands for validation, collaboration, and risk mitigation. Thus, temporal brokerage often required CEA actors to act as strategic filters, deciding which SME ideas to take forward, under what terms, and with what types of support.

1.1.1.1. Lessons from brokering failure

Not all brokering efforts succeeded. In the case of SME 6, who initially sought to develop a hydration-monitoring device disengaged due to mismatched expectations regarding project timelines and control.

While the SME sought fast results and ownership over the design, CEA adhered to its standard collaborative procedures and IP models.

“They wanted something quick and ready to go. We needed more exploration. There was a mismatch we couldn’t bridge.” (Informant 16, Innovation Project Manager, CEA)

Brokering failure and its lessons illustrate that intermediary support is not always sufficient to sustain collaboration, particularly when the pace and expectations of innovation partners diverge significantly. In the case of SME6, the firm’s need for rapid development clashed with CEA’s more exploratory and phased approach. This misalignment reveals how differences in temporal expectations, governance preferences, and perceived urgency can lead to breakdowns in otherwise promising partnerships. Such failures are revealing. They underscore the organizational constraints that RTOs like CEA face when trying to balance internal scientific rigor and public accountability with the speed and flexibility often required by entrepreneurial SMEs.

More broadly, these breakdowns point to a deeper tension. While adaptive brokering practices make collaboration more inclusive and responsive, they still operate within organizational boundaries that can limit agility. Thus, there is still the fragility of brokerage in contexts where organizational rigidity and SME agility collide. In the cases we investigated, rigidities in CEA’s collaborative strategy, timelines, legal frameworks, and evaluation criteria hindered collaboration with SMEs. Across such cases, brokering emerged as an adaptive form of intermediation, combining technological, strategic, and relational activities. It required CEA experts to navigate uncertainty, tailor engagements, and make untapped opportunities accessible for SMEs. This form of intermediation contrasts with traditional perspectives of RTOs as solution providers and aligns more closely with an emerging and adaptive upstream innovation support function.

Nevertheless, it is interesting to note that the most successful brokering activities were characterized by four key elements: (1) early-stage involvement in problem definition and exploration, (2) use of knowledge from the ecosystem to identify gaps and opportunities, (3) active alignment between SME needs and RTO capabilities, and (4) flexibility to manage tempo, ownership, and expectations.

Table 2. 3: Extract from data structure on CEA Y. SPOT's intermediary practices across SMEs' idea journey.

Idea journey phase	Practices	Description	Illustrative quotes	CEA's strategic role
Idea Strategizing	Guided support; ambition profiling	Business developers explore SME goals & clarify open-ended problems through strategic dialogue.	<i>"Introduction by Y. SPOT is an advantage... who do I contact? It's a huge organization." (Informant 19, Industrial Director, SME1)</i>	Enables early-stage engagement; shifts CEA from technology-push to SME-driven entry.
			<i>"It always takes time to establish a common understanding..." (Informant 23, CSO, SME5)</i>	
			<i>"We are here to meet companies, to listen to them, to translate their problems and needs, to find the technical experts" (Informant 1, Director, CEA)</i>	
	Ecosystem mapping	Identifying internal labs or partners that align with SME's needs & context.	<i>"They helped us find the lab... because we couldn't know all the capabilities..." (Informant 29, Co-founder, SME6)</i>	Positions CEA as a connector across internal silos and external ecosystems.
			<i>"They did a lot of interviews, internally at CEA. Asking experts in different areas what they would do with bonding..." (Informant 28, President, SME3).</i>	
			<i>"There are customers who don't know what they want...here's where we work a bit." (Informant 12, Director, CEA)</i>	
Idea Generation & Elaboration	Collaborative ideation	Collaboratively exploring & shaping SME challenges & opportunities through exploratory discussions and teaming.	<i>"We had turns of interviews with different actors... So, we asked a lot of questions" (Informant 26, CEO, SME4)</i>	Supports sensemaking, problem refinement, & upstream co-creation.
			<i>"We worked together with the medical team and it was important for us to make a significant investment like this." (Informant 29, Co-founder, SME6)</i>	
			<i>"We talk about our needs and then we look at the different technologies at CEA, and that's where everything converges" (Informant 19, Industrial Director, SME1)</i>	

CHAPTER 2 - ESSAY 1

Idea Championing	Value proposition & POC cocreation & framing	Using design tools & facilitation to articulate innovation value for users, markets, and internal stakeholders.	<i>“The solution must meet expectations of both users and markets.” (Informant 14, Designer, CEA)</i> <i>“Things like this help to crystallize the thinking and the solution which, is now clear” (Informant 19, Industrial Director, SM5)</i> <i>“What we’ve got out of it in concrete terms is that, for example, we’ve been able to put together a costing for a company.” (Informant 31, R&D Director, SME3)</i>	Builds internal and external legitimacy around emerging ideas.
Idea Implementation	Cocreation & formalization	Developing POCs, scripting ideas, & supporting SME access to funding & formal project structures.	<i>“The POC will probably be more of concept of the business, the idea of business proven in terms of figures, market size, investment needed.” (Informant 28, President, SME3)</i> <i>“We can now prove that the feasibility is okay for this technology. It was really uncertain.” (Informant 26, CEO, SME4)</i> <i>“We have a resume from Y. SPOT... like the deliverable. It summarizes the needs and mentions what kind of technology and partners we can meet.” (Informant 19, Industrial Director, SME1)</i>	Institutionalizes support; converts upstream collaboration into fundable partnerships.

Table 2.3 illustrates how each practice contributes to strategic adaptation, enabling CEA to build alignment, reduce uncertainty, and translate early-stage ideas into structured innovation collaborations.

Brokering failures therefore exposed the organizational boundaries of CEA's responsiveness, where standardization, internal logics, and IP structures limited the flexibility SMEs required. However, it also supported the revelation of the key features of successful brokering for SMEs. Understanding these limits and key features is thus crucial for designing more differentiated collaboration models that account for the varied capacities and temporalities of SME partners.

1.1.2. Framing: Shaping the value and meaning of early-stage innovation

While brokering helped align actors and mobilize collaboration, a key practice, framing, was pivotal to how CEA, through Y. SPOT, made early-stage innovation accessible and actionable for SMEs. Framing refers to how ideas, needs, and innovation objectives were interpreted, translated, and legitimized, often before a formal R&D project could be initiated. This framing work was not a passive communication effort. It was an active process of constructing meaning around ambiguous ideas and potential value propositions. It was especially crucial when SMEs struggled to articulate their innovation goals and position their ideas to be consistent with business and technology strategies.

1.1.2.1. Framing as a diagnostic and sensemaking practice

CEA teams helped SMEs give form to loosely defined ideas through exploratory dialogues, co-design sessions, and visualization tools. Several SMEs entered collaboration with vague ideas, often framed internally as "new markets" or "new technology use". Project managers and business developers at CEA helped reframe these initial fragments into structured propositions

"They come in with a blurry picture, we try to clarify: What's the need? Who benefits? What do we need to explore?" (Informant 13, Director, CEA)

This work was partly diagnostic, defining what was "at stake" and where exploration could occur. For instance, one firm sought to diversify its elastomer components into healthcare but lacked clarity on applications. Through interviews and strategy sessions, CEA helped reframe the opportunity:

"We realized it wasn't about applying our tech to health, it was about redefining what problem we're solving and for whom." (Informant 4, Other SMEs, Health Practitioner)

This example shows that framing helps SMEs translate technological capabilities into meaningful innovation narratives, often in a language better aligned with users, funders, or ecosystem partners. Through structured exploratory dialogues, co-design sessions, and strategic questioning, CEA teams guide SMEs in clarifying what the real innovation opportunity is, and for whom. This sensemaking practice is strategic. It often begins by developing assumptions and reframing them around concrete needs, potential users, and viable paths for exploration. By this, CEA helps SMEs move from abstract technical ideas to narratives that resonate with broader stakeholders, i.e., internal R&D teams, funding agencies, and industry collaborators. These framing activities do not simply refine ideas; they reorient them, aligning technological exploration with market relevance and ecosystem needs.

1.1.2.2. Building coherence: From unstructured ideas to project proposition

Building coherence involves translating SME motivations, often loosely defined or technically focused, into viable and fundable innovation project propositions. At this stage, CEA project teams help SMEs transform raw ideas into structured project concepts with clear objectives, value propositions, and stakeholder alignment. This helps to align internal and external logics, particularly reconciling SME motivations with CEA's evaluation criteria and processes:

“If the idea is too early or unclear, it won't go anywhere. We help bring structure, what's the idea, what's the challenge, how do we explore it?” (Informant 10, Innovation Project Manager, CEA)

This was achieved through visual mapping tools, storytelling exercises, and exploratory diagnostics, which helped SMEs articulate a clearer logic of innovation. One business developer explained:

“We use co-design sessions to draw out the real story, what makes sense for the market, what fits with what we can offer.” (Informant 19, Industrial Director, SME1)

These framing efforts enabled SMEs to shift from ambiguous aspirations to fundable and testable project ideas. The transformation was often subtle, not just rewording ideas but reshaping their structure and perceived feasibility. This process bridges the gap between initial ideation and concrete planning, enabling both internal evaluation by CEA and external engagement with funding agencies and

ecosystem actors. The process is inherently iterative. Through co-design sessions, design tools, and strategic dialogue, CEA teams assist SMEs in uncovering the “real story” behind their ideas, further clarifying what makes technical, commercial, and organizational sense. Thus, CEA did not only increase the potency of early-stage innovation ideas but also enhanced their strategic and operational feasibility. This framing practice is vital to enable collaboration; it provides a shared language and focus that moves an idea along the innovation pipeline towards implementation.

1.1.2.3. Framing for internal buy-in and strategic fit

Framing was also critical for internal advocacy. It served an internal function where stakeholders at CEA crafted narratives to align exploratory projects with the organization’s strategy. Framing for internal buy-in and strategic fit highlights that the success of SME collaborations depends not only on external alignment with markets or users but also on internal resonance with the CEA’s logic and priorities. At CEA, exploratory projects often pass through internal evaluation, both to secure access to technical teams and to justify the allocation of resources. CEA teams needed to justify upstream SME projects to internal reviewers and collaborators, many of whom prioritized technical maturity and sector alignment. In this context, project champions at Y. SPOT act as internal advocates, framing SME collaborations in ways that align with CEA’s strategic mission, scientific expertise, and public missions. Business developers often acted as these advocates, crafting narratives to align SME ideas with CEA’s strategic areas of application (e.g., energy, health, etc.).

“It’s not enough to say: this SME has an idea. we must show why it’s meaningful for us too.” (Informant 7, Director, CEA)

This dual framing, for the SME and for CEA, was essential to go between external exploration and internal integration. While traditionally, CEA experts simply transfer SME ideas, in this practice, they construct compelling narratives that answer questions like: why does this matter to us? This practice thus involves articulating how a collaboration aligns with ongoing research agendas, supports regional priorities, and advances long-term scientific objectives. Framing from this perspective helps to manage the internal stakeholders’ perception of risk by translating SME initiatives in a way that is understood by decision-makers that appeared more accustomed to structured, downstream projects. Hence, framing

becomes a form of internal effort to render uncertain or exploratory ideas legitimacy within the organizational structure at CEA. Without this, even promising SME projects risk stalling due to a lack of alignment and support.

1.1.2.4. Framing failure: When ideas lose momentum

The absence of shared framing led to stalled collaborations. In some cases, framing failed to generate traction. This reveals an important vulnerability in CEA-SME collaborations. Promising ideas can stall not because of a lack of technical feasibility, but due to weak and lack of framing. In some of our cases, enthusiasm around initial concepts were not sustained because the stakeholders were unable to articulate a coherent, compelling narrative about its value, purpose, and strategic fit. Without shared understanding across stakeholders, both within the SME and internally at CEA, projects lost momentum and eventually collapsed. For instance, one SME sought help developing an AI model for hydration monitoring but could not align the problem with CEA's technological focus and business priorities

“They couldn’t tell a compelling story about the value, and we couldn’t justify it internally.” (Informant 18, Business Developer, CEA)

In these situations, the absence of a shared frame meant the idea remained suspended, lacking the narrative clarity and organizational legitimacy to move forward. This breakdown points to the importance of framing not just as a communication tool, but as a coordination process. It aligns diverse interests, clarifies objectives, and secures organizational support. When this is missing, innovation efforts often remain ambiguous and disconnected, difficult to evaluate, resource, and sustain. As one CEA informant reflected, the inability to tell a persuasive story about an idea's relevance meant it *“couldn’t be justified internally” (Informant 15, Innovation Project Manager, CEA)*. This highlights that where innovation is exploratory and uncertain, the ability to frame ideas persuasively is as vital as the underlying technological efforts.

This finding illustrates the fragility of framing as a practice. While brokering builds connections, framing builds meaning, and without shared meaning, collaboration may stall. Framing, thus, emerged a critical practice for shaping innovation possibilities, especially when ideas were novel, vague, and uncertain. Unlike brokering, which connects actors and aligns agendas, framing helps ideas gain clarity,

credibility, and momentum within and across organizations. Our findings reveal that the effectiveness of framing in successfully fostering innovation for SMEs included: (1) clarifying the value proposition and stakeholders involved, (2) translating SME intentions into structured, testable project concepts, (3) aligning narratives with internal institutional logics, and (4) creating shared language across boundaries of disciplines and sectors.

In contrast, weak and inconsistent framing left ideas unclear, failing to gather support and advance toward development. Taken together, brokering and framing illustrate how CEA, through Y. SPOT, reconfigures traditional RTO engagement strategies by moving upstream, supporting SMEs in the early, often ambiguous stages of innovation where relational, cognitive, and organizational effort is critical. These practices reflect a shift from transactional support to adaptive intermediation, where value is not just transferred but collaboratively constructed.

1.1.3. Interdependence of brokering and framing: Enabling adaptive intermediation

While analytically distinct, brokering and framing are interdependent, each reinforcing the other across the collaborative innovation process. Brokering establishes the structural and relational groundwork: connecting actors, aligning interests, and assembling the necessary technological, organizational, and ecosystem components. Framing, in turn, provides the cognitive and narrative infrastructure: making innovation ideas clear, legitimate, and directionally coherent. In CEA's collaboration with SMEs, brokering often initiated engagements by identifying entry points, mobilizing actors, and staging exploration. Yet without effective framing, these efforts risked lacking direction. Alternatively, framing alone could not sustain momentum or secure commitment without the relational ties, resource access, and exploratory tools enabled through brokering.

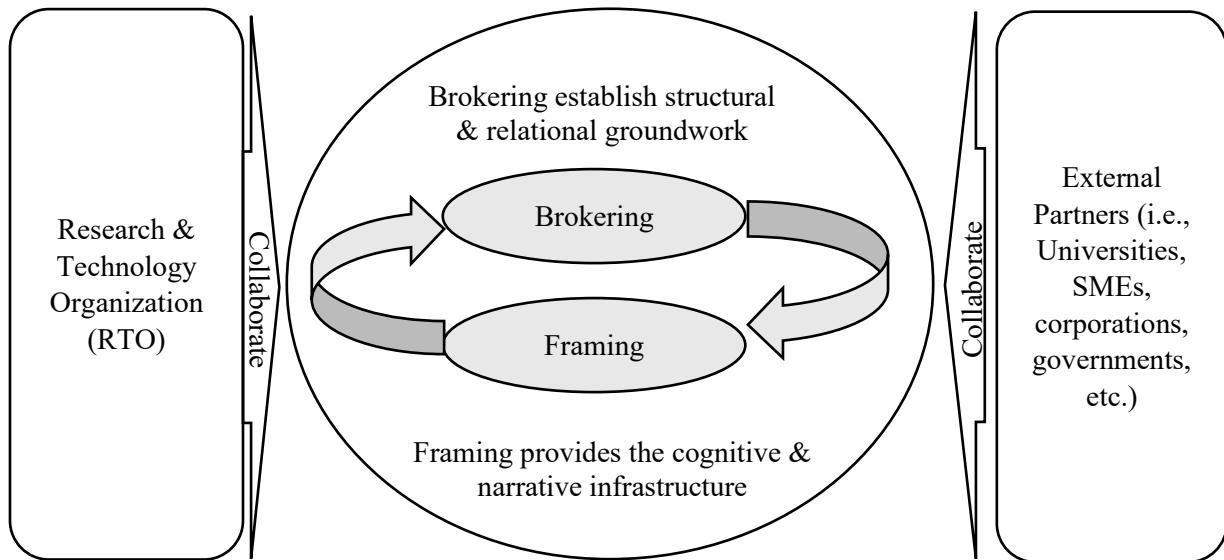
In this sense, framing made sense of the collaboration, while brokering made it possible. The interdependence is particularly evident in upstream innovation, where ideas are often ambiguous, context-specific, and underdeveloped. Brokering and framing are not sequential phases but mutually reinforcing cycles. Framing helps define what is being brokered (the value, the stakeholders, the intent),

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while brokering enables framing to evolve through new partnerships, insights, and opportunities. Strategically, this dual practice positions CEA not simply as a technology provider but as a capability-oriented intermediary. Taken together, they form an adaptive intermediation capability that positions CEA not merely as a technology provider but as a co-creator of innovation trajectories.

For SMEs with limited absorptive capacity, underdeveloped strategies, or uncertain market positioning, this brokering and framing from this understanding offers a differentiated form of support that aligns more closely with their actual needs. It enables CEA to operate upstream in the innovation process, influencing not just technical outcomes but also how innovation problems are defined, interpreted, and carried forward. This reconfiguration has implications for CEA's broader strategy. It requires greater flexibility, institutional support for exploratory work, and recognition that value creation is cocreated, not only through outputs but also through the intermediary processes that shape the innovation journey.

Figure 2. 1: Brokering and framing as enablers of adaptive intermediation



1.2. DISCUSSION

1.2.1. Rethinking RTO Engagement with SMEs: From Transactional Support to Adaptive Intermediation

This study examined how RTOs, through the case of CEA, adapt their strategies to support the upstream innovation needs of SMEs. Our findings reveal that such adaptation is not simply a matter of providing technical support or access to R&D infrastructures, as often emphasized in RTO literature (e.g., Giannopoulou et al., 2019; Barge-Gil & Modrego, 2011). Instead, RTOs require a more dynamic and relational approach, which we conceptualize in this study as “adaptive intermediation”. This intermediation is characterized by iterative brokering and framing that help SMEs make sense of their innovation ambitions and move ideas to implementation. We use this concept to capture the adjustment in roles and methods of innovation intermediaries like RTOs, as implicitly suggested in extant literature (see Agogu   et al., 2017; Katzy et al., 2013; Howels, 2006), in response to emerging dynamics in innovation ecosystems.

Our findings extend the literature on RTOs in three important ways. Firstly, while prior studies emphasize the role of RTOs in downstream innovation activities such as technology transfer, contract research, and service provision (Siegel et al., 2023; Gillier & Schweitzer, 2021; Arnold et al., 2010), our findings show that upstream collaborative innovation, especially with SMEs, requires more interpretive and relational work. SMEs typically do not approach RTOs with fully formed problems or clear technological roadmaps. They bring unstructured ideas, emerging needs, and exploratory objectives. Responding to such needs requires collaborative approaches to defining problems, aligning expectations, and gradually building project coherence. These practices go beyond the traditional transactional and collaboration strategies that often characterize RTO support.

Secondly, we contribute to innovation intermediation literature by demonstrating that intermediation at the upstream innovation phase should be approached in both a strategic and adaptive way. Instead acting as neutral facilitators and matchmakers (Zhang & Liu, 2024;

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Sheikheldin, 2021; Agogu  et al., 2013; Klerkx & Leeuwis, 2009; Howells, 2006), RTOs must act as co-creators of innovation trajectories and actively shape the direction and structure of collaborations. Practices such as ambition profiling, ecosystem mapping, and strategic framing show how RTOs can help SMEs navigate the ambiguity of early-stage innovation by translating vague intentions into viable project pathways. These findings align with recent work on innovation intermediaries as agents of knowledge configuration and capability development (De Silva et al., 2018; van Lente et al., 2003). We advance these debates by emphasizing the importance of temporal orchestration and internal advocacy within RTOs.

Thirdly, our study challenges the notion that failed collaborations are simply due to SMEs' limited capabilities (e.g., lack of absorptive capacity, resources, or clarity) (Gimenez-Fernandez et al., 2020; Goduscheit & Knudsen, 2015; Albors-Garrig s et al., 2014). We show that failures often emerge from misalignments in framing activities, where the absence of a shared narrative and aligned timelines lead to disengagement and sometimes breakdowns in collaborative innovation project efforts between an RTO and its SME partners. This finding underscores the need for RTOs to develop not only technical capabilities, but also interpretive and flexible ones that allow them to adjust their collaborative innovation strategies and engagement models to diverse SME conditions.

1.2.2. Theoretical and practical implications

This study makes some important contributions to the literature on RTOs and intermediation in the context of innovation support for SMEs. Precisely, we foreground brokering and framing to offer a process-oriented view of how public RTOs adapt their strategies to better support upstream innovation. This aspect of literature on RTOs has been underexplored, to the best of our knowledge, with studies often emphasizing downstream functions such as technology transfer and R&D (Gillier & Schweitzer, 2021; Giannopoulou et al., 2014; Barge-Gil & Modrego, 2011).

1.2.2.1. Theoretical implications

Our findings extend the understanding of RTO strategy by showing that adaptation is not merely a matter of organizational restructuring or resource reconfiguring and redeployment. Instead, adaptation involves the cultivation of intermediary capabilities that are socially and cognitively complex, such as diagnosing innovation needs, orchestrating collaborations over time, aligning project narratives with organizational strategy, and maintaining internal advocacy. These capabilities reflect what van Lente et al. (2003) termed “systemic intermediation” where actors not only connect but also configure and frame innovation pathways. Our study complements this work by showing how public RTOs engage in this type of intermediation at the upstream innovation stage, where innovation needs are often unclear and ill-defined.

Moreover, we enrich innovation intermediation literature by conceptualizing adaptive intermediation as a dynamic process of relational, temporal, and interpretive work. Whereas earlier studies often treated intermediation as a functional or transactional role (Dalziel, 2010; Howells, 2006), our study shows that successful intermediation, particularly in support of SMEs, depends on the ability to navigate uncertainty, build shared meaning, and negotiate strategic alignment across actors with different logics, capacities, and time horizons. Framing emerges as a critical but under-theorized process through which intermediaries stabilize collaboration, align expectations, and secure internal and external buy-in. As such, we suggest that framing should be understood as a core intermediation function, alongside more commonly studied practices like networking, matchmaking, or resource brokering.

We also address an emerging gap in the literature on how the issue of managing internal tensions between scientific mandates and entrepreneurial responsiveness. While scholars like Kivimaa et al. (2019) and Knockaert et al. (2014) recognize that intermediaries operate under multiple organizational logics, few studies have examined how this plays out in everyday practices. Our findings show that internal buy-in at CEA depends on the ability of project stakeholders to craft compelling narratives that justify SME collaborations considering broader strategic objectives. This sense-giving work is essential not only for securing organizational

support, but also for legitimizing upstream collaborations within publicly funded innovation ecosystems where scientific credibility and impact accountability remain dominant.

1.2.2.2. Practical implications

Our study points to three key implications for RTOs and policymakers aiming to improve innovation support for SMEs. Firstly, managers and policymakers should build interpretive and relational capabilities within RTO teams. Beyond technical expertise, RTO staff should be equipped with some soft skills (i.e., facilitation, negotiation, and sensemaking skills) required for facilitation, strategy design, and narrative construction. This shift requires rethinking recruitment, training, and performance measurement metrics to reflect the value of these non-technical capabilities in fostering innovation. Secondly, there is the need to institutionalize flexible, upstream-oriented collaboration strategies. Tools like ambition profiling, co-design workshops, idea road-mapping, and value proposition and POC co-design sessions are not random, or practices developed to improvise. They form the core infrastructure for enabling SMEs to engage with RTOs. These practices should be integrated into the traditional operating strategies of public RTOs, with dedicated resources and strategic support.

Thirdly, RTO managers should revise governance frameworks to support exploratory SME-driven innovation. RTOs that seek to adapt to the needs of SMEs must go beyond the one-size-fits-all project approval systems and linear technology transfer logics. Evaluation systems should account for upstream innovation impacts such as capability development, problem redefinition, and market exploration. These may not yield immediate outputs but are vital for long-term innovation capability building. Considered as a whole, the insights from our study contribute to a more nuanced understanding of how RTOs operate as adaptive innovation intermediaries. Thus, how they operate as organizations in a continuous process of realigning internal practices, collaborative tools, and strategic orientations to engage meaningfully with diverse innovation actors. This is particularly relevant, if not vital, for SMEs operating in resource-constrained and uncertain environments to engage more with public RTOs.

1.3. CONCLUSIONS

This study examined how RTOs adapt their strategies to support the upstream innovation needs of SMEs, an aspect of RTO and innovation intermediation literature that is often overlooked. Through a qualitative multi-case study of SME collaborations at CEA, particularly within its Y. SPOT innovation labs, we found that effective support for SMEs in early-stage innovation does not rely solely on technology provision or traditional knowledge transfer processes. Instead, it depends on an RTO's ability to engage in adaptive intermediation, a process that combines brokering and framing to translate unclear SME ambitions into collaborative innovation pathways. Our findings demonstrate that brokering, involving guided support, temporal orchestration, and ecosystem mapping allow RTOs to design flexible collaboration strategies that respond to the ambiguity of SME needs.

Meanwhile, framing, which involves diagnosing ideas, building coherence, and crafting internal narratives, are equally vital in aligning collaborations with both SME business goals and RTO strategic imperatives. Together, these processes reframe the role of RTOs as co-creators of innovation meaning and direction, rather than just technology and R&D service providers. This process-oriented view contributes to theoretical debates on the evolving role of RTOs in contemporary innovation ecosystems. Particularly as RTOs seek to serve a broader base of firms, including those with limited absorptive capacity and poorly defined strategies. Our study adds insights to the literature on innovation intermediation by identifying the interpretive and relational dimensions of upstream innovation support, particularly in contexts where traditional approaches to project delivery become inadequate.

1.4. FUTURE RESEARCH DIRECTIONS

Our study opens some opportunities for further exploration. First, future research could examine how transferable these adaptive intermediation practices are, particularly to other institutional and geographical contexts. CEA Y. SPOT operates within a specific French innovation and policy landscape. Comparative studies across other national or even regional RTO,

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especially in emerging or less centralized innovation ecosystems, would be valuable in assessing how institutional logics shape the design and delivery of upstream innovation support for SMEs.

Secondly, a longitudinal research approach could investigate how intermediary processes like brokering and framing evolve over time. Studies could examine whether adaptive intermediation leads to sustained organizational learning within RTOs, or whether these practices remain dependent on individual initiative and informal structures. Understanding this dynamic could offer insights into how RTOs can formalize flexible engagement strategies without compromising their scientific rigor and accountability.

Thirdly, we encourage further work on the internal governance tensions that RTOs face when aligning exploratory collaborations with strategic objectives. While our study highlights how project managers navigate these tensions through framing, deeper exploration of internal resistance, performance metrics, and incentive structures could enhance understanding of the conditions under which exploratory SME collaborations succeed or fail. Finally, future research should consider exploring the impact of adaptive intermediation on SME innovation outcomes, particularly for firms operating in underserved sectors and ecosystems. While our study focused on the practices of the RTO, further investigation into how these practices influence SMEs' learning, capability development, and market entry would enrich the empirical and policy relevance of this line of investigations.

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**CHAPTER 3 - GENERATING INTERNAL VALUE IN
RESEARCH AND TECHNOLOGY ORGANIZATIONS
FROM COLLABORATIVE INNOVATION (ESSAY 2)**

ABSTRACT

Purpose: This study explores how public Research and Technology Organizations (RTOs) adapt and position themselves to capture value from collaborative innovation and use that value to improve their own capabilities over time.

Research Design: Using a qualitative case study of a French RTO, CEA (*Commissariat à l'énergie atomique et aux énergies alternatives*), we draw on 41 interviews, field observations, and project documents collected over 24 months. We apply the dynamic capabilities framework, focusing on sensing, seizing, and transforming, to examine how CEA adjusts its internal processes for more effective external collaborations.

Findings: The study identifies two key processes, prospecting (finding and preparing collaboration opportunities) and feedbacking (gathering and using knowledge from past projects), that help CEA build the capabilities needed to adapt. These processes enable the RTO to identify opportunities, act on them, and gradually change how it works internally. The study also reveals important challenges as knowledge gained from past projects are not always shared across the organization, and regional teams often lack the flexibility to adapt strategies to local needs.

Practical Implications: For RTOs to remain relevant and effective, especially when working with SMEs, they must invest more in internal learning, coordination between teams, and flexible strategies that align with different regional contexts. Developing these capabilities will be critical as RTOs take on more diverse roles in fast-changing innovation systems.

Originality: To the best of our knowledge, this study is one of few studies to apply the dynamic capabilities perspective to a public RTO. It shifts the conversation from technology transfer and R&D to how RTOs learn and evolve through collaboration. We also reframe value appropriation not as an outcome but as a key part of how RTOs grow and adapt strategically.

3. INTRODUCTION

Research and technology organizations (RTOs) have long been identified as key contributors to value generation in the innovation ecosystem. Yet, how RTOs adapt and position themselves to appropriate more value from collaborative innovation is a subject of inadequate discussion. RTOs operate at the intersection of industry, academia, and government (Giannopoulou et al., 2019), playing key roles in enabling technology transfer and research and development (R&D) (Intarakumnerd & Goto, 2018; Barge-Gil & Modrego, 2011). As publicly funded, sometimes supported by private funds from groups of companies with common interests (Suominen et al., 2021; Readman et al., 2015), RTOs prioritize generating value for external stakeholders over generating value for their own long-term sustainability.

While external value generation (like new services, technologies, reputation, etc.) is crucial for their long-term relevance, RTOs must also prioritize internal value generation to foster their operations and contributions to value generation for clients. However, there is little focus on this internal aspect of value generation by RTOs, exacerbated by their public missions and governments shifting towards performance-based funding systems (Sheikheldin, 2021). Internal value generation involves the accumulation of learning, routines, and collaborative competencies that strengthen the organization's capacity to innovate, adapt, and maintain relevance within evolving ecosystems (Giannopoulou et al., 2019; De Silva et al., 2018; Howells, 2006). De Silva, Howells, and Meyer (2018) refers to internal value as the set of "knowledge-based" outcomes that organizations like RTOs appropriate from their collaborative engagements.

Past research has extensively discussed the role of RTOs and how they generate value for their clients (Siegel et al., 2023; Gillier & Schweitzer, 2021; Sheikheldin, 2021; Giannopoulou et al., 2019; Bandarian, 2018; De Silva et al., 2018; Readman et al., 2015; Albors-Garrigós et al., 2014; Barge-Gil & Modrego, 2011; Albors-Garrigos et al., 2010; Arnold et al., 2010; Leitner, 2005), but presents a lingering lack of understanding on how RTOs adapt and position themselves to appropriate value from collaborative innovation. Addressing this gap is vital as innovation moves towards more open and networked environments (De Silva et al., 2018). "Who gets what" in terms of value generation is a key

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concern in modern business environments where actors operate in open innovation environments (Chesbrough, 2003) and a system in which “we move from single-firm revenue generation towards multi-firm control and interface issues” (Ballon, 2007:7).

In such dispersed systems and networks, how to efficiently appropriate value for each stakeholder remains a daunting task but is essential for the long-term survival of not only firms (Johnson et al., 2008) but RTOs (Gillier & Schweitzer, 2021; Giannopoulou et al., 2019; De Silva et al., 2018) as well. It is this aspect of internal value generation by RTOs, which the literature has yet to adequately address (De Silva et al., 2018; Krenz et al., 2014), that is the focus of this study. Internal value could be multidimensional, comprising both financial and non-financial values. The immediate gain for RTOs from collaborations can be expected to be from financial benefits, i.e., revenues from services provided to clients and funding secured from research grants.

RTOs also generate non-financial value that comprise of knowledge, market, and network related benefits. In collaborative innovation, RTOs with other partners may develop new knowledge (Kale et al., 2000; Gulati, 1999; Mowery et al., 1996), new capabilities (Hardy et al., 2003; Martin-de Castro, 2015; Cepeda & Vera, 2007), intellectual property (Martin-de Castro, 2015), new forms of innovation (Earl, 2001) and useful networks (Nagaoka & Kwon, 2006). While taking this to an extreme might be seen to be exploitative of partners, especially for a public organization, RTOs need to sufficiently gain from the value they help generate for their own long-term survival. Without such gains, their contribution to value generation for external stakeholders, third parties, and the wider innovation ecosystem would not be possible. To understand how RTOs appropriate value in collaborative innovation, we draw on dynamic capabilities (Hafeez et al., 2025; Teece, 2007; Teece et al., 1997) as a theoretical framework.

In the ability of RTOs to generate internal value, the effective development and utilization of value appropriation processes is a critical component. The dynamic capability theory (Teece, 2007; Eisenhardt & Martin, 2017; Teece et al., 1997) and the appropriability literature (Teece, 2006; 1986) highlight that a firm's ability to integrate, build, and reconfigure internal and external competences is crucial for responding to changes in the business environment. Consequently, dynamic capability as a theoretical

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lens is often applied to understand how firms continuously adapt and reconfigure to generate and appropriate value in collaborative environments. However, this theoretical lens has yet to be used in understanding value appropriation in RTOs and has only now begun to gain attention in the context of innovation intermediaries (Hafeez et al., 2025).

Applying this lens thus becomes crucial to understand how RTOs adapt and position themselves to capture value and transform them to foster their role in innovation ecosystems. Using data from multiple case studies of SME collaborations with a leading European RTO in France, the Alternative Energies and Atomic Energy Commission (CEA), we seek to contribute in three ways to our knowledge of RTOs. First, we offer insights for RTOs to effectively design, integrate, and assess internal practices that help them to appropriate more value from their collaborative engagements. Secondly, we conceptualize internal value generation in RTOs as a distinct, multi-dimensional process involving value appropriation and developing dynamic capabilities. Thirdly, we advocate for extension of current policy and performance measurement frameworks for RTOs. These frameworks should be re-examined to better reflect the dynamics of internal value generation. We thus call on policymakers to reinforce efforts in supporting RTOs as a pathway to generate wider innovation ecosystem value.

The remainder of this study is organized as follows. The next section offers a brief review of existing literature on RTOs and value generation in innovation ecosystems, the relevance of value appropriation to RTOs, and presents dynamic capabilities as a theoretical framework for understanding internal value generation in RTOs. This will be followed by a methodology and findings sections with the paper concluding by discussing the findings, limitations, and future research directions.

3.1. LITERATURE REVIEW

3.1.1. RTOs and value generation

RTOs are key actors in innovation ecosystems, often serving as intermediaries that facilitate knowledge exchange, capability development, and technological advancement (Suominen et al., 2021;

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Readman et al., 2015). Traditionally, RTOs are nonprofit, publicly mandated organizations often established through government support or sometimes established through support from groups of companies with common interests (Leitner, 2005). Their role involves conducting applied research to support firms, particularly small and medium-sized enterprises (SMEs), in adopting new technologies, building capabilities, and accessing collaborative networks (Gillier & Schweitzer, 2021; Giannopoulou et al., 2019; Goduscheit & Knudsen, 2015). These functions represent the role of RTOs in generating value for external actors or third parties. RTOs are widely recognized for their role in generating external value, by supporting innovation in firms and enhancing ecosystem competitiveness (Sheikheldin, 2021; Uribe-Echeberria et al., 2019). However, their capacity to appropriate the value they help create remains underexplored.

Existing literature treats RTOs as facilitators or intermediaries (Albors-Garrigós et al., 2014; Barge-Gil et al., 2011; Albors-Garrigos et al., 2010) rather than as organizations with their own strategic and sustainability imperatives. This has led to a significant oversight in literature, particularly how RTOs themselves benefit from the collaborative innovation processes they enable. Recent studies have started to address this gap in the literature. De Silva et al. (2018) and Noviaristanti et al. (2023) argue that RTOs derive both financial and non-financial value through collaboration, but the processes through which this occurs remain clearly unspecified. Additionally, existing literature often examines RTOs by combining them with other innovation intermediaries (Noviaristanti et al., 2023; Giannopoulou et al., 2019; Uribe-Echeberria et al., 2019; De Silva et al., 2018). This focus on lumping RTOs together with other intermediaries often obscures their unique governance structures, missions, and constraints that necessitate specialized attention and support.

Consequently, the internal dynamics of value generation, particularly how RTOs adapt and position themselves to appropriate value, remain relatively unknown, insufficiently theorized, and barely empirically examined. The lack of attention to this gap in our understanding of value generation by RTOs is not an inconsequential issue. An empirical examination and sufficient theorization of the internal dynamics of RTO value generation is crucial in contemporary innovation landscapes and business environments where these organizations are expected to contribute to addressing grand

challenges, act entrepreneurially, and demonstrate impact (Khelfaoui & Bernier, 2023; Sheikheldin, 2021). Thus, without a deeper understanding of how RTOs appropriate value for themselves, both their sustainability and capacity to contribute to broader innovation objectives, especially in the innovation ecosystem, may be jeopardized.

3.1.2. The relevance of value appropriation to RTOs

Value appropriation offers a useful lens for exploring how RTOs generate internal value. More recently, value appropriation has been defined as the processes by which actors in collaborative environments capture a share of the value they help to generate (Reitzig & Puranam, 2009; Teece, 1986). Processes such as intellectual property (IP) rights, contracts, market positioning, and firm-specific capabilities have widely been studied in the private and high-tech sectors (Cabral et al., 2019) with shifting attention to their relevance in RTOs. For instance, Teece (1986) emphasizes the role of complementary assets and appropriability regimes which are particularly important for organizations like RTOs. His framework presents the understanding that the ability to capture returns from innovation depends on factors like IP protection and firm strategic positioning, presenting an important framework for understanding why actors like RTOs may fail to profit from value generated in collaborative innovation.

RTOs often lack direct access to markets and operate under public mandates that prioritize openness and impact over commercial returns. This creates tensions as RTOs contribute to knowledge creation and innovation but risks being excluded from the returns on such innovations. Snihur et al., (2021) refers to these tensions as “appropriation dilemmas”. Managing appropriation dilemmas is essential for ensuring the organizational sustainability and operational viability of RTOs. Moreover, RTOs must manage complex intra-organizational and inter-organizational dynamics. As intermediaries, RTOs manage complex partnerships with universities, industry, and governments and in such collaborative partnerships, the different stakeholders may have competing priorities about what and how value should be appropriated. Managing these tensions can be challenging (Coff, 1999) and value appropriation in these contexts is not merely a function of transactions. Instead, specific processes and the ability to manage stakeholder expectations are crucial.

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Considering this, RTOs must balance openness, critical for their legitimacy in the innovation ecosystem, with the need to retain sufficient value for reinvestment (Alexy et al., 2013). Notwithstanding, the tensions worsen as governments are gradually shifting towards performance-based funding systems, which often tie public support and funding to impact demonstrations. Moreso, recent studies extend value appropriation theory to public and non-profit organizations (Cabral et al., 2019; Van den Oever & Martin, 2019) highlighting the need for the long overdue empirical examination and theorizing of value appropriation processes in organizations like RTOs. These studies also highlight the relevance of informal value appropriation processes such as secrecy, trust, and complexity, especially in relation to SMEs. For RTOs, who frequently support innovation for SMEs, often resource-constrained, understanding the different processes for value appropriation to promote innovation is crucial.

Yet there remains a lack of empirical work that examines how RTOs (especially public RTOs) develop value appropriation processes tailored to their distinct missions, stakeholder landscapes, and hybrid (public/private) funding models. Value appropriation is an organizational capability (Reitzig & Puranam, 2009) that RTOs must develop to sustainably manage their role and contribution to innovation ecosystems. Thus, while value appropriation is well theorized, its application to RTOs is crucial and long overdue. Investigating how RTOs adapt and position themselves to appropriate value from collaborative innovation while serving the public interest is necessary to offer insights for theory and practice. We address this gap, contributing to a more nuanced and operational understanding of value generation in RTOs.

3.1.3. Dynamic capabilities as a theoretical lens

Dynamic capabilities theory provides an important lens for analyzing how organizations adapt to change, innovate, and sustain competitive advantage in uncertain environments (Teece, 2007; Teece et al., 1997). Central to this framework is the firm's capacity to sense emerging opportunities and threats, seize them through timely resource mobilization, and transform internal structures and competences in response to evolving conditions. These dynamic capabilities are not static endowments but are developed and refined over time through processes of learning, collaboration, and feedback. In the

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context of RTOs, dynamic capabilities are particularly critical given their intermediary position between scientific research and industrial application. Collaborative activities enable RTOs to develop a dynamic repository of organizational knowledge and reflexive learning processes, that underpins the development of dynamic capabilities over time.

Through ongoing interactions with industrial partners, RTOs accumulate experiential knowledge about technological trajectories, market needs, and organizational arrangements that can shape their ability to adapt and remain strategically relevant. Recent studies have emphasized that value appropriation is not merely an outcome of dynamic capabilities but also a process that reinforces them. For instance, Ahuja et al. (2013) introduced the notion of generative appropriability, highlighting how the ability to capture value from innovations can spur further innovation and learning. Similarly, Alexy et al. (2013) demonstrate that strategic knowledge disclosure and selective revealing enhance a firm's sensing and seizing capabilities. Najda-Janoszka (2016) further argues that value appropriation depends on the development of specific organizational routines and adaptive processes. Schilke (2014) also argued that organizational adaptation can be based on second-order dynamic capabilities, developed through routines that are repetitive and learned.

These perspectives underscore the recursive relationship between value capture and capability development, particularly in organizations like RTOs that operate at the nexus of research, policy, and industry. Adopting the dynamic capabilities perspective thus enables a nuanced understanding of how RTOs evolve in response to environmental change, develop processes to appropriate value from collaborative innovation, and strategically position themselves within innovation ecosystems. This framework guides our analysis of how RTOs can foster their sensing, seizing, and transforming capabilities to generate and appropriate value in increasingly complex and competitive contexts.

3.2. METHOD OF STUDY

To investigate how RTOs adapt and position themselves to capture and retain value from collaborations, we employed a qualitative case study design (Yin, 2003, 2009) and an abductive

analytical approach (Dubois & Gadde, 2002). This design enables the iterative interplay between theoretical concepts, namely, dynamic capabilities and value appropriation, and empirical insights derived from the case. The abductive strategy was particularly suited to our aim of refining theory while engaging deeply with the contextual specificities of a leading RTO.

3.2.1. CEA as an embedded RTO case

We selected the French CEA, one of Europe's leading RTOs, as our single-case setting. The choice of CEA was purposive, grounded in its dual role as a national provider of R&D services and a key actor within the European innovation landscape. Specifically, we focused on CEA Tech, the technology research division of the CEA, due to its extensive involvement in collaborative innovation with a broad spectrum of stakeholders, including SMEs, corporations, universities, and public institutions. CEA's relevance stems from its evolving strategy to extend operations into underserved regions of France, such as parts of Occitanie, Nouvelle-Aquitaine, and Auvergne-Rhône-Alpes.

These regional expansions offer a compelling context to examine how an established RTO reconfigures its capabilities and internal processes to respond to new and underserved innovation ecosystems. Furthermore, CEA's historical emphasis on specific industries such as the defense and energy sectors left it relatively closed to industrial diffusion until the early 2000s, making its current transition to more inclusive collaborations particularly interesting to examine. Thus, CEA represents a relevant case for examining how RTOs develop dynamic capabilities to support strategic positioning and value appropriation (Teece, 2007).

3.2.2. Data collection

We adopted a multiple source data collection approach to ensure depth and triangulation (Aguinis & Solarino, 2019) of the information we gathered. Primary data consisted of 41 semi-structured interviews with key informants across CEA's regional installations. Participants were selected based on their active involvement in collaborative innovation projects with external partners. Interviews lasted between 60 and 90 minutes and explored how CEA collaborates with external actors, the benefits derived from such collaborations, and the processes used to capture both financial and non-financial value. To

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enrich our analysis and increase validity, we collected and analyzed 20 internal and confidential documents, including partnership agreements, project reports, and strategic plans, coupled with informal observational notes gathered over our 24 months of field engagements.

Our lead author participated in several CEA outreach and partnership-building activities, allowing for direct observation of knowledge transfer practices and organizational routines in action. Additionally, we held bi-monthly feedback and validation meetings with CEA partners, structured as focus group discussions. These sessions served both to confirm preliminary interpretations and to clarify ambiguous findings, supporting our commitment to analytical rigor and collaborative inquiry.

3.2.3. Data analysis

We followed an abductive coding process, moving between emerging empirical themes and existing theoretical frameworks. Interviews were transcribed verbatim and independently coded by the lead author, reviewed with co-authors, before discussions, reflections and revisions were made.

Table 3. 1: Description of interviews with CEA informants

Infor.	Int.	Position	Experience (yrs)	Expertise
1	2	Director	11	Reorganize teams. Entangles business development, communication and innovation teams as a new entity to build better partnerships with industrial companies.
2	1	Director	26	Part of innovation/start-up department. Manage a program for business creation and animation of correspondents of innovation networks.
3	2	Director	13	Lead designers, engineers, and project managers to support partners in achieving technological ambitions.
4	1	Project manager	11	Manage bilateral projects with industry partners & collaborative projects at Y.SPOT. Support pivoting for SMEs in the aeronautic sector.
5	1	Project manager	12	Part of exploration and innovation team. Involved in different projects in Agri/Agro, Energy & Silver economy strategic exploration projects.
6	1	Project manager	13	Develop innovation methods i.e., value proposition design, user experience studies, etc.
7	1	Tech prospecting officer	11	Manage lab for products & services innovation. Support market and technology exploration for technology foresight.
8	1	Director	12	Director of the multiple regional sites of CEA Tech.
9	2	Director	13	Director at CEA Tech Occitanie, in charge of Labège site.
10	1	Designer	5	User experience & user interface designer in the Y.SPOT team in Labège.

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11	3	Designer	10	Create digital/tangible demonstrators to disseminate CEA technologies. Collaboratively design medical devices with CHU Toulouse. Define innovation projects for startups & SMEs to adopt CEA technologies.
12	2	Project manager	6	Support SMEs in Occitanie & beyond to construct projects with technological breakthrough components.
13	2	Business developer	10	Develop innovative industry partnerships & support the operation of CEA Tech Occitanie.
14	1	Business developer	14	In charge of industrial partnerships in the “Pays de la Loire” region of France.
15	1	Business developer	11	Responsible for defining, developing and managing strategic partnerships aimed at supporting the ambition and value creation of CEA Tech.
16	1	Team leader	8	Complex Systems Control and Monitoring Platform Manager. Manage projects involving the development of innovative tools to facilitate the work of crisis teams.
17	1	Adjunct director	21	Deputy head at CEA Tech Occitanie. Develop industrial partnerships & support management of Labège site.
18	1	Lab manager	20	Expert fellow scientist, Algae processes & products. Internal & external scientific expert advice and consulting on bioenergy & photosynthesis.
19	1	Tech transfer advisor	16	Researcher & project contributor, involved in medical technology development within the context of collaborative innovations facilitated by Y.SPOT
20	1	Researcher	20	Physicist & materials researcher, based at CEA Tech Occitanie. Specialized in materials science. Contribute technical expertise to collaborative projects at Y.SPOT.
21	1	Lab manager	24	Facilitate innovation by coordinating collaborative projects at Y.SPOT between CEA & industrial partners, particularly startups & SMEs.
22	1	Researcher	21	Project contributor. Specialized in process development for manufacturing lipid nanoparticles, instrumented micro-needles, & formulation, shaping & characterization of biomaterials
23	1	Lab manager	15	Lab manager/innovation orchestrator. Works closely with Y.SPOT to shape collaborative projects & align them with both industrial & internal research objectives
24	1	Researcher	25	Technical expert & engineer. Contribute directly to applied R&D projects often facilitated through Y.SPOT
25	1	Lab manager	20	Project leader, manage 50 engineers & technicians. Selects, purchase & commissions industrial tools for microelectronics. Support the establishment of startups.
26	1	Business developer	10	Two missions: development of industrial partnerships & the development and operation of CEA’s Occitanie technology transfer platforms.
27	2	Researcher	15	Researcher/business developer work in close collaboration with Y.SPOT. Involved in organizing & structuring collaborative innovation projects. Plays a central role in projects where user-centered health innovation is co-developed through Y.SPOT’s exploratory framework
28	1	Researcher	17	Research director. AI specialist: symbolic AI, explainable AI, machine learning, fuzzy logic. Lead researcher and project manager on CEA Tech’s ExpressIF AI technology

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29	2	Junior project manager	4	Project lead/strategy expert. Directly involved in executing collaborative projects at Y.SPOT.
30	1	Business developer	15	Expert in projects involving renewable energy technologies, robotics, AI, etc. Facilitate tech transfers & manage projects between R&D teams & enterprises.
31	1	Lab manager	14	Responsible for managing an innovation platform at CEA Tech. Involved in multiple projects geared toward the development of molecule vectorization technologies for various therapeutic applications.
32	1	Project manager	5	Project lead/strategy expert. Involved in executing collaborative projects at Y.SPOT.

Initial codes were both inductively generated and informed by prior literature on dynamic capabilities and value appropriation. Through ongoing comparison, we clustered these codes into higher-order categories corresponding to practices that foster sensing, seizing, and transforming activities. All discrepancies in our coding process were resolved through collective deliberation, and themes were refined through constant comparison until we reached thematic saturation. We analyzed data, not merely to describe these practices, but to uncover the processes that enabled CEA to capture and retain value, particularly in resource-constrained collaborations with SMEs and regional actors.

From this approach, our analysis focused on two core items: (1) how CEA internally generates and appropriates value through collaborative innovation, and (2) how these practices reflect and enable the development of dynamic capabilities in the face of institutional and geographic expansion. This methodological approach hence enabled us to develop the empirical findings presented in the next section and structure our discussions around the core dimensions of dynamic capabilities. We thus focus our discussion section on highlighting how an RTO may develop and deploy sensing, seizing, and transforming capabilities through specific practices to enhance its value appropriation capacity in different contexts.

3.3. FINDINGS

This section presents the empirical findings from our case study of CEA. Drawing on the interviews, documents, and field observations, we identified two core processes: prospecting and feedbacking, that enable CEA to engage with external stakeholders and adapt its value generation processes. These

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processes, implemented through Y. SPOT, reflect and reinforce dynamic capabilities. Prospecting aligns with sensing, while feedbacking facilitates transformation. Our findings also revealed some enabling practices such as accompaniment on innovation projects, technology demonstration, and funding acquisition, which contribute to CEA's ability to seize value from collaborations.

3.3.1. Prospecting as both sensing and seizing capability

Prospecting emerged as a structured process through which CEA identifies, engages, and evaluates potential collaboration opportunities with external actors and transforming them into shared value.

Table 3. 2: Extract from data structure

Representative statements	1st order themes	2nd order themes	Aggregate themes
<i>"We help them take a vague idea and turn it into something concrete they can act on, whether that's a prototype, a roadmap, or a technical plan." Inform. 27</i>	Facilitate firms in bridging uncertainty to actionable innovation	Accompany firms on innovation projects	Prospecting
<i>"We qualify companies and then we move them along a process, from framing their needs to signing and launching projects." Inform. 21</i>	Explaining CEA processes to move firms along the innovation pipeline		
<i>"We then develop a prototype or a proof-of-concept that demonstrates the potential of the innovation." Inform. 9</i>	Use prototypes to validate & promote new technologies	Technology demonstration & expert support	
<i>"We moved from just demonstrating technologies to thinking about the future of industries, new business models, and pre-industrialization" Infor. 28</i>	Swiftly materialize concepts into tangible outputs for industry application		
<i>"We match industrial needs with the lab's capacities. Sometimes, it's about finding the right overlap." Inform. 28</i>	Market exploration with projects, focusing on matching competencies with market needs	Exploration (product, market, tech., etc.)	
<i>"We split the project into short-term delivery and long-term exploration to ensure we can execute something useful quickly." Inform. 29</i>	Comprehensive approach to uncover needs & explore solutions across products, services, & technology.		
<i>"The prototype helped us convince potential investors, it showed that the concept was credible and that there was real technological depth behind it." Inform. 26</i>	Use innovation to attract investment & enhance product appeal	Funding search strategies	

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<i>"We formed a consortium... an organization of banks and laboratories. There's a development bank... it finances part of the program, and Europe funds also." Inform. 12</i>	Assist SMEs to secure funding through regional initiatives		
<i>"We start by mapping out what the company thinks it needs, then we dig deeper to uncover what's behind that, sometimes the real issue isn't what they first describe." Inform. 12</i>	Systematic approach to acknowledge & document client needs	Acknowledge & collect information	Feedbacking
<i>"Some companies want to innovate but don't know where to start. That's where we come in, to help frame the problem." Informant 13</i>	Acknowledgement of needs & exploratory discussions		
<i>"We use the feedback from industry to build a roadmap that prioritizes what's feasible and valuable." Inform. 12</i>	Analyze needs & trends to propose innovative concepts	Explore & analyze information	
<i>"We use design workshops and road-mapping sessions to help narrow down the possibilities and focus on what's technically and strategically viable." Informant 24</i>	Use structured exploration to refine focus areas for innovation		
<i>"After identifying the concept, we tested it with our partners and moved into technical validation." Inform. 22</i>	Hands-on analysis & development of solutions & ideas	Develop & execute findings	
<i>"Once we've identified the pain points and validated the use case, we move quickly to define technical specifications and outline what the labs need to build." Inform. 21</i>	Transition from analysis to actionable inputs		
<i>"We presented the results of the workshops to the lab heads to get their feedback before moving forward." Inform. 23</i>	Structured communication framework to inform & engage stakeholders	Inform stakeholders	
<i>"As we progress, we share each stage of the results...so they can react, adjust, and guide the next steps, it's very collaborative." Inform. 22</i>	Iterative feedback to stakeholders based on technical findings		

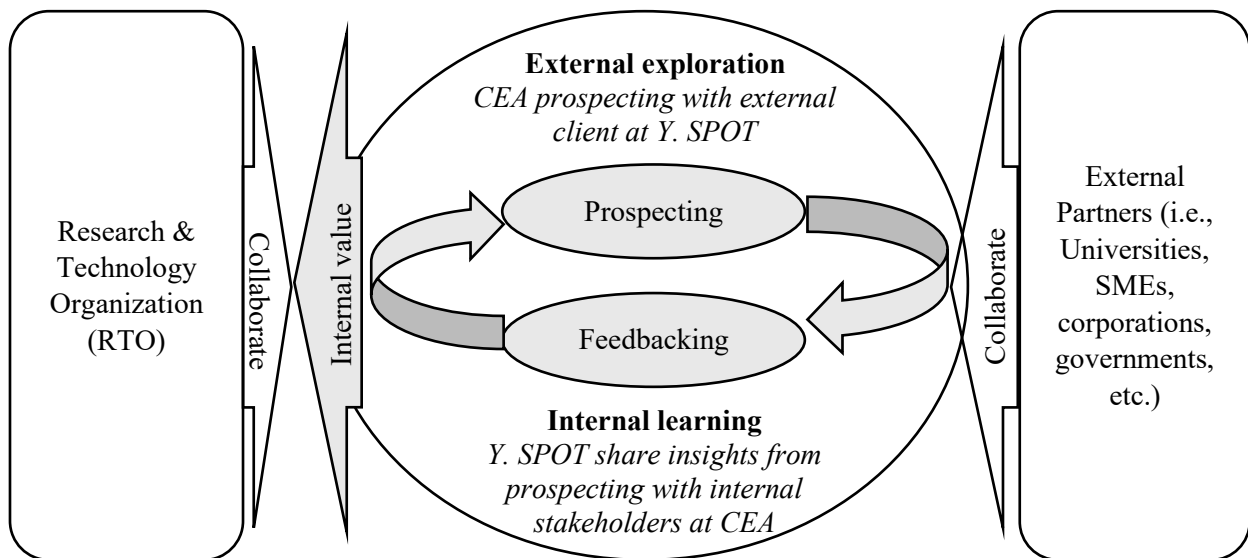
Implemented by Y.SPOT in Occitanie, prospecting allows CEA to explore innovation ecosystems and business environments for emerging technological needs, stakeholder interests, and opportunities for new product development and service diversification. These sensing and seizing activities are oriented toward identifying partners, particularly SMEs and public institutions, whose innovation needs align with CEA's technological expertise. Y.SPOT initiates prospecting by mapping client ambitions, technical capabilities, and market orientations. This involves assembling cross-disciplinary teams and engaging partners through ideation spaces such as the "Centrifugeuse", prototyping labs like the

“Façonnerie”, and “Technology Showrooms” within the Totem building (see Figure 4). These tools foster interaction and early-stage co-creation. For example, one informant explained:

“My role is to identify new companies... who wish to do R&D and innovation using our technologies”. (Informant 13)

Through initiating exploratory discussions and offering dedicated innovation spaces, Y.SPOT enables CEA to adapt to the evolving needs of clients, supporting the organization’s sensing and seizing capabilities. Importantly, prospecting also supports strategic alignment by guiding CEA’s efforts to bring its services for application in new sectors and underserved regions. Informant 21 noted that such interactions help to: *“Translate business needs into structured R&D tasks”*. This highlights CEA’s attempt to anticipate future market trends and technological applications, an essential characteristic of sensing and seizing as presented by scholars of dynamic capabilities theory.

Figure 3. 1 Prospecting and feedbacking as a recurring process for value appropriation



3.3.1.1. Accompaniment as a sensing capability

Accompaniment refers to CEA’s practice of guiding firms on their innovation journey: from articulation of needs to development and execution of collaborative projects. This practice is particularly relevant for SMEs and non-traditional R&D organizations, who often lack internal innovation capabilities and rely on external expertise to pursue technological advancement. Through accompaniment, CEA goes

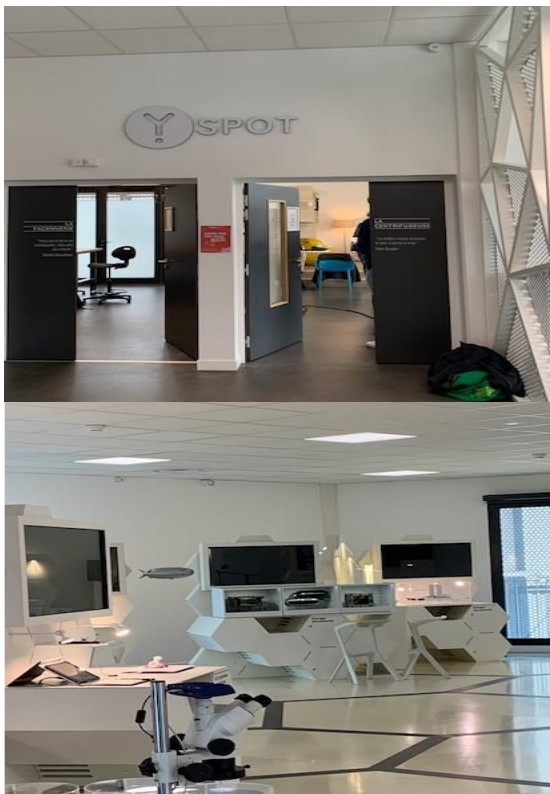
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beyond supporting clients to mobilize its internal resources to accompany clients on the journey to identify value from emerging innovation opportunities, thus exercising its sensing capabilities (Teece, 2007). Our findings indicate that accompaniment is enacted through structured support processes, including diagnostic consultations and tailored technology search. Informants described these engagements as essential to aligning CEA's technological offerings with the specific needs and constraints of clients. As Informant 28 noted:

“We qualify companies and then we move them along a process... to signing and launching projects.”

This structured progression, from initial contact to project launch, reflects how CEA designs and implements formalized pathways to initiate and deepen collaboration. The processes are particularly important for firms that face uncertainty regarding their innovation direction or lack in-house R&D capabilities. Through these interventions, CEA helps clients conceptualize future market needs and integrate them into product development strategies, an essential aspect of opportunity recognition and capture.

Figure 3. 2: Y.SPOT Innovation Center at CEA in Labège, Occitanie.



THE TOTEM BUILDING AT CEA

The TOTEM building at CEA Occitanie houses the Y.SPOT innovation hub, with the ideation center (Centrifugeuse), a fabrication and prototyping lab (Façonnerie), and a technology showroom for the demonstration of CEA technologies and expertise.

Accompaniment also creates opportunities for project development and value realization. Informants consistently shared that tailored support, such as offering expert consultation or facilitating partnerships, enables firms to accelerate innovation processes. This was particularly beneficial for resource-constrained organizations:

“CEA designed tailored services to interact with clients, offering them key support in the form of external expertise.” (Field notes)

Beyond technical support, accompaniment often includes navigating institutional complexity, such as accessing public funding or complying with regulatory requirements. From this perspective, accompaniment is not a passive service offering, but a strategic process that allows CEA sense how to align its assets with market opportunities and co-create value through embedded engagement processes. Accompaniment thus emerged as a core component of CEA’s sensing capability. It enables CEA to identify and deploy its expertise, reconfigure resources, and establish pathways for capturing collaborative value, particularly when working with resourced-constrained partners.

3.3.1.2. Technology demonstration and expert support as seizing capability

Technology demonstrations and expert support represent a critical dimension of CEA’s approach to value capture from collaboration. These activities reflect the CEA’s seizing capabilities, allowing internal actors to translate conceptual knowledge into tangible outputs that resonate with both clients and stakeholders. By demonstrating proof-of-concept (POC) technologies and offering expert guidance, CEA facilitates the alignment of its scientific assets with industry-specific applications, thereby fostering trust, credibility, and willingness to collaborate and invest (Gillier & Schweitzer, 2021). Technology demonstrations served both as validation tools and a communication process. They materialize technological potential and reduce uncertainty for clients, especially SMEs, who are often hesitant to invest in emerging and untested solutions. As one informant explained:

“We create demos that help companies find investors or transfer technology to industry.” (Informant 26)

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These demonstrations are not merely technical showcases; they represent a strategic process for engagement and knowledge transfer. Informants described how POCs and prototypes were deployed to attract funding, initiate new partnerships, and promote the industrial appreciation of CEA technologies. Informant 21 noted that the purpose of these demonstrations and POCs is to:

“Generate demos and think about new products for the industry or laboratories.”

Expert support plays a complementary role in technology demonstrations by embedding CEA personnel into collaborative innovation processes. This includes guiding client firms through prototyping, designing market scopes, and iterative product design. Informant 20 described this interplay between technical expertise and accelerated innovation stating:

“Our role is to accelerate innovation processes by quickly moving from concepts to demonstrators.”

This ability to mobilize internal knowledge and adapt existing technologies to new industry contexts is characteristic of effectively seizing emerging opportunities and technological inspiration. For example, one team adapted micro-needle technologies, originally developed for biomedical purposes, to address new use cases in ophthalmology:

“We adapted our micro-needle technologies to explore their applicability for myopia treatment.” (Informant 10)

These activities reflect both the flexibility of CEA’s technical expertise and its ability to pivot research toward emergent market needs. Thus, our findings reveal that technology demonstration and expert support function as strategic enablers of value capture, reinforcing CEA’s position as a responsive and trusted innovation partner. These practices contribute to CEA’s seizing capabilities by mobilizing internal competencies, validating solutions through prototyping, and building relational capital with client organizations. When combined with accompaniment as a prospecting process, they form a cohesive framework for operationalizing innovation and translating it into shared value.

3.3.1.3. Market and technology exploration activities: Linking sensing and seizing capabilities

Market and technology exploration plays a pivotal role in bridging CEA's internal knowledge with external innovation needs. This practice encompasses the systematic integration of technical and market insights to assess the commercial relevance of emerging technologies. The practice activates both *sensing capabilities*, by identifying latent and emerging demand, and *seizing capabilities*, through the alignment of organizational competencies with specific market opportunities. Through exploratory engagements with clients, CEA seeks to uncover unmet needs, assess the viability of applying its technologies across sectors, and guide innovation strategy development. These activities are typically facilitated through co-conception workshops, iterative ideation sessions, and stakeholder consultations. One informant described this phase as an effort to help clients articulate and communicate concealed needs that can be translated into technology-driven solutions:

"How to get people to express a need... which may eventually be expressed in a technological need, product, or even service." (Informant 25)

Such iterative exploration enhances CEA's ability to tailor solutions and support early-stage innovation, particularly for SMEs with limited foresight and strategic planning capacity. The process often begins with market scanning and opportunity mapping, as Informant 6 noted:

"The goal was to see what type of market the client could address based on their skills and technology."

This alignment of client capabilities with viable market segments reflects a proactive effort to co-create innovation trajectories that are both technically sound and commercially promising. Similarly, CEA conducts internal reviews of its own technological portfolio to determine strategic fit and potential adaptation. Informants described how bibliographic analyses and feasibility assessments were used to match existing technologies with industry problems. For example, Informant 9 shared:

"We carried out an analysis of separative chemistry processes to see how we could add value to our client's products."

By embedding structured exploration methods into client interactions, CEA facilitates knowledge inflow and outflow. Clients gain insight into the practical application of new technologies, while CEA builds a

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deeper understanding of evolving industry demands and application contexts. This exchange informs both the development of new offerings and the refinement of existing technological assets. Importantly, this “exploratory” phase lays the groundwork for future demonstrations, partnerships, and funding strategies. It helps to translate sensing into seizing, by moving from need identification to solution development. These eventually lead to project structuring and resource mobilization. Our findings hence reveal that market and technology exploration serve as a critical link between CEA’s external exploration activities (sensing) and its resource deployment (seizing). By facilitating mutual learning and co-creation, this practice enhances CEA’s ability to adapt its offerings to real-world market conditions. Thus, strengthening CEA’s strategic positioning in the innovation ecosystems it serves.

3.3.1.4. Funding search as a seizing capability

Securing funding emerged as an important enabler in CEA’s strategy to support collaborative innovation and capture value from its engagements, especially with resource-constrained firms such as SMEs. Through prospecting by Y.SPOT, CEA acts as both a facilitator and a strategic intermediary, connecting clients with public and private funding sources while simultaneously sustaining its own innovation support operations. This dual role reflects an “advanced” seizing capability, wherein proactive search for funding serves to mobilize external resources that can be used to co-develop, advance, and institutionalize innovation outcomes. The funding search process is embedded within broader prospection and collaboration practices. Informants emphasized that funding availability often determines the feasibility and scope of innovation projects. For instance, one senior informant explained:

“Regional branches must find technological solutions for SMEs, using local and national funds.” (Informant 27)

Through this intermediary role, CEA helps clients navigate complex funding systems, including regional, national, and European sources, and supports them in building feasible value propositions. Technology demonstrations and POCs often serve as leveraging tools to secure investment and grants. As Informant 26 noted:

“This demonstration will help secure funding and investors for technology transfer.”

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By combining technical validation with funding search strategies, CEA improves the attractiveness of collaborative projects, thereby enhancing both impact and sustainability for innovations. In some cases, CEA's support for funding search led to the formation of consortia involving multiple external stakeholders. This strengthens the CEA's network positioning and its ability to coordinate large-scale innovation initiatives. Informant 24 shared:

"We have developed collaborative hubs that are funded... with partners like HP and Renault."

Such partnerships enable risk-sharing and reinforce CEA's visibility as a trusted orchestrator of collaborative innovation. Additionally, these collaborations deepen relational ties that support long-term value generation for both CEA and its partners. The search for funding also serves a strategic internal purpose. It allows CEA to capture and reinvest value, sustaining its operations while expanding its relevance across sectors and regions. This capability is especially crucial in contexts where SMEs may be unable to co-finance innovation projects independently. Informant 9 emphasized:

"CEA's support included identifying potential innovations that could make the client's product more attractive to investors."

Thus, CEA's ability to identify funding opportunities, and align them with both client needs and its own technological offerings, is central to its capacity to seize value from collaborations. From this understanding, search for funding is not simply a transactional activity but a strategic enabler of innovation. Finally, the practice of funding search as part of the prospecting processes reinforces the interconnectedness of accompaniment, demonstration, and market and technology exploration. The visibility and credibility provided by early-stage demonstration, combined with the tailored support offered through accompaniment, create a compelling platform for securing funds. In contrast, access to funding increases the scope and ambition of CEA's collaborative engagements, supporting sustained technological development and value capture. The findings thus further reveal that funding search is an integral part of CEA's seizing capability. It enables CEA to unlock value from collaborative innovation by securing financial resources, reducing client-related constraints, and reinforcing the institutional viability of its regional innovation missions.

3.3.2. Feedbacking as a transforming capability

While prospecting initiates external engagement, feedbacking serves as a recursive, internal loop that transforms stakeholder input into actionable knowledge and strategy. We define feedbacking as the structured process through which CEA gathers, analyzes, and integrates feedback from partners and priori collaboration to refine its innovation processes and service offerings. Feedbacking at CEA is carried out by Y.SPOT and comprises four main stages: (1) acknowledging and collecting information on client needs; (2) analyzing them as inputs to generate insights; (3) developing and executing findings; and (4) informing internal stakeholders at CEA. This process enables iterative learning and supports the transformation of organizational routines. For example, Informant 17 described that the collection and analysis of information as inputs starts from:

“The need expressed by the firms... We begin by interviewing the client to understand their problem and what they think the solution could be...to put them in touch with CEA.”

This first step sets the foundation for capturing context-specific information by codifying client needs into a single, formalized, document. CEA (through Y. SPOT) use this step to acknowledge and seek an understanding of client perspectives, needs, and perceived solutions before proposing a roadmap for translating these needs into technological and innovation inputs. This helps ensure that CEA acknowledges misalignments between ecosystem needs and dynamics emerging from within its own internal structures. This prompts discussions to tailor subsequent support activities in a relevant way. Additionally, Informant 20 explained how feedbacking relies on internal analysis, stating that they:

“Did a lot of bibliographical work to see what already existed and to understand what we could bring to the table with our technologies”

Informant 17 described the exploration and analysis of client needs and perspectives as the key to:

“Translate business issues into a concrete technical roadmap, that’s where the insights happen.”

This emphasizes how insights emerge not from technology alone, but from the process of translating abstract business goals into actionable roadmaps. This first step emerged as a core function of Y.SPOT’s methodology within CEA, discussing and generating actionable insights by re-exploring client inputs in-house. Informant 49 describes this, stating:

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“We needed input from industry experts to understand how Idrop should work in practice.”

By this, CEA transforms experiences and knowledge from previous and ongoing collaborations into a learning and adapting processes. For instance, after identifying a promising use case scenario in the medical sector, project managers shared the findings with the relevant technical teams at CEA to evaluate whether the labs had the right expertise and interest to support the project’s development. According to Informant 45

“We presented the results of the workshops to the lab heads to get their feedbacks before moving forward.”

This reflects developing and acting on findings by informing internal stakeholders to advance the alignment and transformation of internal processes in response to the findings. From this perspective, Y.SPOT plays a role as a strategic intermediary, aligning business opportunities with appropriate R&D capabilities within CEA. This informs future prospecting and enhances iterative learning, strengthens ecosystem fit, and supports long-term adaptation. According to Informant 20:

“Once we identified the use case, we briefed the relevant CEA labs so they could assess their involvement.”

Similarly, Informant 17 revealed how developing findings, sharing them with internal stakeholders at CEA, and facilitating them to act on it promotes alignment of internal processes with the needs of clients and the ecosystem:

“CEA units were updated at every milestone so they could align their work with what the industry partner expected.”

These activities exemplify how CEA transforms unstructured input into codified knowledge that informs both current and future projects. This final phase of informing stakeholders of findings and recommendations helps to close the feedback loop, reinforcing trust and co-ownership of outcomes. Yet, despite the potential of feedbacking as a transformative process, we observed that CEA currently lacks a formal managerial structure to consistently receive and integrate such feedback into its organizational routines and innovation processes. This gap limits the full realization of feedbacking’s potential to drive adaptive change.

3.3.3. Prospecting and Feedbacking: An iterative process for dynamic capability development

Our findings reveal that prospecting and feedbacking are not isolated practices. Taken together, they form an integrated, and mutually reinforcing, process through which CEA continuously generates and appropriates value. Deployed concurrently, they constitute an iterative capability-building cycle that enables CEA to adapt to changing client needs, regional contexts, and technological frontiers. The interdependence between these practices is vital to the development of dynamic capabilities, as it fosters continuous sensing, agile seizing, and strategic transformation across collaborative engagements. Prospecting provides the foundation for opportunity recognition by allowing CEA to identify potential partners, assess market signals, and align technological offers with emerging needs.

Feedbacking, however, closes the cycle by capturing, analyzing, and integrating insights derived from these interactions. This cycle enables CEA to refine routines, service offerings, and innovation practices. Prospecting and feedbacking form a recurrent cycle. Thus, information gathered through prospecting informs project design and execution, while insights generated through feedbacking refine future prospecting strategies. This synergy is particularly evident in the evolution of projects involving SMEs. For instance, early-stage ideation workshops and technology demonstrations initiated by prospecting often expose unmet and poorly articulated needs. These needs are subsequently clarified and codified during feedbacking, which generates actionable points for clients and CEA.

The expression of such needs mostly served as a gateway to developing tailored solutions, validating technologies, and identifying funding pathways. At each stage, feedbacking sharpens the focus and relevance of ongoing and future collaborations, turning one project's insights into inputs for the next. Moreover, the interplay between prospecting and feedbacking enhances learning, agility, and cumulative knowledge development. As insights from collaborative projects are analyzed and codified, they contribute to a growing internal repository of contextualized knowledge. This facilitates organizational learning, informing CEA's future engagements and improving its capacity to navigate the complexities of innovation ecosystems. Informant 4 described the integration of prospecting and feedbacking, saying:

“Through these discussions, we establish technical use cases to meet the needs identified.”

The effectiveness of this cycle, however, depends on the presence of internal structures capable of receiving and acting on feedback. While Y.SPOT provides a promising framework for external engagement, our findings suggest that CEA has yet to fully develop internal processes for processing and integrating feedback into its strategic and innovation processes. Without such structures, feedback risks remaining sporadic and disconnected from long-term organizational learning and transformation.

In essence, the interplay between prospecting and feedbacking enables CEA to dynamically align its technological assets with client needs, co-create innovation pathways, and adapt internal practices. This repeated process represents how dynamic capabilities are developed through recurrent engagement, organizational learning, and feedback-informed reconfiguration. It is through this cycle that CEA strengthens its position as a trusted innovation intermediary and sustains relevance across diverse and evolving innovation ecosystems

3.3.4. Organizational challenges and the need for integration

CEA has developed a promising process of prospecting and feedbacking to enhance its value appropriation capabilities in collaborative innovation. However, our findings reveal key challenges that limit the broader institutionalization of these capabilities. First, the disconnect between departments and regional sites restricts internal learning and the flow of insights gained from collaboration. While Y.SPOT serves as a hub for exploration, CEA lacks formal mechanisms for capturing and integrating feedback into strategic decision-making. As a result, lessons learned at the project level often remained localized, limiting the development of organization-wide dynamic capabilities.

This is particularly problematic when successful approaches cannot be adapted across different regions and ecosystems. A second challenge stems from the tension arising between standardized and contextual responsiveness. CEA's centralized mandates require consistency and scientific rigor, yet its regional operations require flexibility and adaptation to serve diverse local innovation ecosystems. Informants noted that regional teams face constraints in tailoring engagement strategies, limiting the effectiveness of initiatives like prospecting and feedbacking in underserved areas.

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Additionally, the absence of structured feedback loops between exploration and strategic planning constrains CEA's ability to transform, despite strong evidence of sensing and seizing activities. Without more interdepartmental integration and formalized organizational learning, dynamic capabilities may remain unconsolidated, hindering CEA's potential to evolve, respond to ecosystem-specific needs, and deliver on its broader innovation mission. Table 3.3 below presents a mapping of prospecting and feedbacking practices onto the dimensions of the dynamic capability framework: sensing, seizing, and transforming (Teece, 2007).

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Table 3. 3: Mapping CEA's value appropriation process to dynamic capabilities dimensions

Practice	Description	Dynamic capability dimension	Function in CEA value appropriation process
<i>Prospecting as both sensing & seizing capability</i>			
<i>Accompaniment</i>	Structured support guiding clients from idea articulation to project development. Scanning & identifying opportunities through stakeholder engagement & ideation platforms.	<i>Sensing (can sometimes be used simultaneously as seizing)</i>	Identify potential partners, uncovers latent needs, & aligns with future market trends Mobilize internal resources to co-develop tailored solutions, especially for SMEs
<i>Market & technology exploration activities</i>	Joint exploration of technological feasibility & market relevance with external actors	<i>Sensing (sometimes links sensing to seizing)</i>	Match CEA capabilities with client ambitions & defines early-stage innovation pathways
<i>Technology demonstration & expert support</i>	Use of prototypes, POCs, & embedded expertise to reduce uncertainty & validate solutions	<i>Seizing</i>	Builds trust, communicates value, & facilitates project initiation & funding leverage
<i>Funding search facilitation</i>	<i>Identification & alignment of public/private funding with project goals</i>	<i>Seizing</i>	Secure resources to launch/scale innovation projects & supports collaboration
<i>Feedbacking as a transforming capability</i>			
<i>Acknowledge & collecting information</i>	Setting the foundation & capturing contextual information by codifying client needs into a single, formalized, document	<i>Transforming (Often linking seizing to transforming)</i>	Identify & acknowledge experiences (challenges, needs, misalignments, etc.)
<i>Explore & analyze information</i>	Discussing & generating actionable insights by re-exploring client inputs (from prospecting) in-house	<i>Transforming</i>	Convert experiential knowledge into adaptive learning
<i>Develop & execute findings</i>	Validating & translating insights into shared language to be understood by internal stakeholders	<i>Transforming</i>	Inform future prospecting and design
<i>Inform stakeholders</i>	Reintegration of insights from prospecting & findings into organizational processes by internal stakeholders with support from prospecting project managers (i.e., business developers)	<i>Transforming</i>	Enhance iterative learning, strengthens ecosystem fit, & supports long-term adaptation

3.4. DISCUSSION

Our study examined how RTOs adapt and position themselves to capture value through collaborative innovation using the case of CEA, a leading public European RTO in France. By adopting the dynamic capabilities framework, we identified and analyzed a set of intermediary processes, prospecting and feedbacking, that enable an RTO to sense opportunities, seize them strategically, and gradually transform its internal innovation processes. Our findings contribute to the growing literature on dynamic capabilities and value appropriation by demonstrating how these capabilities are enacted and co-evolve within the context of an RTO embedded in a complex regional innovation ecosystem.

3.4.1. From capability to configuration: Understanding value appropriation processes in RTOs

While prior research emphasizes the importance of dynamic capabilities in enabling innovation and organizational adaptation (Teece, 2007; Eisenhardt & Martin, 2017), few studies have unpacked how these capabilities are translated into actual processes for value appropriation within hybrid (publicly/privately funded) RTOs. Our study addresses this gap by showing that an RTO's collaborative practices are not only knowledge transfer processes as often alluded to in RTO literature (Arnold et al., 2010; Leitner, 2005) but are strategically configured processes that enable value generation and appropriation. These processes, i.e., prospecting and feedbacking, play a dual role by *allowing an RTO to sense and interpret the needs of diverse actors, especially SMEs, and enabling an RTO to appropriate value from these interactions.*

Value in this sense takes the form of revenue from services provided, strategic learning, improved legitimacy, and expanded influence in the regional innovation ecosystem. For example, prospecting, typically understood as “boundary-spanning” or “matchmaking” (De Silva et al., 2018; Albors-Garrigós et al., 2014), in the case of CEA emerges as a capability-intensive sensing practice. Thus, to be carried out effectively, these practices require and rely heavily on a deep set of organizational capabilities: i.e., technical expertise, stakeholder understanding, collaborative experience, and problem-solving skills.

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These capabilities hence require more than just the traditional notion of “matchmaking” to involve some degree of cognitive, relational, and organizational capabilities that is not fully elaborated in our study but deserves further investigations. Therefore, prospecting in this sense is not just procedural or transactional, it depends on and contributes to dynamic capabilities like sensing and seizing. Prospecting helps align an RTO’s latent technological offerings with emerging industrial needs, positioning the RTO to appropriate part of the resulting value from such alignments.

Technology demonstrations and funding search facilitation represent more than support services. These are seizing strategies that help transform sensed opportunities into structured collaborations, through which an RTO can appropriate value, be it through collaborative projects, IP licensing, or privileged access to industrial knowledge (Giannopoulou et al., 2019; Lichtenthaler & Ernst, 2008). This perspective moves beyond the narrow categorization of RTOs as passive knowledge and technology brokers (Barge-Gil & Modrego, 2011; Arnold et al., 2010) and align with studies emphasizing RTOs as “super-intermediaries” (Sheikheldin, 2021) and potential architects of ecosystems (Agogu   et al., 2013).

From this understanding, value appropriation is not a downstream activity to be pursued post-innovation, but an integrated part of the organizational capability system. Our findings also complement and extend the concept of “generative appropriability” (Ahuja et al., 2013), which suggests that the ability to appropriate value from current innovations can spark new innovations and build further capabilities. In our in-depth case analysis, strategic funding search and feedbacking reflect precisely this recursive dynamic. Appropriation enables learning, which in turn strengthens the RTO’s ability to sense and seize future opportunities. This interrelationship contrasts with static views of appropriation as a protective or defensive process (Reitzig & Puranam, 2009; Teece, 1986).

Importantly, our study supports recent work by Cabral et al. (2019) and Van den Oever and Martin (2019). They emphasize that value appropriation in public and nonprofit organizations must be understood in broader terms, beyond monetary outcomes, to encompass reputational, strategic, and ecosystem-level benefits. For RTOs, whose legitimacy and funding depend in part on demonstrating relevance to public policy goals and industrial competitiveness, these non-financial values are crucial to sustain their central role as intermediaries (Giannopoulou et al., 2019; D      & Garrig     , 2017). By these

revelations, our study repositions value appropriation within RTOs as a capability-driven, co-constructed, and multi-dimensional process.

Thus, value appropriation is enabled by and enabling of dynamic capabilities, supporting continuous engagement, organizational transformation, and ecosystem alignment rather than just a straightforward by-product of collaborative innovation. By identifying the specific practices through which these capabilities are configured and enacted, we provide a grounded understanding of how RTOs generate and capture value, contributing to advancing the theory of dynamic capabilities and the evolving literature on RTOs.

3.4.2. Iterative capability development in RTO context

A key takeaway from our study is that dynamic capabilities in RTOs do not exist everywhere in the organization the same way. Instead, they are built gradually over time through hands-on experience, learning from previous engagements, and ongoing collaboration with external partners. This finding resonates with broader literature on the core elements of dynamic capabilities (Cepeda & Vera, 2007; Teece, 2007). It sheds new light on how public research organizations like RTOs, operating under hybrid institutional logics, gradually build their sensing, seizing, and transforming capabilities. In our case study, dynamic capabilities are not evenly embedded across the organization but are localized in specific departments, particularly those interfacing directly with regional innovation ecosystems.

More importantly, prospecting and feedbacking represent two sides of a dynamic learning process. The former engages with external opportunities and market needs, while the latter internalizes stakeholder insights and project outcomes to inform future practices. This feedback-informed adjustment process reveals that the interaction between sensing and transforming is not linear. These capabilities are often interdependent and recursive, with each cycle of collaboration refining the RTO's ability to act more strategically in subsequent collaborations. For instance, lessons from collaborative projects and funding search experiences are often used to shape the design of future partnerships, creating a path-dependent pattern of capability maturation (Gillier & Schweitzer, 2021). This dynamic

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is particularly pronounced in regional outreach programs, where RTOs must navigate diverse stakeholder interests, shifting policy agendas, and asymmetric knowledge levels.

As studies by Díaz and Garrigós (2017) and Knockaert et al. (2014) have suggested, the ability of RTOs to maintain relevance across such contexts requires not just technical expertise but adaptive processes and relational capabilities. Our data supports this claim, illustrating how RTO teams in innovation ecosystems engage in iterative project structuring, problem reframing, and opportunity recognition activities that are inherently dynamic in nature and often catalyze deep organizational learning. Simultaneously, we observe that while sensing and seizing capabilities are relatively well developed, the transforming capability remains unformalized. Thus, while frontline managers and regional innovation platforms demonstrate high responsiveness and creativity, there is a lack of formalized structures to consolidate and advance them internally.

Our findings also suggest that while RTOs are more active in exploration at the project level, they often face challenges in translating localized learnings into organizational-wide practices and strategic capability transformation. This disconnection limits the potential for advancing innovation practices across regional sites and embedding them into organizational learning processes. Indeed, the capacity to transform, defined by Teece (2007) as the ability to reconfigure and integrate new competences, is particularly demanding in RTOs. They must balance established processes, centralized mandates, and a growing need for local responsiveness (Bandarian, 2018; Intarakumnerd & Goto, 2018).

In our case, this tension manifests as a disconnect between innovation practices and organizational strategy, where successful micro-level exploration struggles to influence organizational-wide priorities and resource allocation. Our findings therefore support a more nuanced view of dynamic capability development in RTOs: one that emphasizes experiential accumulation, situated and organizational learning, but recognizes the structural barriers that limit the formalization of such capabilities. This perspective complements recent studies on RTOs as innovation intermediaries (Uribe-Echeberria et al., 2019; Agogué et al., 2013). These studies illustrate that RTOs engage in continuous learning and adaptation through multi-actor coordination and absorption of external knowledge.

This positions RTOs as adaptive actors in ecosystems capable of responding to shifting technological landscapes, but only to the extent that their internal governance allows for reflexivity, integration, and organizational transformation. Our findings therefore reveal that while an RTO can demonstrate considerable success in deploying dynamic capabilities through collaboration, its experience also reveals the vulnerabilities that shape capability development in public research organizations. These insights invite further inquiry into how RTOs can better link micro-level adaptation with meso-level coordination and macro-level strategy; a challenge that remains central to their future relevance and resilience in innovation ecosystems.

3.4.3. Organizational and integration challenges

Our study demonstrates that an RTO can possess significant potential to develop and deploy dynamic capabilities but also reveals the organizational constraints that limit their full realization and impact. These constraints are not merely operational challenges but reflect deeper tensions in how public RTOs are structured, governed, and incentivized; particularly in mission-driven innovation ecosystems. One key constraint that we observed at CEA is how capability development is scattered across regional centers and project teams. Although processes like prospecting and feedbacking are actively employed in collaborative engagements at the different regional centers, they often remain localized and disconnected from broader strategic learning.

This fragmentation limits the potential for learning across regional centers and project teams as well as organizational-wide capability development. As reflected in literature, RTOs mostly struggle to achieve the organizational integration needed to advance innovation beyond the project level (Giannopoulou et al., 2019; Barge-Gil & Modrego, 2011). For instance, while Barge-Gil and Modrego (2011) highlight the need for structured organizational processes and relational capabilities to transform technical outputs into firm competitiveness, Giannopoulou et al. (2019) show that RTOs often emphasize service innovation over transformative change. This suggests an implicit challenge in advancing project insights across their organizational structure. Thus, the literature reveals that realizing broader, organization wide impact requires more than isolated exploration or learning.

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This issue is worsened by a lack of formal feedback processes between operational activities and strategic management. While frontline managers often display high levels of initiative, their insights are not systematically captured and disseminated through formal organizational channels. This leads to what can possibly be termed a “learning trap” where knowledge remains tacit, embedded in specific teams and regions, and thus unavailable for organizational transformation. This finding supports Zollo and Winter’s (2002) argument that while organizations accumulate valuable learning through experience, this learning often remains tacit and localized. Thus, they often reside with individual teams or centers unless deliberate efforts are made to codify and integrate insights across the organization. For dynamic capability, this limits internal transformation and the promotion of organizational-wide learning.

Such limitations hinder the development of transforming capabilities, the capacity to reconfigure internal assets, policies, and structures in response to environmental change (Teece, 2007). A second organizational constraint is the tension between centralization and localization. A national, publicly funded RTO must balance the need for unified strategic direction with the flexibility required to respond to regional stakeholder demands. This dual pressure creates governance frictions, where regional teams are tasked with ecosystem engagement but often lack the autonomy to adapt tools, processes, and incentives to local contexts (Intarakumnerd & Goto, 2018; Díaz & Garrigós, 2017). These frictions can affect the effectiveness of frontline processes and restrict rapid adaptation, particularly when organizational processes are highly institutionalized.

Moreover, our findings suggest that an RTO’s value appropriation efforts, while often effective at the micro-level (e.g., through collaboratively owned demonstrations and POCs, funding acquisition, partner retention, etc.), are yet to be grounded by a formalized appropriation process. As Reitzig and Puranam (2009) argue, value appropriation is not simply the result of good project execution. It is an organizational capability requiring deliberate investment in structures, processes, and governance frameworks. At present, CEA appears to lack such overarching appropriation logic, which limits its ability to strategically link collaboration outcomes to long-term organizational objectives. These challenges are not unique to CEA.

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Uribe-Echeberria et al., (2019) highlighted that RTOs must carefully combine open innovation practices with robust internal management, especially around IP protection, to avoid risking their technological competencies. Moreover, Bandarian (2018) revealed that RTOs rely on strategic alignment and structured organizational processes to drive their operations. This suggests that RTOs traditionally operate in organizational settings that emphasize adherence to processes, governance structures, and technical excellence. However, these may inadvertently relegate entrepreneurial adaptation, and the development of broader organizational capabilities needed for strategic transformation. In such contexts, the development of dynamic capabilities requires not only bottom-up but also top-down alignment and support process. This includes coordination across centers and structures, learning platforms, and outcome-based evaluation metrics.

Finally, the absence of an integrated knowledge management system at CEA limits the organization's ability to codify and circulate experiences and knowledge gained through collaboration. While managers report high levels of informal learning and ad hoc knowledge sharing, there is little evidence of systematic efforts to transform this learning into collective knowledge despite its central role in the foundations of dynamic capabilities. We therefore share the view that, although CEA exhibits several promising practices for value generation and appropriation, their transformational potential is constrained by disconnected organizational structures, relatively misaligned governance processes, and weak organizational feedback systems. To move from localized innovation success to organizational-wide capability building, RTOs must invest in strategic integration processes that connect micro-level learning with meso- and macro-level organizational transformation.

3.5. THEORETICAL AND MANAGERIAL CONTRIBUTIONS

This study makes three interrelated contributions to the literature on RTOs. By investigating how a leading public RTO adapts and positions itself to appropriate value through collaborative innovation, we advance theoretical understanding of dynamic capabilities in non-market contexts, provide empirical insights into how value appropriation unfolds within RTOs, and offer practical recommendations for RTO managers and innovation policymakers.

3.5.1. Theoretical contributions

We extend the dynamic capabilities framework by unpacking how sensing, seizing, and transforming capabilities are enacted in practice through specific, embedded processes, namely: prospecting and feedbacking. While much of the extant literature conceptualizes dynamic capabilities at a high level of abstraction (Teece, 2007; Eisenhardt & Martin, 2017), our study provides a grounded, context-specific perspective on how these capabilities are configured, localized, and mobilized within a public RTO. Secondly, we contribute to the literature on value appropriation by reframing it as a capability-intensive process, instead of a downstream outcome. In contrast to traditional perspectives that consider appropriation as a function of IP protection and commercialization success (Reitzig & Puranam, 2009; Lichtenthaler, 2007), we show that appropriation is cocreated through collaboration, facilitated by the same capabilities that support value generation.

Moreover, our findings align with and extend recent work on generative appropriability (Ahuja et al., 2013; Alexy et al., 2013). We suggest that appropriation in itself can be a driver of innovation, learning, and capability development in “public research organizations” (Intarakumnerd & Goto, 2018). Additionally, we contribute to studies on RTO by advancing a more nuanced and dynamic understanding of their role in innovation ecosystems. While existing literature often categorizes RTOs as intermediaries and innovation support agencies (Giannopoulou et al., 2019; Arnold et al., 2010), we demonstrate that they are not only facilitators of knowledge exchange, technology transfer, and R&D, but also strategic partners that build and refine capabilities to shape the conditions for innovation and value capture. By investigating how these capabilities emerge and interact within CEA, we respond to recent calls to better theorize the strategic behaviors and internal evolution of RTOs (Sheikheldin, 2021; Uribe-Echeberria et al., 2019; Bandarian, 2018).

3.5.2. Empirical Contributions

Our study also offers rich process-level evidence of how capability development and value appropriation unfold in a real-world RTO context. The longitudinal observation approach, and the nature of our data (collected from multiple CEA centers across different regions) reveals both the underlying

process of capability development and the organizational barriers to their formalization. More specifically, we shed light on how feedback-informed learning, funding intermediation, and project-level adaptation contribute to capability development, even in the absence of integrated processes. Through this, we add depth to current knowledge on governance of innovation in public research organizations (De Silva et al., 2018; Intarakumnerd & Goto, 2018). Our case also brings into focus the tensions that arise when RTOs must simultaneously fulfill public mandates and engage regionally grounded innovation actors, especially in underserved and unconnected ecosystems. These empirical insights have relevance for scholars of innovation ecosystems, public-private partnerships, and open innovation.

3.5.3. Managerial and policy contributions

The findings of our study also offer actionable insights for RTO managers and regional innovation policymakers. For managers, we highlight the importance of investing in internal coordination and knowledge-sharing processes to convert localized learning into organization-wide capability development. The gaps that we observed in transformation activities at CEA suggest a need to formalized feedback processes and integrate frontline insights into strategy formulation. For policymakers, the study suggests that support for RTO expansion into underserved regions must go beyond funding and infrastructure.

It must also include processes to foster learning, dynamic exploration, and governance flexibility across regional centers and departments of the organization. In contexts where national priorities are being decentralized, RTOs must be empowered to co-design local solutions while maintaining strategic coherence. Finally, our study provides a framework that RTOs and public research institutes can use to assess and enhance their value appropriation strategies. By linking specific practices to dynamic capabilities, our framework helps organizations move from project-based knowledge and technology transfer to organizational-wide positioning and value appropriation.

3.6. CONCLUSION

Our study examined how public RTOs adapt and position themselves to capture value from collaborative innovation using the French RTO, CEA, as a case study. Drawing on the dynamic capabilities framework, the findings show that value appropriation is not merely a by-product of collaboration, but an intentional, capability-driven process embedded in organizational practices. Two interconnected processes, prospecting and feedbacking, were identified as central to activating CEA's dynamic capabilities. These processes enable CEA to sense innovation opportunities, seize them through structured engagement, and initiate internal transformation. The study makes three key contributions. First, it applies and extends dynamic capabilities theory to the underexplored context of public RTOs. Additionally, our study repositions value appropriation as a foundational element of capability development within public RTOs. Finally, the study shifts the RTO literature's focus from technology transfer toward the internal dynamics that shape how RTOs learn, evolve, and offer innovation support. Simultaneously, our study highlights persistent barriers including fragmented learning, rigid structures, and weak feedback loops, that constrain extensive organizational transformation. Addressing these challenges requires stronger internal coordination, adaptive governance, and strategic knowledge management, especially as RTOs expand into diverse innovation ecosystems.

3.7. FUTURE RESEARCH DIRECTIONS

We encourage future research to examine how different types of RTOs (varying by size, mission, governance, and ecosystems) develop, adapt, and formalize their capabilities to capture value. Comparative studies across RTOs and innovation ecosystems could shed light on the configurations that enable or limit the transition from localized project success to strategic capability development. We also see value in exploring how RTOs manage trade-offs between openness and appropriation, and how these decisions shape their long-term contribution to inclusive and sustainable innovation ecosystems. By offering a nuanced account of how RTOs co-create and appropriate value through dynamic capability deployment, our study provides both a conceptual foundation and a practical roadmap for rethinking the role of RTOs in contemporary innovation ecosystems.

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**CHAPTER 4 - FROM INTERMEDIARIES TO
ECOSYSTEM SHAPERS: THE ROLE OF RESEARCH
AND TECHNOLOGY ORGANIZATIONS IN
DIRECTING INNOVATION TRAJECTORIES (ESSAY
3)**

ABSTRACT

Purpose: This study explores how research and technology organizations (RTOs) can play an active role in shaping the direction of innovation ecosystems. It explores the contribution of France's leading RTO, CEA, through leveraging its exploratory innovation support program, *Opendive*, to guide small and medium-sized enterprises (SMEs) toward emerging technological and societal opportunities.

Research Design: The study is based on a qualitative longitudinal case study design that draws on four years of embedded participant observation, 51 semi-structured interviews, and internal project documents. This intensive and embedded data collection approach captured the formal and informal mechanisms through which *Opendive* coordinates SME engagement, problem definition, and innovation re-direction.

Findings: *Opendive* is an ecosystem orchestration tool that combines methodological scaffolding (e.g., design thinking, C-K theory) and relational brokerage that spans organizations and sectors. Such capabilities allow SMEs to reframe issues, explore adjacent markets, and align with broader societal goals. The study elaborates on the concepts of exploratory orchestration and collaborative orientation as new RTO intermediary capabilities and illustrates how directionality can be systematically embedded rather than dictated as a top-down policy mandate.

Practical Implications: The study offers practical insights to RTO managers and policy makers on how to design flexible, mission-oriented support programs for innovation that enable ecosystem alignment, cross-sector learning, and strategic exploration.

Originality: The study adds to innovation intermediation theory by reframing RTOs as institutional orchestrators, capable of knowledge transfer knowledge but more importantly shaping innovation ecosystem directionality through design, facilitation, and cross-sector collaboration.

4. INTRODUCTION

RTOs have long been positioned at the core of regional innovation ecosystems, acting as intermediaries between industry and public research institutions (Dalziel & Parjanen, 2011; Howells, 2006). However, growing evidence suggests that RTOs are undergoing a transformation, from technology service providers to proactive innovation ecosystems orchestrators (Zhang & Liu, 2024; Sheikheldin, 2021; Díaz & Garrigós, 2017). As organizations operating at the intersection of science, policy, and industry, RTOs are more equipped and better positioned to shape the direction and trajectory of innovation. Yet, literature continues to portray RTOs largely as innovation support service providers rather than strategic leaders capable of shaping innovation trajectories and ecosystems (Suominen et al., 2021; Giannopoulou et al., 2019; Bandarian, 2018; Albors-Garrigos et al., 2010; Arnold et al., 2010).

This view downplays the growing capacity of RTOs to influence the evolution of ecosystems through the design and implementation of targeted innovation support programs. More precisely, the instruments that RTOs use to shape innovation ecosystem directionality remain insufficiently investigated, both theoretically and empirically. Directionality refers to the capacity to steer innovation efforts towards collectively defined societal goals (Parks, 2022). Thus, how RTOs promote innovations that “contribute to a particular direction of transformative change” in alignment with societal goals, instead of promoting all innovations as inherently desirable (Weber & Rohracher, 2012; p. 1042) requires an in-depth examination.

This is particularly relevant in the context of small and medium-sized enterprises (SMEs) as they often engage RTOs for R&D and technical problem-solving, while they rarely perceive RTOs as leaders of innovation ecosystems (Siegel et al., 2023; Goduscheit & Knudsen, 2015). As such ecosystems become more distributed, mission-oriented, and involving multiple actors, a deeper understanding is required of how RTOs mobilize their assets to steer innovation towards strategic directions. This study addresses this gap by exploring how RTOs shape innovation trajectories through their innovation support programs.

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To achieve this objective, I draw on a qualitative case study of the French Alternative Energies and Atomic Energy Commission (CEA), particularly its *Opendive* initiative. The *Opendive* initiative is an exploratory innovation support program designed, in the aftermath of the COVID-19 crisis, to help SMEs diversify beyond traditional sectors such as aerospace. Since its inception, *Opendive* has evolved into a methodological and collaborative platform through which CEA actively reconfigures innovation pathways, catalyze cross-sector innovation, and aligns ecosystem activity with its internal R&D capabilities and mission-driven objectives.

Thus, instead of investigating *Opendive* as a traditional RTO support program, this study conceptualizes the initiative as a strategic orchestration instrument. Through this, *Opendive* emerges as an initiative through which CEA transcends its traditional role to not only promote upstream exploratory innovation for SMEs but to steer innovation trajectories toward emerging socio-technical opportunities. By adopting an embedded case study design, this study draws on interviews with stakeholders at CEA, SME partners, and innovation experts to examine the operational mechanisms, collaborative dynamics, and organizational logics that underpin *Opendive*. Thus, I analyze how *Opendive* operates as a boundary-spanning program, connecting SME needs with organizational capabilities and leveraging methodological neutrality to stimulate ecosystem-wide realignment.

I draw on the findings of this study to make three key contributions. First, the study contributes to the literature on innovation intermediaries by demonstrating how RTOs can move beyond brokerage and innovation support functions to shape ecosystem directionality. Moreover, it offers empirical insights into how RTOs enable upstream SME engagement and strategic diversification. Finally, this study provides practical implications for RTO managers, ecosystem builders, and policymakers seeking to design innovation programs that not only support but actively steer innovation trajectories. By unpacking the orchestration logic of *Opendive*, this study advances our understanding of how RTOs can act as agents of directionality in increasingly complex and mission-oriented innovation ecosystems.

4.1. LITERATURE REVIEW

4.1.1. RTOs as strategic actors in innovation ecosystems

RTOs are traditionally conceptualized as intermediaries that facilitate the transfer of applied research to firms and other public sector actors (Charles & Ciampi Stancova, 2014; Howells, 2006). Through contract research, technical services, and R&D, RTOs help bridge the gap between scientific research and industrial application. However, this technical and transactional role is increasingly seen as insufficient in contemporary innovation ecosystems, which are characterized by complex networks, uncertain environmental conditions, and a diversity of actors. Recent studies have thus reframed RTOs as embedded, strategic, actors in innovation ecosystems capable of transferring knowledge but also shaping the very structure and direction of innovation (Khelfaoui & Bernier, 2023; Sheikheldin, 2021; Kuhlmann & Rip, 2018). From this understanding, RTOs are identified as “institutional entrepreneurs” (Khelfaoui & Bernier, 2023; Giannopoulou et al., 2019), capable of aligning technological development with broader societal missions. They are also capable of catalyzing ecosystem reconfiguration through the design and implementation of relevant infrastructures, innovation support programs, and relational activities.

4.1.2. From intermediation to orchestration

The evolution of RTOs reflects broader changes in intermediation logics. While intermediation was initially discussed primarily in terms of brokerage and knowledge transfer (Dalziel & Parjanen, 2011), recent studies have highlighted the need for intermediation that is not only strategic, but dynamic as well, what some scholars refer to as “orchestration” (Bergek et al., 2023; Zhang & Liu, 2023). The growing positioning and recognition of RTOs as hybrid organizations, that bridge scientific, public, and industrial logics (Gulbrandsen, 2011), enables them to facilitate collaboration across multiple actors and ecosystem-level alignment. Despite this potential, many RTOs continue to rely on supply-driven, technology-push strategies (Siegel et al., 2023; Barge-Gil & Modrego, 2011). The reliance on such strategies deepens their structural rigidity, limited methodological capacity, and narrow performance evaluation metrics (often focused on patents or licensing). This constrains their ability to support

upstream exploration, cross-sector collaboration, and co-creative innovation processes (Hall, 2022; Kuhlmann et al., 2019). Moreover, many RTOs lack the cultural and relational capabilities, such as trust-building, sensemaking, and user-oriented framing, essential for innovation under uncertainty (Giannopoulou et al., 2019; Goduscheit & Knudsen, 2015).

4.1.3. Directionality and ecosystem shaping

Directionality has emerged as a central concept in recent debates on innovation policy and innovation ecosystem design. It refers to the capacity to steer innovation efforts toward collectively defined societal goals, such as sustainability, resilience, or digital sovereignty, rather than leaving innovation pathways to evolve in an undirected, path-dependent fashion (Bergek et al., 2023; Mazzucato, 2018; Schot & Steinmueller, 2018; Weber & Rohracher, 2012). Innovation ecosystems are thus increasingly being recognized not as neutral and self-organizing, but as strategically co-constructed platforms shaped by organizations, norms, and support infrastructures (Borrás & Edquist, 2013).

From this understanding, RTOs are uniquely positioned to embed directionality in practice. Their dual role, as providers of scientific and technical expertise, and as boundary-spanners, allows them to configure partnerships, frame problems, and align actors around shared missions. Through the design of innovation programs, facilitation instruments, and collaborative methods (e.g., design thinking, foresight), RTOs can guide exploration toward preferred futures (Kuhlmann et al., 2019; Díaz & Garrigós, 2017).

Yet, while macro-level policy instruments for mission orientation are well documented, we know relatively little about how directionality is embedded at the level of innovation support programs enacted by RTOs. Particularly, how the practices and instruments that RTOs use to support innovation for firms embed directionality in SME innovation processes remain relatively unknown. This constitutes an important gap in the literature on both directionality and innovation intermediation.

4.1.4. Supporting SMEs through exploratory innovation

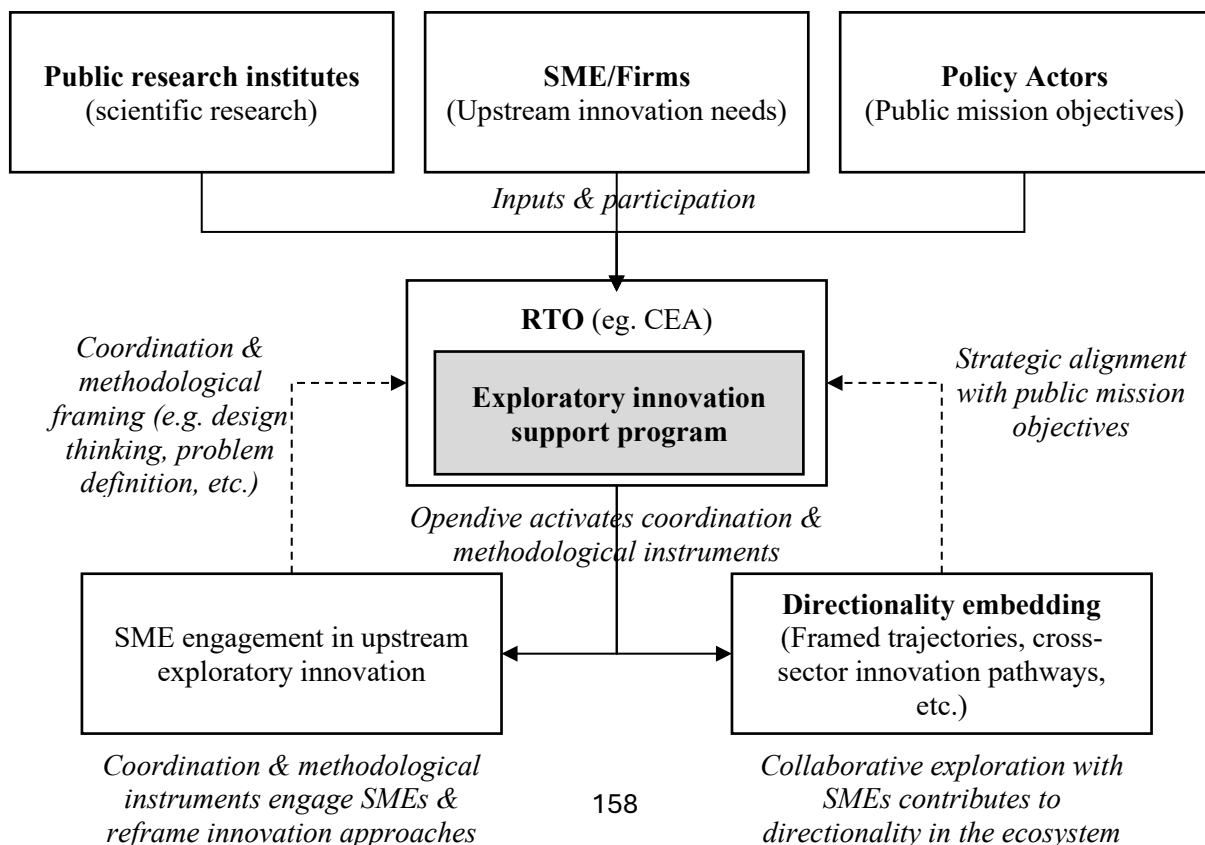
SMEs are vital to innovation ecosystems but face persistent barriers to innovation, often ranging from limited R&D capabilities to market uncertainties (Audretsch et al., 2012; Van de Vrande et al., 2009).

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As ecosystems become more complex and interdisciplinary, SMEs are increasingly relying on external actors, like RTOs, for technical services and innovation support. RTOs are well known for providing access to advanced infrastructure and scientific capabilities for these firms. However, recent studies highlight that RTOs play a more active role for SMEs, enabling them to reorient innovation strategies, expand their opportunity spaces, and engage in upstream exploratory innovation processes (Hilkenmeier et al., 2021; Tödtling & Kaufmann, 2002). Yet, empirical insights into how RTOs accomplish this, particularly through exploratory innovation support programs, remain limited.

I explore these gaps in the literature, contributing to three underexplored areas. First, I use this study to investigate exploratory innovation support programs, as a distinct form of RTO activity that supports the exploration of early-stage ambiguous innovation problems rather than downstream technology transfer activities. Additionally, I examine how directionality is embedded in practice, not through policy mandates, but through the design and implementation of innovation support programs, the configuration of innovation partnership, and the facilitation of relational activities. Finally, through this study, I expand the understanding of RTOs as orchestrators, and not merely technology brokers or service providers.

Figure 4. 1: A conceptual framework of RTOs as ecosystem orchestrators



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By analyzing how CEA leverages *Opendive* to reconfigure SME innovation trajectories, this study provides a grounded account of how RTOs can strategically influence and shape the evolution of the innovation ecosystems they serve. The study contributes to literature on innovation intermediation by integrating concepts of orchestration and directionality and offers practical insights for building next generation of innovation infrastructures that are purpose-driven, adaptive, and collaborative. *Figure 1* conceptually illustrates RTOs as more than innovation intermediaries (Sheikheldin, 2021), showing that they are active orchestrators that operate through innovation support programs (as will later be discussed). The trajectory of innovation ecosystems is shaped by the tools, relationships, and frameworks embedded in these programs. The framework also illustrates that directionality is not an abstract policy outcome but co-constructed through the design of such programs, SME engagement, and cross sector alignments.

4.2. METHOD OF STUDY

4.2.1. Research design

This study adopted a qualitative, longitudinal case study design to investigate how CEA leverages its exploratory innovation program, *Opendive*, to strategically shape the trajectory of innovations within its ecosystem. Innovation ecosystems are often made up of many different actors, changing objectives, and uncertain conditions. Using a case study approach was necessary to facilitate a deep and detailed investigation into how coordination and direction are achieved in practice (Yin, 2018). Thus, in this study, I focused on activities at the intersection of ecosystem orchestration, embedding directionality, and methodological intermediation. This focus supports a positioning of my case study as an opportunity for theory-building (Siggelkow, 2007).

4.2.2. Case Selection

I selected the case of CEA's *Opendive* due to its unique design as a neutral, exploratory innovation support platform that seeks to guide SME innovation beyond traditional sectors, which aligns with mission-oriented priorities. From January 2021 to January 2025, I engaged in a participant observation role embedded within Y. SPOT and the *Opendive* program. This internal-external positioning allowed me to observe in real-time, the organization and implementation of orchestration practices, stakeholder alignment, and the reframing of innovation trajectories (Bergek et al., 2023; Kuhlmann & Rip, 2018). The long-term access enabled me to monitor emerging routines, informal practices, and the development of shared direction. These perspectives would otherwise be obscured in retrospective accounts if collected through interviews. Observations were complemented by informal conversations, reflections from field notes, and real-time participation in design sessions, one-on-one meetings, and stakeholder workshops.

4.2.3. Data collection

I collected data through three data collection tools including interviews, confidential documents, and field observations. I draw on a total of 51 semi-structured interviews with informants from SME executives, CEA staff, *Opendive* project leads, and external innovation experts (see Table 4.1 for details). Out of these interviews, 12 were directly drawn from previous data analyzed for the first and second essays. These interviews, although did not form the primary data for analysis, gave insights into how *Opendive* was previously envisioned and how it is actually being implemented. This data played a vital role in the data collection strategy deployed. This data was complemented by 12 project documents, and a longitudinal analysis of observational, interviews, and documents gathered over my 3-year embedded participation at CEA. These internal materials and documents (such as workshop templates, project briefs, strategic roadmaps, and report documents) helped to track methodological framing and organizational learning processes. Over the 3-year period, I closely observed the everyday activities of *Opendive* from within, taking notes on how stakeholders worked together, made sense of problems, co-created shared understanding, and reached informal agreements. These multiple data collection

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approach enabled triangulation across diverse sources (Lincoln & Guba, 1985), strengthening the validity and depth of the study.

Table 4. 1: Informants characteristics

Infor.	No. Int.	Position	Exp. (yrs)	Direction
1	5	Director	11	CEA
2	2	Valorization officer	26	CHU Toulouse
3	1	Medical doctor	13	CHU Toulouse
4	1	Medical doctor	11	CHU Toulouse
5	2	Director	12	CEA
6	1	Innovation project manager	13	CEA
7	1	Innovation project manager	11	CEA
8	1	Designer	12	CEA
9	2	Designer	13	CEA
10	3	Innovation project manager	5	CEA
11	1	Business developer	10	CEA
12	1	Industrial director	6	Client Firm
13	1	Business developer	10	CEA
14	1	Directeur	14	Client Firm
15	1	CSO	11	Client Firm
16	1	CEO	8	Client Firm
17	1	CEO	21	Client Firm
18	1	CEO	20	Client Firm
19	1	CEO	16	Client Firm
20	1	CEO	20	Client Firm
21	1	Director	24	Client Firm
22	1	Business developer	21	CEA
23	1	Researcher	15	CEA
24	1	Innovation Project Manager	5	CEA
25	1	Business Developer	13	CEA
26	1	Platform Manager	10	CEA
27	1	Enterprise Creation Manager	15	SATT
28	1	Strategy specialist/Project Manager	5	CEA
29	1	Director of Innovation	25	ADOCC
30	1	COO/Academic Relationships Officer	26	SATT
31	1	Incubator Manager/University Professor	23	Mines Albi
32	1	Innovation Lab Manager	24	CEA
33	1	Project manager (medical devices)	18	CEA
34	1	Startup program manager	24	CEA
35	1	Researcher	6	CEA
36	1	Deputy director for innovation	20	CEA
37	1	Patent engineer/attorney	22	CEA
38	1	R&D technician at CEA	8	CEA
39	1	Scientific director	14	CEA
40	1	Ophthalmologist (Cataract surgeon)	15	CHU Toulouse
41	1	Professor of ophthalmology	14	CHU Toulouse

42	1	Innovation project manager	7	CHU Toulouse
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Tables 4.1 presents demographic information about interview informants (from CEA and external partners) who engaged Y. SPOT and Opendive for collaborative innovation.

4.2.4. Analytical approach

Data was analyzed thematically using both deductive and inductive coding strategies. Deductive codes were informed by core theoretical constructs such as ecosystem orchestration, directionality, intermediation, etc. Inductive coding, which involved allowing patterns to emerge directly from the data, promoted the identification of emerging patterns that ultimately helped to address the research question. Coding was performed iteratively using manual coding methods (Corbin & Strauss, 2014; 1990) and NVivo software coding process to triangulate information from both manual and NVivo codes. I organize the codes into four main analytical dimensions: exploratory orchestration, methodological intermediation practices, SME commitment and learning dynamics, and ecosystem alignment and directionality. Triangulation was performed within and across these dimensions, comparing insights from interviews, documents, and field observations, to ensure the maintenance of analytical coherence and empirical openness.

4.2.5. Limitations

My role as an external researcher, embedded at CEA, offered deep access to real-time data and evolving situations in collaborations. However, it also raised issues on the risk of bias through selective attention and interpretive framing. To address this issue, I employed the use of memoirs and peer debriefs with external researchers who were not directly embedded at CEA but offered supervisory guidance and undertook validation interviews with three senior CEA stakeholders involved in *Opendive* and Y. SPOT. This approach promoted crucial interrogation of my interpretations and the identification of the weaknesses of my methods.

Additionally, while a single case study design is often perceived as posing generalizability challenges, it provides the opportunity for analytical generalization. This was relevant for understanding how RTOs can reconfigure innovation ecosystems through embedded, exploratory, and relational practices

(Flyvbjerg, 2006) and hence offered a suitable method for responding to my research question. Taking together, my methodological approach to this study positioned it, as was the objective, to facilitate contributions to theory refinement in literature on innovation intermediation, ecosystem directionality, and the evolution of the role of RTOs in innovation ecosystems.

4.3. FINDINGS

In this study, I investigate how RTOs shape the direction of innovation ecosystems through innovation support programs. I use CEA's *Opendive* program, embedded within its Y. SPOT innovation platform in Occitanie, as a case study to explore this issue. My findings reveal that RTOs do more than just provide technological services, in fact, they act as ecosystem orchestrators by helping SMEs to reimagine innovation trajectories through structured exploration, cross-sector collaboration, and user-centered methodological design. *Opendive* was launched as an intervention program in response to the economic impact of the Covid19 pandemic, initially targeting firms in highly affected sectors like aerospace and aeronautics, and the healthcare sector. Nevertheless, it has evolved, since then, into a broader strategic innovation support program. The purpose of *Opendive* is to facilitate SMEs to pivot into new markets, expand their innovation potential, and build collaborative innovation pathways with researchers and designers at CEA and other innovation ecosystem actors.

4.3.1. Opendive as a strategic exploration program

Opendive enables SMEs to rethink their existing technological assets and identify new applications through structured yet open-ended exploration. This process is supported by innovation experts at Y. SPOT, who use tools like design thinking, foresight, and co-creation to help SMEs reframe their assumptions and engage in unfamiliar sectors. As one informant explained:

“A project whose mission is to help companies with their pivoting strategy, i.e. to develop or sell their products in sectors other than aeronautics.” (Infor. 21)

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For many SMEs, the *Opensive* program represented a fundamental shift from linear product development to strategic diversification. CEA's facilitation in this program helped firms step out of their comfort zones and explore the future value of their technologies.

"Thanks to innovation management techniques and Y. SPOT, which have given us this open-mindedness." (Infor. 21)

Unlike the traditional RTO approach of delivering predefined outputs, the *Opensive* program is both problem and opportunity driven. It allows participants to collaboratively define innovation pathways through iterative exploration. This includes redefining value proposition, exploring potential user needs, and identifying underexplored markets. One informant noted how *Opensive* helped reshape their vision:

"We could identify a new interest of a new position of this technology for a new market." (Infor. 11)

Opensive provided more than just structured workshops and tools, it connected SMEs with actors far beyond their existing networks. Through this program, firms accessed CEA's internal researchers, patent analysts, clinicians, and market specialists, enabling a broader systemic view of innovation.

"This project... required the participation of CEA, but also of other partners, especially in the medical field, which CEA also helped us to get to know." (Infor. 21)

In one case, this cross-sector collaboration led to a new spin-off:

"We were able to use all the spaces to brainstorm, then centralize our ideas... A start-up spin-off from the CEA" (Infor. 21)

These findings demonstrate that *Opensive* is not just a support program, it is a strategic lever through which CEA and Y. SPOT orchestrate ecosystem change by enabling SME-level reorientation. Through a flexible, exploratory, and partnership-driven design, *Opensive* facilitates a broader innovation logic centered on alignment, diversification, and directionality.

"We have narrowed down to four different themes... now they're working on a kind of business investigation to see the level of opportunity." (Infor. 18)

4.3.2. A platform for cross-sector collaboration

Opensive also functions, more than a support initiative, as a collaborative platform that brings together different actors, i.e., SMEs, CEA researchers, health experts, designers, market analysts, etc., within a

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semi-structured space. It operates through a multi-phase approach, which gradually guides participants from problem framing to potential R&D engagements.

“Three very distinct phases, the analysis phase, then stupefaction and research, then a slightly more structured phase that has been tried and tested..” (Infor. 17)

These phases are designed not just for project execution but for strategic alignment. They allow SMEs to bring forward application-oriented challenges while CEA experts and innovation facilitators scaffold exploration using structured methods. This dynamic is essential to CEA’s orchestration function.

“The good thing is that they are experts in many different trades... they also have a network of people they know, industrialists, centers of competence.” (Infor. 14)

The collaboration is not transactional, it is iterative, mediated, and co-constructive. CEA facilitators play a coordination role, ensuring that participants not only share expertise but also rethink their assumptions.

Some informants explained:

“How Y. SPOT with its new approaches could help health professionals to develop new projects, and different ways to develop this research.” (Infor. 2)

“We’ve really stepped out of our limiting zone of thinking, thanks to innovation management techniques and Y.SPO... several markets have emerged from 10 of these works.” (Infor. 21)

The collaborative structure of *Opendive* extends beyond bilateral partnerships into a temporary, project-based innovation ecosystem. Through collaborative projects, stakeholders co-develop future scenarios, validate use cases, and identify strategic openings.

“My purpose is to find good methodology to help organizations find new technology to implement inside their business model... We have several steps, and the objectives... are decision-making tools.” (Infor. 10)

From this approach, *Opendive* becomes an instrument of ecosystem orchestration, enabling CEA to connect actors but also guide them toward alignment with emerging societal needs and opportunities.

4.3.3. A methodological innovation mechanism

At the core of *Opendive*’s orchestration logic is its methodologically structured approach to exploration. CEA applies a tailored mix of design tools such as C-K theory, blue ocean strategy, user-centered design, etc., to scaffold decision-making and imagination.

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“Mostly I use C-K theory... to make a great distinction between what is unknown and what is known.” (Infor. 10)

This methodological logic is not coincidental; it is central to the program’s value. While SMEs may prefer aiming for immediate outcomes to address their uncertainty concerns, *Opendive* supports open-ended, structured exploration that treats uncertainty as a resource for learning and innovation.

“It’s really exploration, no quantified objective, a commitment, means more than a commitment to results... The objective is to really go after something we hadn’t imagined at all.” (Infor. 21)

This represents a shift from traditional “technology push” approaches to one where exploration itself is the outcome. By treating innovation as a cognitive and relational process, *Opendive* reframes the role of CEA from a service provider to a strategic sense-maker.

“We came with the questions and then they came with their past experiences. Doing additional primary research, helped to crystallize the thinking.” (Infor. 15)

The methods used in *Opendive* also function as boundary objects, shared tools that help diverse stakeholders (e.g., engineers, designers, clinicians) collaborate despite differences in language, approaches, and objectives.

“I have a core role of coordination between different expertise... from the organization, from the CEA, from designers.” (Infor. 10)

Through forecasting, value proposition development, and innovation workshops, *Opendive* generates alternative outcomes, in contrast to the often-predefined solutions that RTOs offer. The tools help participants map innovation trajectories and understand when and how to move into more formal R&D partnerships. Nevertheless, my findings also reveal a tension in the tradeoff between exploration and development. In some cases, innovation experts were removed once the project transitioned into formal R&D, potentially weakening the exploratory insights that should guide the R&D process.

“At the end of the exploration project, we are moving to an R&D project, led by the technological experts... The innovation experts are completely taken out of the project, it’s a shame.” (Infor. 1)

Yet, by embedding flexible, context-specific methods, *Opendive* becomes a cognitive instrument that enable SMEs and other stakeholders to explore emerging opportunities, redefine problems, and reframe markets. It is through this methodological orchestration that CEA subtly guides the directionality of the broader ecosystem.

“We have to always think about new ways of making stuff... I try to understand the main philosophy and infuse it inside my methodology.” (Infor. 10)

4.3.4. A neutral space for technology exploration

A defining feature of *Opendive* is its methodological neutrality. *Opendive* is intentionally designed as a space without predefined technological or sector-specific orientations. This neutrality gives participants cognitive space and safety to explore without fear of failure or misalignment with predefined deliverables.

“We are taking a step back., we are not trying to find a solution to a problem, but rather an idea. We are not trying to do R&D straight away.” (Infor. 10)

This flexibility allows CEA to serve as an orchestrator that is not tied to a specific technology, which helps decouple innovation from predefined applications. Instead, the program creates space for cross-sector exploration, enabling SMEs to see their technologies in new light.

“We are completely open in terms of the use of the technology... we don’t want to be specific to a single field... this was a very good way of giving us that flexibility.” (Infor. 19)

For RTOs traditionally embedded in sector-specific silos, this neutrality represents a new form of intermediation, one that does not push a technology, but opens space for new contextualization and positioning.

“This was an opportunity to show another kind of use of our technology... and that helps in convincing internally that there is another way of looking at the technology.” (Infor. 19)

This function also extends to reframing technological value. By allowing participants to decouple their technologies from familiar contexts, *Opendive* invites firms to reimagine what technologies can do, for whom, and in what kinds of futures.

“We came with the idea that we had a sensor... and we ended up with a medical device that helps people with a degenerative disease.” (Infor. 14)

4.3.5. Fostering SME commitment through adaptive engagement

While *Opendive* offers an important exploratory space, maintaining SME engagement throughout the program from inception to completion emerged a challenge. Informants noted that SMEs sometimes disengaged mid-process due to unclear expectations, ambiguous outcomes, and internal constraints.

“In some cases, we started with companies and then they stopped halfway through... They felt unsure how to continue or didn’t see immediate value.” (Infor. 4)

This highlights the tension between long-term exploration and short-term pressures of SMEs to find and deliver value in immediate markets. Many SMEs, constrained by limited resources, struggled to commit to open-ended processes without early-stage tangible returns.

“Exploration is good, but when you have a team of 15 people and a limited budget, you also need quick wins.” (Infor. 15)

CEA attempted to address this issue through structured milestones, such as “decision points” and tailored design sessions, which created a sense of progression and reduced ambiguity.

“We had clear phases... a roadmap that made the process easier to follow.” (Infor. 10)

Another challenge that arose in the program was maintaining coherence between the exploratory process and subsequent R&D execution. In some situations, innovation facilitators at CEA who had followed and guided firms in the program were removed too early as R&D phase took off. Consequently, the transition to technology teams reduced to the background and diluted earlier exploratory insights.

“The R&D teams who come in later don’t always understand the context we have built... the framing gets lost.” (Infor. 1)

These concerns reveal a significant tension in orchestration. Exploratory processes generate new logics of value and direction, but sustaining these logics requires continued collaboration, especially during transitions between exploratory and development phases. In response, CEA has experimented with simple activities such as follow-up sessions, fast-track workshops, and cross-team briefing templates, to preserve the exploratory logic across project phases.

“We are trying now to develop new models... shorter exploration sessions or hybrid formats that fit better with SME constraints.” (Infor. 4)

Taken together, my findings show that CEA’s *Opendive* program functions as a tool for shaping innovation trajectories within its ecosystem. The findings reveal that *Opendive* does not merely support

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SMEs through technical assistance or knowledge transfer as is often the goal of innovation support at CEA. Instead, the program operates as an orchestrated platform that enables the alignment of diverse actors, the co-construction of exploratory innovation pathways, and the reframing of technological opportunities beyond established sectors and boundaries. Through *Opendive*, CEA has created a collaborative infrastructure that fosters interaction across organizations and sectors. This infrastructure supports the emergence of cross-sector collaborations by enabling SMEs, researchers, designers, etc., to collaboratively explore potential opportunities, often outside their usual markets and application domains.

The methodological design of *Opendive*, which is centered on structured exploration rather than the conventional predefined deliverables RTOs embedded in innovation support offerings, plays a central role in this process. Innovation facilitators use tools such as design thinking and strategic foresight to coordinate and guide participants through different phases of the innovation process. An interesting understanding from the findings is the importance of *Opendive*'s neutrality. As *Opendive* was not tied to specific technologies, sectors, or markets, it offers a space where stakeholders can conceptually detach their technologies from familiar applications and reimagine their relevance in new contexts. This neutrality fosters imagination and cognitive flexibility, which are necessary for redirecting innovation trajectories. Similarly, *Opendive* must navigate the inherent tension between the open-ended nature of exploration and the more immediate concerns of SMEs, particularly those with limited resources. Efforts to maintain collaborations, through simplified follow-up activities and phased transitions, demonstrate how orchestration must be both adaptive and sensitive to ecosystem constraints.

In conclusion, RTOs traditionally offer direct solutions that are usually embedded in predefined technologies or objectives. However, CEA, through *Opendive*, supports a form of exploratory scaffolding that enables this RTO to act as both cognitive and organizational intermediaries, helping stakeholders to collectively construct meaning, coordinate direction, and shape the future of innovation ecosystems. Thus, *Opendive* illustrates how exploratory innovation support programs can serve as levers for ecosystem orchestration, providing RTOs with a new approach to embedding directionality into the evolution of collaborative innovation.

4.4. DISCUSSION

This study examined how RTOs shape the trajectory of innovation ecosystems through exploratory innovation support programs. Using the case of CEA's *Opendive* initiative, the study finds that RTOs are not only technology brokers or service providers but can also act as strategic orchestrators to redefine problems for innovation, reframe opportunities, and coordinate stakeholder alignments through structured exploratory programs. I discuss these findings below in detail and present the contributions of the study to the literature on innovation intermediation and ecosystems.

4.4.1. From technology transfer to ecosystem orchestration

The findings reveal a shift in the traditional role of the RTO investigated, from acting as a technological service provider and knowledge transfer agent to its developing function as an innovation ecosystem orchestrator. As opposed to responding to already defined needs, CEA, through *Opendive*, creates the conditions for collective exploration of unstructured needs and problems. This enabled SMEs to reimagine new applications for their existing resources and capabilities, discover new markets, and co-design innovation trajectories. This aligns with recent debates that RTOs are evolving beyond traditional intermediation roles and increasingly engaging in ecosystem coordination and strategic facilitation (Giannopoulou et al., 2019; Kuhlmann & Rip, 2018; Díaz & Garrigós, 2017).

Similarly, this revelation supports emerging views of RTOs as hybrid, strategic, and increasingly mission-oriented organizations capable of shaping, not just knowledge flows but also innovation trajectories (Khelfaoui & Bernier, 2023; Borrás & Edler, 2020; Mazzucato, 2018; Gulbrandsen, 2011). The orchestration observed in *Opendive* is not hierarchical or directive. Thus, unlike the traditional top-down approach where RTOs impose direction, decisions, and structure on collaborating firms, CEA orchestrates innovation through *Opendive* by guiding exploration, encouraging collaboration, and helping stakeholders shape new directions together. This is done through a mix of methodological scaffolding, cognitive reframing, and cross-sector facilitation. This approach confirms that innovation ecosystems can be steered through embedded practices, and not just a top-down control (Bergek et al., 2023; Mazzucato, 2018).

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This highlights how RTOs can influence innovation ecosystems by enabling collaborative learning and alignment, instead of imposing already defined technological solutions to firms. The way CEA designed *Opendive* exemplifies what Kuhlmann et al. (2019) describes as directive forms of governance, which is the capacity to embed purpose into the everyday practices of innovation support. More specifically, they termed this “tentative governance” which captures purposeful yet flexible approaches that shape innovation trajectories without controlling them. This enables directionality through methodological framing and structured exploration, not through top-down control. This further underscores the importance of designing adaptive innovation support programs design and institutional scaffolding, as revealed in this analysis of CEA’s *Opendive*.

4.4.2. Methodological tools as enablers of directionality

Another key insight from the findings is the strategic use of methodological tools as facilitation methods, but more importantly as cognitive infrastructures. Tools like C-K theory, design thinking, and strategic foresight are not just used to facilitate workshops. They are used as frameworks for collaborative thinking that help stakeholders understand problems differently, explore new ideas, and imagine future possibilities together. These tools help SMEs and other stakeholders (i.e., research scientists) shift from their traditional logics and open to alternative ideas and opportunities. This shows, particularly how RTOs can influence the direction of innovation by shaping how people think and collaborate, and not just by providing technology and expertise.

Additionally, while the RTO would traditionally solve predefined problems, *Opendive* begins with ambiguity, and leverage structured exploration activities to cocreate latent needs and reframe opportunities. This supports interpretations from extant literature that suggest that the tools and methods employed by intermediaries, such as facilitated co-creation or problem redefinition and reframing, can help shape innovation dynamics and stakeholder relationships in a way that is transformative (Dalziel & Parjanen, 2011; Howells, 2006). The tools used in *Opendive* act as shared boundary objects (Star & Griesemer, 1989), allowing actors from previously unconnected sectors to co-develop visions, align goals, and iteratively refine problems. This methodological dimension underscores the finding that

RTOs can embed directionality not through mandates but through carefully designed supportive programs.

4.4.3. Reconceptualizing innovation intermediation

The case of CEA's *Opendive* adds to existing understanding of innovation intermediation. Innovation intermediaries are often perceived as brokers, connecting supply and demand, translating knowledge, or reducing transaction costs for firms (Howells, 2006). *Opendive*, however, highlights an expanded understanding of these intermediation roles from two perspectives: exploratory orchestration and collaborative orientation. Exploratory orchestration refers to the deliberate creation of structured, open-ended exploration through which innovation stakeholders collectively identify problems, imagine futures, and test alternative solutions and directions.

This indicates a shift in the role of intermediaries from matchmaking (connecting known problems with existing solutions) toward catalyzing emergence, enabling new problems, partners, and innovation directions to emerge. This expanded understanding of the role of RTOs intermediaries is important in mission-driven and highly uncertain environments where innovation is not predefined and must be co-created (Bergek et al., 2023; Borrás & Edler, 2020). Collaborative orientation however refers to facilitating alignment between ecosystem stakeholders, not through direct control, but through shared learning, iterative sensemaking, and collaborative goal setting.

Opendive does not only connect actors, but it also reorients their innovation trajectories through collaborative exploration. This positions intermediaries like RTOs, not just as connectors, but as epistemic anchors. Thus, RTOs become intermediaries that help shape how stakeholders of innovation ecosystems understand problems, imagine future possibilities, and decide what kinds of innovation are worth pursuing. Altogether, these expanded roles offer insights into what can be termed *transformative ecosystem intermediation*. This form of intermediation goes beyond optimizing knowledge flows and facilitating partnerships. It involves strategic, reflexive, and directional practices that actively shape the trajectory of innovation ecosystems. Intermediaries engaged in *transformative ecosystem intermediation*

thus help configure the collaborative, cognitive, and institutional conditions under which inclusive and mission-oriented innovation can emerge..

4.4.4. The emergence and design of ecosystem directionality

The findings also contribute to literature on directionality in innovation ecosystems. As opposed to the perception of innovation ecosystems as evolving organically, my case study shows how directionality can be embedded within innovation support programs through methodological and relational design choices. Methodologically, exploratory tools such as design thinking and strategic foresight help guide how stakeholders frame problems and envision future innovation trajectories. Relationally, curated networks and cross-sector collaborations facilitated by CEA, through *Opendive*, enable the emergence of shared purpose. This supports the growing recognition in innovation policy literature that directionality is a necessary function of ecosystems that aim for transformative outcomes and align with studies on mission-oriented innovation (Mazzucato, 2018; Schot & Steinmueller, 2018; Hekkert et al., 2007).

This revelation aligns with emerging scholarly consensus that innovation policy must go beyond R&D to support socio technical transformation. Schot & Steinmueller (2018) argue for new policy frameworks oriented toward experimentation, participation, and directionality, a shift beyond purely economic or systemic approaches. Hekkert et al. (2007) also note that innovation ecosystems require functions that guide exploration and shape emerging technologies and not just support them in an abstract way. Similarly, Borrás and Edler (2020) further emphasize the roles of institutions in steering innovation ecosystems toward societal missions, calling attention to the need for governance mechanisms that actively shapes transformation. My findings add an important nuance to these debates, highlighting directionality as not only imposed through policy but cultivated through the design and implementation of innovation support infrastructures. *Opendive*, as implemented by CEA, is an example of how this can be carried out.

This study shows that RTOs can embed purpose and public missions into innovation processes not through control, but through design. The program uses methodological scaffolding (tools that shape how

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participants think, explore, and frame innovation opportunities) and relational brokerage (curated collaboration between actors with different roles and missions) to align emerging innovation trajectories with broader public value goals. From this understanding, directionality is not a static characteristic imposed from the top down, in a hierarchical manner but a dynamic quality that is cultivated over time. Thus, directionality can vary in strength and be shaped through evolutionary practices, tools, and relationships. Programs like *Opendive* show that directionality can be cultivated through structured support. As Borrás and Edler (2020) argue, systemic governance increasingly relies on actors and institutions capable of guiding collective innovation toward shared societal challenges. In view of this, RTOs are well positioned to function as institutional anchors that embed directionality not by imposing mandates, but by facilitating cognitive and relational alignment. *Opendive* demonstrates how such embedded approaches can work in practice.

4.5. IMPLICATIONS OF THE STUDY

4.5.1. Theoretical implications

This study contributes to literature on innovation intermediaries by showing how RTOs are evolving beyond the role of R&D and technology service provision to institutional orchestrators capable of shaping the trajectory of innovation ecosystems. RTOs are increasingly acting as institutional orchestrators, actors that guide and coordinate innovation across ecosystems through structured programs, strategic framing, and cross-sector alignment. In contrast to linear models of innovation where RTOs are positioned at the supply end of the value chain (e.g., Charles & Ciampi Stancova, 2014), the CEA's *Opendive* case shows how RTOs can define problems collaboratively, facilitate cross-sector learning, and embed societal purpose into innovation pathways.

Firstly, this study identifies cognitive orchestration as a new function of RTOs. Through the use of design methodologies and foresight tools, RTOs like CEA are not only enabling innovation but framing what should be innovated and why. This highlights a shift from technology-push approaches, that often characterize these types of RTOs, to strategic sensemaking and activities that shape innovations of the

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future within ecosystems. Additionally, the study advances how we understand innovation intermediation by introducing the concepts of exploratory orchestration and collaborative orientation. These concepts, capturing emerging roles of RTOs, go beyond traditional matchmaking and knowledge transfer. They include the facilitation of open-ended exploration and collaborative alignment and realignment around emerging opportunities.

This reconceptualization suggests that intermediaries are gradually playing the role of epistemic and institutional infrastructures, guiding innovation direction as opposed to managing knowledge flows and technology transfer. Finally, my findings extend recent debates on ecosystem directionality. While directionality is often perceived as a top-down policy mandate, my findings show that directionality can also be cultivated from within innovation programs. Through methodological scaffolding (structured tools and frameworks that guide exploration) and relational brokerage (intentional facilitation of cross-sector partnerships) RTOs can embed purpose into the dynamics of innovation ecosystems. These insights complement recent calls for more nuanced and embedded forms of mission-oriented innovation governance (Bergek et al., 2023; Schot & Steinmueller, 2018).

4.5.2. Practical implications

My findings offer actionable insights for RTO managers and innovation practitioners seeking to design more effective innovation support programs for SMEs and emerging ecosystems. RTOs should develop exploratory innovation platforms that support upstream engagement, problem framing, and opportunity discovery, especially for SMEs navigating highly uncertain business environments. *Opendive* shows that structured exploration helps SMEs rethink their market positioning, identify new use cases, and expand their innovation horizons beyond core sectors. For this, RTOs must invest in capabilities that promote methodological facilitation, cross-sector navigation, and relationship building.

The findings also emphasize the need for collaboratively designed innovation pathways. Instead of imposing rigid innovation support, programs like *Opendive* succeed by involving firms, particularly SMEs, and other stakeholders in shaping the scope, rhythm, and framing of innovation processes. This flexibility builds commitment, trust, and relevance, particularly critical when working with resource-

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constrained SMEs. Moreover, the investigation suggests that transversality, or the ability to enable knowledge recombination across sectors (Cooke, 2018), is vital to promote ecosystem resilience.

RTOs should thus actively foster cross-sector collaborations and create environments where SMEs can explore alternative application scenarios. For instance, repurposing technologies from aerospace to healthcare, thus enhancing both diversification and adaptability. For SMEs, the *Opendive* case demonstrates the value of participating in structured exploration as a strategic innovation process. Engaging in open-ended innovation support programs allows firms to identify emerging user needs, test alternative futures, and consider new societal roles. These outcomes extend beyond short-term product development and contribute to long-term strategic positioning.

4.5.3. Policy implications

Findings from this study supports the case for public investment in flexible, exploratory intermediary programs embedded within RTOs. Such programs offer a model for how mission-oriented policy goals, such as green transitions and digital sovereignty, can be operationalized at the level of innovation support programs, and not just through funding mechanisms. Governments should support RTOs in developing neutral and cross-sector collaborative platforms like Y. SPOT and *Opendive* that enable SMEs to engage in upstream innovation without the pressure of immediate outcomes and innovation commercialization. These platforms create public value by facilitating learning, reducing lock-in, and aligning innovation efforts with public missions.

Moreover, innovation policies should expand the evaluation criteria for RTOs to include relational, cognitive, and strategic impacts, and not only consider outputs like patents and licenses. Programs like *Opendive* demonstrate how RTOs contribute to ecosystem shaping by embedding directionality, fostering collaboration, and enabling systemic learning. Finally, policymakers should consider intermediary innovation support programs and their design as strategic policy tools in their own right. By doing this, such programs can become policy tools that complement innovation objectives oriented towards grand challenges by enabling adaptive, locally grounded innovation practices.

4.6. CONCLUSION

This paper examined how RTOs can shape innovation trajectories within ecosystems through exploratory innovation support programs, using CEA's *Opendive* initiative as a case study. The study diverges from the traditional understanding of RTOs as primarily technology providers, R&D organizations, and technical problem solvers. My findings show that RTOs can also operate as institutional orchestrators, actors that coordinate, guide, and align diverse stakeholders around emerging opportunities and shared missions. Through its neutral positioning, methodological tools, and facilitation of cross-sector engagement, *Opendive* enables SMEs to reframe problems, discover new markets, and engage in exploration activities for innovation. These features show that RTOs are not just experts in technology services. They also create the tools, support, and partnerships that help guide how innovation develops and where it is headed, thus helping shape the future direction of innovation ecosystems.

Theoretically, the study contributes to emerging debates on innovation intermediation by introducing the concepts of exploratory orchestration and collaborative orientation as key capabilities of next-generation intermediaries. It also offers an embedded view of directionality as a quality that can be cultivated procedurally, through tools, relationships, and innovation support program designs, and not only imposed through top-down public mandates. Practically, my findings suggest that RTOs, policymakers, and SMEs should invest in structured yet open-ended innovation environments that support upstream exploration, trust-building, and transversality (Cooke, 2018; 2013; 2011). Doing this can move them (ecosystem stakeholders) beyond linear models of technology transfer and foster more adaptive, purpose-driven innovation ecosystems capable of addressing complex societal challenges. By showing how RTOs can orchestrate innovation not through dominance, but through design, this study contributes to a richer understanding of how innovation ecosystems can be purposefully shaped from within.

4.7.LIMITATIONS

This study offers insights into how RTOs can shape innovation ecosystems through exploratory innovation support programs. However, the research is based on a single, embedded case study of CEA's *Opendive* initiative. While this design enabled rich, contextual understanding of the orchestration dynamics at play, it limits the generalizability of the findings. Indeed, the case study offers transferable concepts, but the specific institutional, cultural, and sector characteristics of the French innovation landscape may not fully reflect the conditions in other regional innovation ecosystems. Also, my embedded role in the *Opendive* initiative, while offering privileged access to informal dynamics and insider perspectives, introduces the possibility of interpretive bias. I try to mitigate this through triangulation, validation interviews, and reflexive practice. However, the interpretations may still reflect viewpoints shaped by my involvement in the program. Therefore, future research should consider these limitations in replicating or conducting similar investigations.

4.8.FUTURE RESEARCH DIRECTIONS

The limitations of my study point to several promising directions for future research. First, comparative studies of exploratory innovation programs across different RTOs, regions, and sectors are required to further understand RTO orchestration roles. Such studies would help assess whether the orchestration mechanisms observed in *Opendive* are context-specific or part of a broader evolution in RTOs. Also, the development of quantitative or mixed method approaches to evaluate the long-term impacts of exploratory innovation support programs on SME innovation performance, market repositioning, and ecosystem resilience is needed. This would complement the qualitative insights that I present in this study, with more systematic assessments of outcome patterns. Finally, future research could examine how the intermediary roles of RTOs evolve across different phases of the innovation process, from early-stage exploration to development, scaling, and diffusion. Particularly, how these evolving roles influence directionality and value co-creation. Considering these lines of inquiry for future studies can deepen our understanding of how RTOs go beyond their traditional roles as technology providers, to act as strategic agents in the governance of innovation ecosystems.

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This dissertation investigated how *RTOs adapt to balance external impact, internal sustainability, and societal directionality, thereby evolving from intermediaries into institutional orchestrators of innovation ecosystems*. Balancing these objectives lies at the heart of intermediation studies, particularly studies that focus on RTOs. RTOs must remain relevant to their immediate partners, especially SMEs, by providing tangible external value through technological support, problem-solving, and collaborative exploration. Simultaneously, they must ensure their own survival by capturing internal value, reconfiguring their capabilities, and sustaining their long-term strategic alignment. In addition to this, these intermediaries increasingly face societal expectations to steer innovation toward public missions, embedding directionality into ecosystem-level practices.

Innovation Intermediation and Institutional Orchestration

In addressing this triad of demands, this doctoral work responds to a persistent gap in innovation intermediation and ecosystem literature. Research on intermediation has traditionally emphasized the functional contributions of innovation intermediaries: brokering relationships, bridging knowledge domains, and reducing uncertainty for stakeholders in fragmented ecosystems (Howells, 2006; Klerkx & Leeuwis, 2009). Similarly, ecosystem literature highlights the importance of coordination, alignment, and value creation in distributed networks of actors (Adner, 2017; Autio, 2022). Yet, these literature streams pay less attention to the strategic evolution of intermediaries themselves: how they change their roles, structures, and practices in response to new ecosystem demands.

In this dissertation, we argue that understanding how intermediaries transform, from transactional service providers to *institutional orchestrators* is vital to explain innovation ecosystem evolution. This is particularly relevant under conditions of uncertainty, fragmentation, and increasing demand for societal relevance. By examining this transformation, empirically through the case of CEA and its infrastructures, our work reveals that RTOs are not the rigid organizations often portrayed in literature. Instead, they are dynamic stakeholders capable of reconfiguring relationships, reorienting innovation trajectories, and embedding shared vision and purpose into ecosystems. Through the essays we

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presented in this work, we contribute to a more processual and institutional understanding of intermediation and orchestration; one that captures how ecosystems function and how they are actively shaped by intermediaries like RTOs.

We hence situate RTO adaptation at the intersection of innovation intermediation, ecosystem governance, and dynamic capabilities in this dissertation work, contributing to a more holistic and institutional understanding of how innovation is steered in practice. By this work, we promote RTOs as dynamic, reflexive stakeholders that shape how innovation ecosystems are shaped and how directionality is embedded into innovation. From a larger perspective, recent debates on innovation intermediation have recognized that intermediaries are more than neutral brokers; they are active agents who interpret problems, frame opportunities, and sometimes steer the direction of innovation. Previous studies often described them in transactional terms, bridging knowledge gaps, transferring technology, and brokering partnerships (Howells, 2006; Klerkx & Leeuwis, 2009).

More recent contributions, however, emphasize that intermediaries also perform *interpretive* and *strategic* functions; shaping how stakeholders understand emerging technologies, align expectations, and commit to collaboration pathways (Dalziel & Parjanen, 2011; Kuhlmann et al., 2019). From this thinking, intermediation is understood as an institutional and cognitive practice, and not just a technical or relational activity. Similarly, research on ecosystem orchestration has shown that governance in distributed and multi-stakeholder environments does not emerge spontaneously. Instead, it requires purposeful alignment, curation, and coordination mechanisms that enable heterogeneous stakeholders to work together (Adner & Kapoor, 2010; Jacobides et al., 2018; Autio, 2022).

Platforms and digital ecosystems studies reinforce this insight, showing that focal actors such as platform leaders engage in institutional orchestration by designing roles, setting agendas, and embedding governance structures that stabilize collaboration (Gawer & Cusumano, 2014; Gawer, 2021). Yet, this literature has largely concentrated on private firms with strong commercial incentives (e.g., Apple, Google, or platform leaders in biotech), or on macro-level policy initiatives. A systematic examination of how publicly funded organizations, such as RTOs, develop the practices, capabilities,

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and routines needed to perform orchestration roles in contexts where incentives are mixed, resources constrained, and societal demands high.

This is another area where we offer some contributions. By grounding these debates in our longitudinal, practice-oriented, case study of CEA and its innovation infrastructures (i.e., Y.SPOT and *Opensive*), this dissertation demonstrates that RTOs adapt and show how they do so in practice. Through our embeddedness at CEA, we observed the specific adaptive intermediary practices (e.g., *brokering*, *framing*), dynamic capabilities (e.g., *prospecting*, *feedbacking*), and orchestration mechanisms (e.g., *embedding directionality*, *facilitating cross-sector alignment*) that enables an RTO to evolve from a traditional service provider role into an institutional orchestrator position. We thus extend theories of intermediation and orchestration by showing that public and hybrid organizations like RTOs can deliberately shape the structure, orientation, and trajectory of innovation ecosystems. This is not the sole prerogative of private firms or platforms.

Dynamic Capabilities

Our work also brings insights from dynamic capabilities theory (Teece, 2007; Eisenhardt & Martin, 2017) to the study of RTOs. Dynamic capabilities literature has long argued that organizations sustain competitive advantage by developing the ability to sense opportunities, seize them through resource mobilization, and transform their structures to remain aligned with shifting environmental needs. Yet, most applications of this theory have focused on private firms in market contexts. By examining RTOs this dissertation extends current debates by demonstrating that dynamic capabilities can be developed through non-market routines such as *prospecting* (sensing opportunities in collaborative exploration) and *feedbacking* (transforming internal practices based on organizational learning). These practices demonstrate how RTOs build adaptive capabilities to survive and orchestrate innovation ecosystems that align with public missions.

This dissertation contributes to the dynamic capabilities literature by extending its application from private, market-driven firms to public/hybrid organizations such as RTOs. Dynamic capabilities theory has traditionally emphasized the ability of firms to sense, seize, and transform in order to sustain

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competitive advantage under conditions of change (Teece, 2007; Eisenhardt & Martin, 2017). Most studies, however, have been situated in corporate or entrepreneurial contexts where market incentives drive resource allocation and strategic renewal (Helfat & Peteraf, 2009; Barreto, 2010). By focusing on the case of CEA, we demonstrate that dynamic capabilities also emerge in non-market, mission-oriented environments where public accountability, societal goals, and collaborative arrangements shape organizational adaptation.

Specifically, the findings show that RTOs enact dynamic capabilities through non-market routines. Prospecting refers to RTOs' ability to sense opportunities by engaging in upstream exploratory collaborations with SMEs, identifying latent needs, and anticipating emerging technological or societal shifts. Feedbacking captures the capacity to transform by institutionalizing learning from collaborative projects, refining internal practices, and adjusting strategic orientations. These processes extend beyond the traditional resource-allocation logic of seizing opportunities because RTOs operate under hybrid institutional logics, balancing scientific excellence, industrial application, and societal missions simultaneously (Gulbrandsen, 2011; Kuhlmann et al., 2019).

By foregrounding these practices, the dissertation advances three key insights. First, it shows that dynamic capabilities can develop outside competitive market settings, in organizations whose survival depends on legitimacy, public funding, and their ability to align with ecosystem needs. Second, it reframes sensing and transforming as collective, relational processes that rely on intermediating between diverse stakeholders rather than on unilateral managerial decision-making. Third, it highlights how dynamic capabilities contribute not only to organizational resilience but also to ecosystem orchestration, embedding directionality into innovation trajectories that respond to societal missions such as sustainability and digital health.

Thus, the findings presented in the essays enrich the dynamic capabilities literature by bridging it with debates on innovation intermediation and ecosystem governance. It demonstrates that the capability to adapt and orchestrate can be cultivated through interpretive and relational routines, such as prospecting and feedbacking, that enable RTOs to remain relevant while shaping the ecosystems they are embedded in.

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Ecosystem Governance

Our findings also advance literature on ecosystem governance by demonstrating how directionality, often treated in policy studies as an abstract and macro-level initiative, can be operationalized within the everyday practices of RTOs. Traditionally, research on innovation ecosystems has emphasized multi-stakeholder collaborations across without fully examining how shared purpose or direction is embedded into collaborative practices (Adner, 2017; Jacobides, Cennamo, & Gawer, 2018). At the same time, transformative innovation policy studies have called for steering innovation toward societal goals such as sustainability, energy transition, or digital sovereignty (Mazzucato, 2018; Schot & Steinmueller, 2018). Yet, the link between high-level policy intent and the micro-level collaborative practices through which directionality is enacted remains underdeveloped.

We contribute insights to addressing this gap by showing how programs like *Opensive* at CEA operationalize directionality through design choices, methodological tools, and relational infrastructures. Cognitive tools such as C-K theory, design thinking, and foresight methodologies shape how problems are framed, ensuring that innovation trajectories consider long-term missions rather than short-term technical fixes. Relational infrastructures (cross-sector partnerships, neutral collaborative spaces, and facilitated alignment processes) help to bring diverse stakeholders, including SMEs, into shared orientation around societal priorities. Iterative exploratory programs further reinforce this alignment by embedding learning and flexibility, allowing directionality to emerge as a dynamic and adaptive process.

Drawing on this, the findings resonate with Kuhlmann, Stegmaier, and Konrad's (2019) notion of tentative governance, which argues that governing emerging science and technology requires experimentation, iteration, and provisional alignment rather than rigid planning. By empirically grounding this idea in the case of CEA's Y.SPOT and *Opensive* program, we show that RTOs can act as institutional anchors for such tentative governance, cultivating directionality through the orchestration of methods, spaces, and relationships.

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Our contributions to the ecosystem governance discourse are hence twofold. First, the outcomes of our work extend ecosystem governance theory by reframing directionality not as an external imposition from policymakers, but as a practice-based outcome of program design and intermediary work. Second, it highlights the role of RTOs as *institutional orchestrators* capable of translating policy missions into operational routines, thereby connecting macro-level governance ambitions with micro-level innovation practices. This opens new avenues for studying how purpose-driven ecosystems are steered in practice and provides actionable insights for designing mission-oriented innovation infrastructures.

5.1. OVERVIEW OF THE FINDINGS

The findings reveal that RTOs develop new roles through three interrelated dynamics that redefine their position in innovation ecosystems.

First, supporting SMEs in upstream innovation requires more than technical service offers and knowledge transfer. Practices such as *brokering* and *framing* extend intermediation into the *interpretive* and *cognitive* domain. *Brokering* connects SMEs with resources and partners they would otherwise not be able to access, while *framing* helps them reconceptualize problems, articulate latent needs, and imagine novel technological futures. This goes beyond the traditional view of intermediaries as neutral bridges (Howells, 2006), highlighting instead their role as sensemakers and cognitive enablers (Dalziel & Parjanen, 2011; Kuhlmann et al., 2019). RTOs, through these practices, help SMEs overcome their specific innovation challenges like limited absorptive capacity and prepare for collaborative innovation even if the conditions indicate high uncertainties.

Second, capturing internal value requires the development of dynamic capabilities that allow RTOs to sustain themselves and remain strategically relevant. The second essay identifies *prospecting* (systematically sensing and identifying opportunities in ecosystem interactions) and *feedbacking* (capturing lessons and reconfiguring internal practices) as two non-market routines through which RTOs adapt. These findings extend dynamic capabilities theory (Teece, 2007; Eisenhardt & Martin, 2017) into the sphere of public and hybrid organizations, showing that such capabilities are not only market-driven

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but can also emerge from non-market, collaborative interactions. Value capture is thus not an automatic by-product of collaboration, but the outcome of deliberate, reflexive processes embedded in everyday practice.

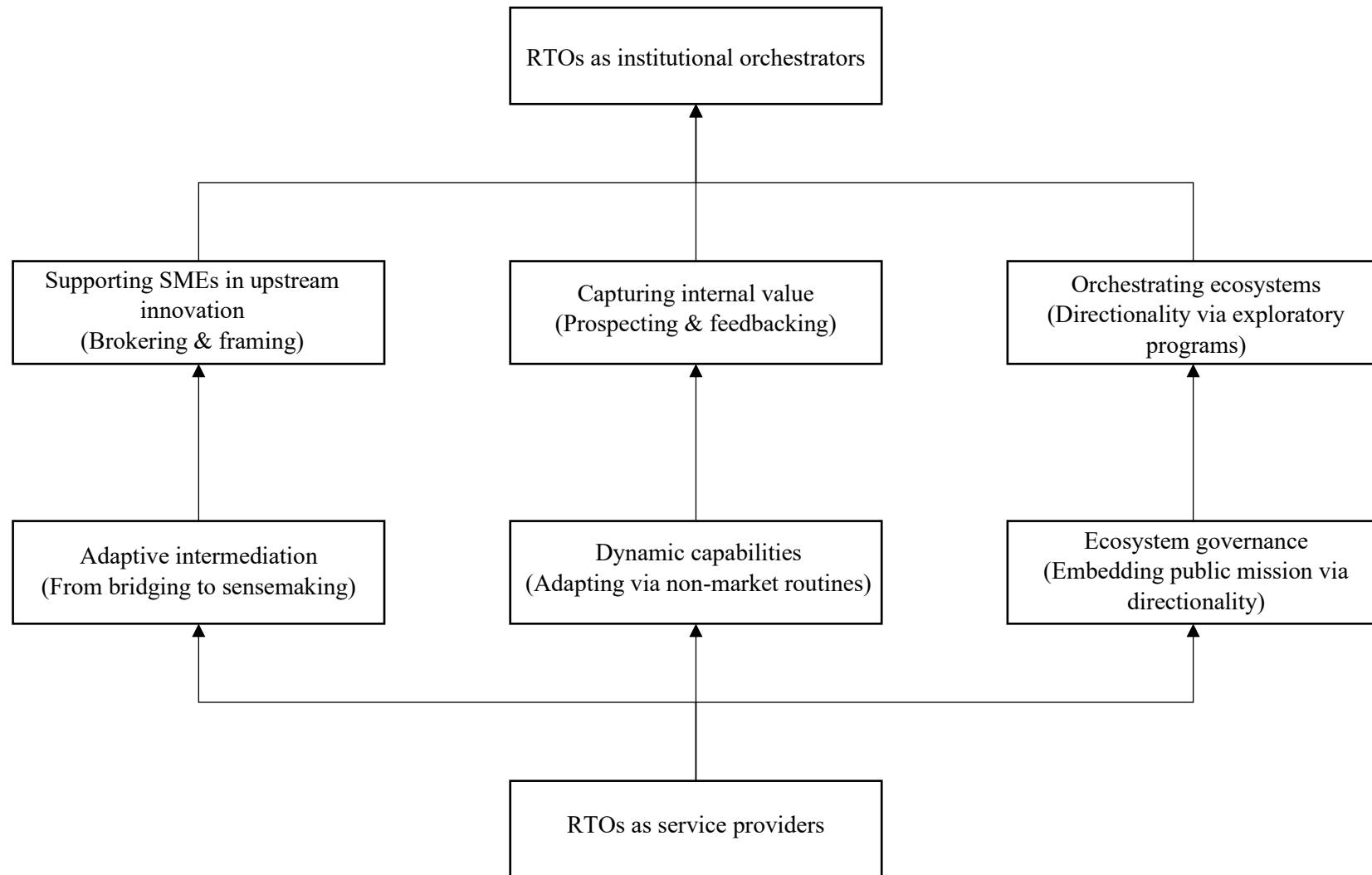
Third, orchestrating innovation ecosystems through exploratory programs such as *Opendive* illustrates how RTOs embed *directionality*, the intentional steering of innovation toward societal missions (Mazzucato, 2018; Schot & Steinmueller, 2018). This is possible by combining *methodological infrastructures* (e.g., design thinking, C-K theory) with *relational alignment* (e.g., curating mission-oriented partnerships). These programs function not simply as support services but as ecosystem design tools that grounds collaboration and orient it toward shared futures. In this context, RTOs act less as passive infrastructures and more as *institutional orchestrators*, cultivating spaces where exploration and societal relevance converge.

These dynamics revealed by this doctoral work demonstrate that RTOs are not rigid organizations but adaptive, reflexive stakeholders capable of reshaping the very ecosystems in which they operate. Their evolution from service providers to *institutional orchestrators* highlights the need to reconceptualize intermediation as both a transactional and strategic practice, dynamic capabilities as extending into public/hybrid organizations, and ecosystem orchestration as a process that can be grounded in institutional infrastructures rather than firm-centric leadership. This repositioning enriches ongoing debates in innovation intermediation and ecosystem literature, showing how organizations at the intersection of public missions and industrial needs actively shape the trajectories of innovation ecosystems.

Figure 5.1 above shows how RTOs evolve from service providers into institutional orchestrators of innovation ecosystems. They do this in three ways: by helping SMEs in upstream phases of innovation (through *brokering* and *framing*), by creating internal value for themselves (through *prospecting* and *feedbacking*), and by shaping ecosystems through exploratory programs like *Opendive*. These dynamics allow RTOs to support innovation and also guide its direction, contributing to wider debates on intermediation, dynamic capabilities, and ecosystem governance.

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Figure 5. 1: RTOs' evolution from service providers to institutional orchestrators



5.2. INSIGHTS FROM THE THREE STUDIES

Considered as a whole, the essays in this dissertation offer a coherent and empirically grounded account of how RTOs are transforming their strategic roles and position in evolving innovation ecosystems. This transformation is in response to shifts in innovation ecosystems, funding mechanisms, and expectations from society. Traditionally, RTOs have operated within a linear, primarily delivering applied research, prototyping, and technical services to firms in need of technological advancement (Arnold et al., 2010; Howells, 2006). This approach positioned RTOs as reactive problem-solvers or service providers that respond to clearly defined innovation needs from industry or government. Thus, the value of RTOs was largely defined by their ability to efficiently transfer knowledge from public research into commercial application.

However, contemporary innovation ecosystems are increasingly being characterized by complexity, uncertainty, and the increasing prioritization of societal challenges (e.g., sustainability, public health, digital transition). These challenges, such as climate change, health system resilience, and digital sovereignty, require new forms of innovation that are collaborative, cuts across sectors, and mission-oriented (Mazzucato, 2018; Schot & Steinmueller, 2018). In this context, the limitations of RTOs' traditional functions have become more evident. As the findings from this dissertation demonstrate, RTOs such as CEA are beginning to operate beyond the logic of technology delivery, position themselves as institutional orchestrators: strategic actors that influence not just the what of innovation, but the why, how, and with whom. In other words, RTOs like CEA, in response to these emerging characteristics of contemporary ecosystems, are adapting into more agile, reflexive, and strategically embedded actors. This adaptation is evident in their ability to operate across organizational boundaries, foster collaborative exploration, and actively steer the direction of innovation through their innovation programs, practices, and partnerships.

This dissertation introduces the concept of institutional orchestrators to capture this emergent role as RTOs do more than just intermediate between science and industry. As institutional orchestrators, RTOs do more than providing technical knowledge and services. They actively configure the relational, cognitive, and infrastructural conditions necessary for collaborative innovation to take root and evolve

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in alignment with broader ecosystem goals. What this also means is that RTOs can create the conditions under which innovation can occur, not just efficiently, but meaningfully and in a particular strategic direction (i.e., to meet specific societal needs or challenges). This represents a significant evolution from the traditional functions of RTOs and requires a renewed appreciation of the role that RTOs play in innovation ecosystems. The findings of this dissertation, when considered together, reveal three functions of RTOs as institutional orchestrators.

Firstly, as institutional orchestrators, RTOs shape ideas and problem definitions in the early, upstream, phases of innovation. They engage in what Howells (2006) refers to as “cognitive intermediation” which is a function that involves sensemaking, opportunity scanning, and problem reframing. As revealed in this dissertation, CEA’s use of design thinking methods (e.g., C-K theory, strategic foresight) within its Y.SPOT lab and *Opendive* program allows SMEs to challenge traditional notions and assumptions to discover opportunities that they may have previously missed. This role is especially crucial for upstream innovation, where user needs are latent and markets are not yet formed or defined.

In addition, RTOs facilitate cross-sector collaboration. This is particularly visible in their design of neutral platforms, such as open labs and exploratory innovation support programs, that foster trust and convergence among stakeholders from different organizational backgrounds. Kuhlmann and Rip (2018) argue that such platforms are essential to achieve distributed coordination in innovation ecosystems. They are spaces where actors with different logics (academic, industrial, governments, etc.) can collaboratively align around shared challenges. The findings show how *Opendive* lowers coordination costs, curates partnerships, and helps SMEs move beyond the boundaries of sectors and disciplines. This is particularly important in regions and sectors where innovation is fragmented and requires directionality.

Finally, and perhaps most striking, RTOs embed directionality into collaborative innovation activities. This aligns with recent studies on mission-oriented innovation policy (Mazzucato & Robinson, 2018), which emphasizes the need for innovation to be steered toward collectively defined goals, such as sustainability or healthcare resilience. Rather than imposing predefined outcomes and

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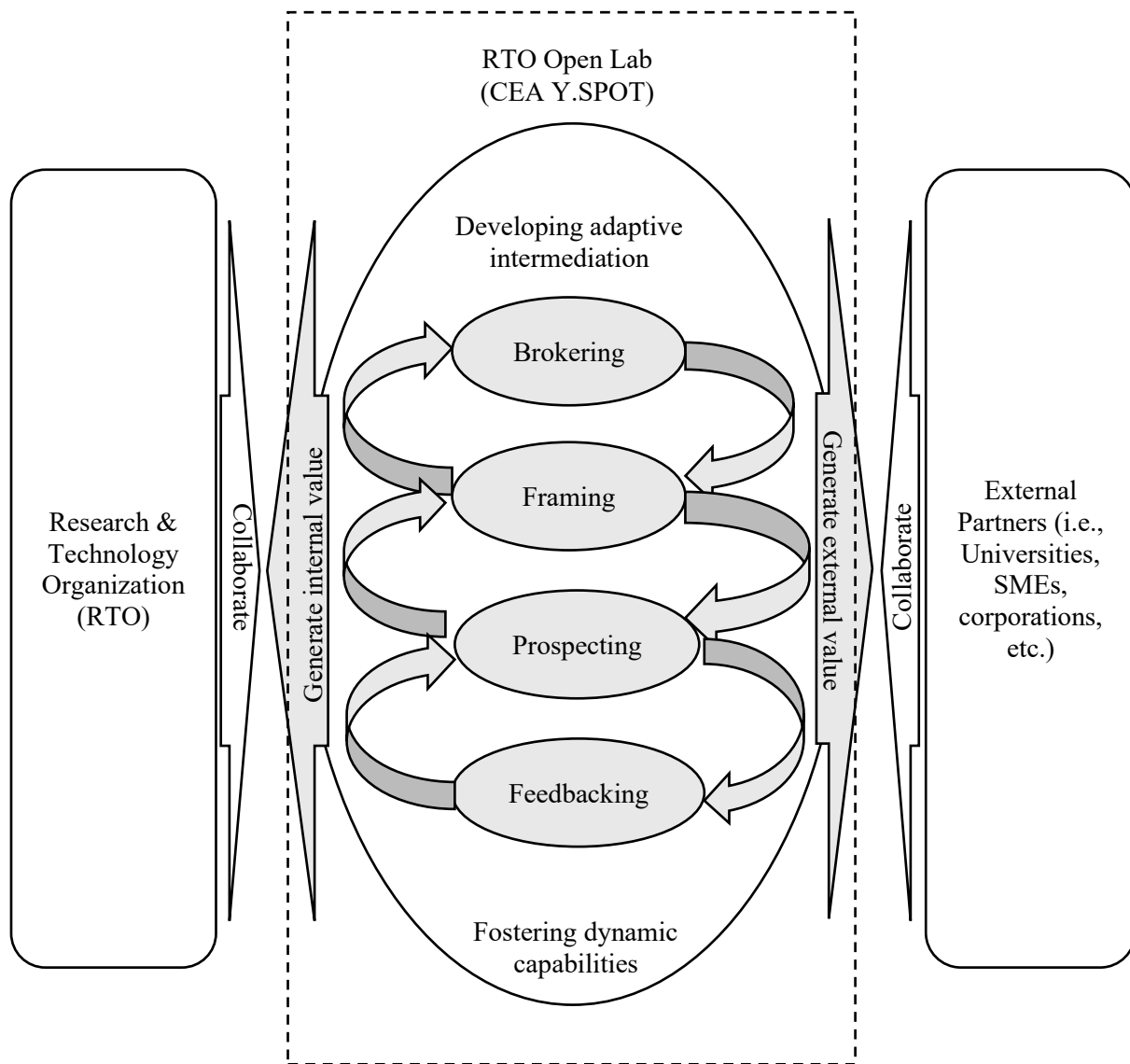
missions, RTOs acting as institutional orchestrators may direct innovation by designing processes, programs, and partnerships that subtly reorient stakeholders toward the future needs and challenges of society, what may be considered value for the public. This “tentative governance” of innovation, as Kuhlmann, Stegmaier, and Konrad (2019) describe it, in this sense, is not enacted or passed on through top-down mandates and policy initiatives but through facilitative infrastructures and iterative engagement led by RTOs.

More importantly, this form of institutional orchestration is not hierarchical or a top-down process. They are embedded in organizational design and practice of RTOs and reflect a deeper strategic repositioning of these organizations to intermediate not only between knowledge and application, but between emerging futures and existing capabilities. As shown in this dissertation, CEA’s orchestration function through Y. SPOT and *Opendive* is neither directive nor prescriptive. It unfolds through adaptive intermediation, a term developed in this research (to the best of my knowledge) to describe how RTOs continuously adapt their strategies based on stakeholder needs, project feedback, and evolving ecosystem dynamics. This flexibility enables RTOs to remain responsive while still guiding ecosystem development toward long-term societal goals.

In a nutshell, the studies in this dissertation converge around a central insight: RTOs are transitioning from knowledge and technology services providers to architects of innovation ecosystems. They no longer play the role of facilitating innovation from a transactional logic as their sole function but enable transformation. Thus, RTOs no longer only respond to technological trends or market demands. They work to embed directionality into innovation processes by curating partnerships, exploration logics, etc., that move innovation ecosystems to address societal challenges. RTOs are therefore dynamic, mission-oriented, orchestrators, organizations that shape the flow of innovation (e.g., technology transfer), but more specifically its direction, purpose, and structure.

This dissertation hence contributes to innovation studies and intermediation theory by empirically showing how RTOs generate both external value (for SMEs and ecosystem stakeholders) and internal value (for strategic renewal), while playing a pivotal role in structuring directionality within mission-oriented ecosystems.

Figure 5. 2: Institutional orchestration mechanism embedded in CEA's Y. SPOT



By conceptualizing RTOs as institutional orchestrators, the dissertation extends the theoretical understanding of public research organizations, provides new frameworks for evaluating their contribution, and offers practical guidance on how to design programs, labs, and infrastructures that enable inclusive, exploratory, and directional innovation.

5.2.1. Theoretical contributions

Theoretically, the implications of the findings of this dissertation contribute to literature on RTOs and innovation intermediation, dynamic capabilities, and ecosystem governance. By analyzing how public RTOs like CEA engage in upstream innovation, generate internal value, and orchestrate

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ecosystem-level directionality, the dissertation addresses key gaps in how these concepts are theorized and applied to hybrid, non-market-based innovation actors. Firstly, the findings advance literature on innovation intermediation by proposing the concept of adaptive intermediation. While foundational work by Howells (2006) established intermediaries as vital stakeholders that bridge gaps in innovation ecosystems, especially through activities like the articulation of needs, information processing, and brokering, subsequent studies have largely focused on intermediaries as transactional organizations that link supply to demand.

However, recent innovation ecosystems, characterized by uncertainty, weak problem definitions, and latent user needs, these linear intermediation strategies are inadequate (Dalziel & Parjanen, 2011; Klerkx & Leeuwis, 2009). Thus, the three studies contribute to a more dynamic understanding of RTOs, revealing that RTOs must engage in interpretive and cognitive work to help stakeholders reframe their innovation challenges and recognize emerging opportunities.

Innovation intermediaries like RTOs must therefore go beyond connecting actors towards aligning them cognitively and temporally (i.e., managing expectations, pacing collaboration, and enabling shared framing of future possibilities) (Boon et al., 2011; Winch & Courtney, 2007). From this context, the concept of adaptive intermediation can be ascribed to an RTO's capacity to flexibly tailor its methods, engagement strategies, and facilitation styles depending on the exploratory phase of innovation and the capabilities of participating stakeholders, particularly SMEs. This reframing expands existing typologies of innovation intermediation by moving from a functionalist perspective (e.g., bridging, brokering, matchmaking) to a process-oriented and situated understanding of intermediation that foregrounds learning, interpretation, and alignment work (Stewart & Hyysalo, 2008; Hargadon, 2002).

Secondly, this dissertation extends the dynamic capabilities theory (Teece, 2007; Teece, Pisano, & Shuen, 1997) into the domain of publicly funded RTOs. While dynamic capabilities, sensing, seizing, and transforming, are widely studied in private firms as mechanisms for competitive advantage, relatively little attention has been given to how they operate in public or hybrid organizations where market signals are weaker and organizational constraints are stronger (Wu et al., 2016; Piening, 2013).

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Table 5. 1: Synthesis of the three essays and their theoretical contributions

Essay	Research Question	Key Findings	Theoretical Contribution
Essay 1 (Chapter 2): Supporting SMEs in Upstream Innovation	<i>How do public RTOs adapt their strategies to better support the upstream innovation needs of SMEs?</i>	Identify two core intermediary practices: <i>brokering</i> (connecting SMEs to partners and resources) and <i>framing</i> (helping SMEs reconfigure problems and imagine new possibilities). These practices extend beyond traditional R&D and technology transfer.	Expands innovation intermediation theory by showing that intermediaries do not only bridge knowledge gaps but also perform <i>interpretive</i> and <i>cognitive</i> roles that enable SMEs to engage in exploration under uncertainty.
Essay 2 (Chapter 3): Internal Value Generation in RTOs	<i>How do RTOs appropriate internal value from collaborative innovation to shape their sustainability and alignment?</i>	Shows how RTOs use dynamic, non-market, routines of <i>prospecting</i> (sensing opportunities) and <i>feedbacking</i> (strategic learning) to capture internal value, ensuring sustainability and adaptation.	Contributes to dynamic capabilities theory by illustrating how RTOs, as public–private hybrids, develop sensing, seizing, and transforming capabilities through non-market routines embedded in intermediation.
Essay 3 (Chapter 4): Ecosystem Orchestration through <i>Opendive</i>	<i>How do RTOs shape the direction of innovation ecosystems through open labs and exploratory support programs?</i>	Demonstrates how <i>Opendive</i> enables ecosystem orchestration by embedding <i>methodological tools</i> (e.g., C-K design, foresight) and <i>relational alignment</i> that align SMEs and partners around societal missions.	Advances ecosystem governance theory by showing how <i>directionality</i> can be embedded in practice, not through policy, but by the design of programs, methods, and relational infrastructures.
Overarching Contribution	–	RTOs evolve from service providers into <i>institutional orchestrators</i> that balance external SME support, internal sustainability, and societal directionality.	Offers the concept of <i>adaptive intermediation</i> to capture this evolution, enriching debates on intermediation, dynamic capabilities, and governance in innovation ecosystems.

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This dissertation shows that RTOs like CEA develop dynamic capabilities not through market-driven competition, but through publicly oriented routines embedded in their intermediary and ecosystem orchestration functions. These functions as sensing emerging needs, engaging in exploratory collaborations, and iteratively adjusting strategic direction to remain relevant.

The findings identify prospecting (the systematic sensing of ecosystem shifts through collaborative exploration) and feedbacking (internal strategic learning based on project outcomes and stakeholder signals) as key practices that enable RTOs to adapt and reposition themselves. These are not simply learning processes but structured responses to the dual imperative of responding to societal challenges and organizational sustainability. By embedding feedback loops into upstream collaborations with SMEs and other ecosystem stakeholders, RTOs align their internal priorities with the evolution of their external environment. By doing this, RTOs demonstrate that dynamic capabilities can be cultivated in mission-driven, non-market settings where adaptation is essential not for competition, but for relevance and legitimacy (Kindström et al., 2013; Barreto, 2010).

Finally, the dissertation contributes to the growing literature on ecosystem governance and mission-oriented innovation by offering a practice-based account of how directionality (the intentional steering of innovation toward socially desirable outcomes) can be embedded in innovation ecosystems (Borrás & Edler, 2020; Mazzucato, 2018; Schot & Steinmueller, 2018). While much of the literature on directionality focuses on macro-level interventions, such as efforts to address grand challenges, public funding strategies, or national agenda setting (Kuhlmann & Rip, 2018), this dissertation provides micro-level empirical evidence of how directionality is implemented by RTOs. Specifically, the findings show that RTOs like CEA embed directionality through the design of innovation support programs (e.g., *Opensive*), the use of exploratory and problem-framing methodologies (e.g., C-K theory, design thinking), and orchestration of relationships and partnerships that aligns stakeholders across organizational boundaries.

These mechanisms function not by imposing solutions, but by creating structured environments for collective exploration and alignment (Kuhlmann et al., 2019). This extends the view of directionality from a top-down policy perspective to a procedural and embedded practice carried out through

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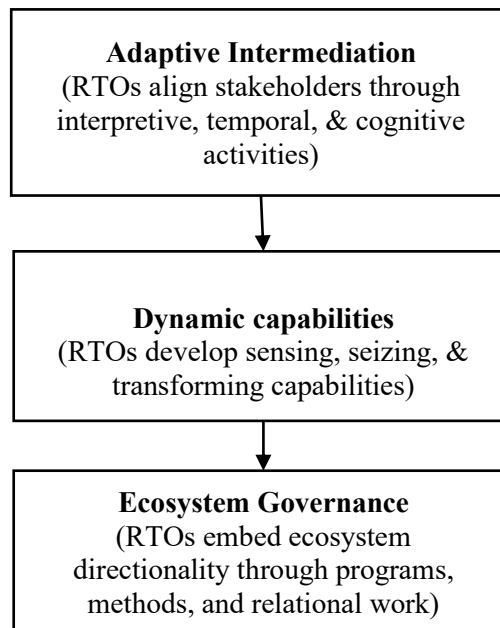
facilitation, infrastructure, and collaborative practices. It positions RTOs as governing entities that contribute to the “tentative governance” of emerging technologies and futures (Stegmaier et al., 2014; Rip & Te Kulve, 2008). These contributions are conceptually unified in Figure 5.3 below, which illustrates how adaptive intermediation enables the development of dynamic capabilities, which in turn support the embedding of directionality and the orchestration of innovation ecosystems.

Altogether, these contributions demonstrate the evolution of RTOs from linear supply-driven organizations into reflexive, strategically embedded actors capable of configuring the conditions for innovation in alignment with societal impact. Through this theoretical integration, the dissertation offers a reconceptualization of RTOs as institutional orchestrators, actors that do not simply transfer technologies but actively shape the cognitive, relational, and procedural infrastructures that underpin innovation ecosystems. This conceptual reframing has implications for how RTOs are supported, evaluated, and positioned in future innovation policies and practice.

Thus, the theoretical contributions of this dissertation are threefold. First, it reframes innovation intermediation as an adaptive, situated practice that involves cognitive alignment, temporal coordination, and collaborative exploration, and only brokering in a transactional way. It also extends dynamic capabilities theory to public or hybrid RTOs, demonstrating how sensing, seizing, and transforming are implemented through mission-oriented practices like prospecting and feedbacking. Finally, the dissertation offers a grounded view of how ecosystem directionality, a central aspect of mission-oriented policy, is not only governed at the macro level, but embedded through intermediary programs, methodological infrastructures, and relational work. These insights contribute to a more integrative and systemic understanding of RTOs, positioning them not only as bridges, but as institutional orchestrators capable of shaping innovation trajectories in response to societal needs and ecosystem evolution

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Figure 5. 3: RTOs as institutional orchestrators, linking adaptive intermediation, dynamic capabilities, and ecosystem governance



5.2.2. Empirical contributions

Empirically, this dissertation offers one of the few longitudinal, practice-oriented investigations into how a leading public RTO, CEA, adapts its structures and strategies across different phases of innovation. Existing literature on RTOs relies heavily on retrospective accounts, survey studies, policy reports, and single-case snapshots (e.g., Arnold et al., 2010; Readman et al., 2015; Uribe-Echeberria et al., 2019). These accounts are valuable but tend to present rigid representations of RTO functions and strategies. In contrast, this dissertation project provides real-time access to CEA, its Y.SPOT open lab, and the *Opensive* exploratory program, offering a dynamic, process-based view of innovation intermediation and orchestration as they unfold over time.

Our longitudinal access to CEA's infrastructures facilitated the development of this in-depth and timely exploratory study of innovation as it unfolds. This access enabled us to take our investigations beyond retrospective accounts of strategies and formal project documents. We observed how CEA's strategic direction is implemented through the deployment of specific tools, the organization of physical spaces, and the day-to-day activities of intermediaries, facilitators, and program designers. The findings demonstrate a situated and process-oriented understanding of how an RTO actively shapes innovation

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in ways that are responsive to external stakeholder needs while remaining anchored in its own organizational relevance and survival.

Table 5.2 contrasts the empirical approaches that dominate prior research on RTOs with the contributions of our work. It highlights how longitudinal embedded access CEA’s innovation infrastructures provides fresh insights on the evolving role of RTOs as *institutional orchestrators*.

Table 5. 2: Empirical contributions of this dissertation work

Aspect	Existing RTO Studies	This Dissertation	Empirical Contribution
Research Design	Predominantly cross-sectional surveys, policy evaluations, or retrospective case studies (Arnold et al., 2010; Readman et al., 2015).	Longitudinal, embedded case study of CEA (2021–2025), with iterative fieldwork in Y.SPOT and <i>Opendive</i> .	Provides a <i>temporal, process-oriented view</i> of how RTO adaptation unfolds in real time.
Focus of Analysis	Emphasis on outputs (e.g., patents, publications, collaborations) and static descriptions of RTO roles (Uribe-Echeberria et al., 2019).	Attention to <i>micro-practices</i> of orchestration: workshops, design sprints, relational negotiation, methodological tools.	Opens the “ <i>black box</i> ” of orchestration by tracing everyday activities that underpin ecosystem shaping.
Data Sources	Surveys, reports, interviews with policy makers or RTO leadership.	Multi-source data: >80 interviews, participant observations, program artefacts, internal documents.	Rich triangulation enables <i>credible, situated insights</i> into how strategy is enacted.
Treatment of SMEs	SMEs often overlooked; focus on large firms and policy-level impact (Giannopoulou et al., 2019; Siegel et al., 2023).	Focus on SMEs as critical but resource-constrained actors; analysis of how RTOs adapt support mechanisms for them.	Reveals <i>upstream intermediation practices</i> (brokering, framing) that specifically enable SME participation.
View of RTO Adaptation	Seen as relatively static service providers within national innovation system frameworks (Howells, 2006; Arnold et al., 2010).	Shows CEA as an <i>adaptive, reflexive actor</i> balancing external impact, internal sustainability, and societal directionality.	Reframes RTOs as <i>institutional orchestrators</i> rather than passive intermediaries.

The empirical richness of our work hence lies in its multi-layered and embedded observations. By combining longitudinal fieldwork with interviews, document analysis, and participant observation, this doctoral research project traces how CEA’s strategic ambitions were implemented. This

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implementation was carried out through (1) methodological tools (e.g., design thinking, C-K theory, foresight methods) used to guide exploration and reframing, (2) innovation spaces (e.g., Y.SPOT's open lab environment) designed to foster cross-sector collaboration, and (3) everyday practices of intermediaries, facilitators, and program designers working to balance SME collaborations, internal learning, and ecosystem alignment.

This embedded access makes visible the “black box” of orchestration that is often obscured in survey-based studies. It shows how strategy is enacted, not only in boardrooms or policy documents, but in the micro-practices of workshops, design sprints, and negotiation where alignment and directionality are built iteratively. This dissertation thus contributes an understanding of how RTOs like CEA adapt in real time to shifting ecosystem demands. It highlights the tensions between serving external stakeholders (particularly SMEs), capturing internal value for organizational survival and relevance, and embedding societal missions into collaborative innovation practices. This focus on how adaptation actually occurs in practice strengthens the empirical foundation of intermediation and ecosystem research. It provides a rare insight into the evolving governance role of RTOs in contemporary innovation ecosystems.

5.2.3. Practical implications

Our findings provide practical actionable insights for RTOs, SMEs, and policymakers seeking to strengthen innovation ecosystems.

For RTO managers, the research underscores that sustaining relevance requires investing not only in technical infrastructures (i.e., labs, prototyping equipment, technical expertise) but equally in soft skills and methodological capabilities. Practices such as facilitation, sensemaking, strategic framing, and the deployment of design thinking logics proved essential in the case of *Opendive*. These capacities enabled CEA to create spaces where innovation was not reduced to technology transfer, but dominated by exploration, alignment, and redefinition of problems. Moreover, the flexible innovation approaches deployed at Y.SPOT (such as ambition profiling sessions, cross-sector design sprints, and lightweight exploration activities) demonstrated that RTOs can avoid the “one-size-fits-all” trap that has long limited

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their SME engagements. These practices enhanced external value generation while simultaneously reinforcing internal learning and coordination. It helps CEA address the dual imperative of societal impact and organizational sustainability.

In another vein, for SMEs, our findings show that upstream collaboration with RTOs can deliver much more than technical fixes or R&D. When appropriately designed, such partnerships provide SMEs with structured spaces for strategic reflection. It encourages them to critically assess their positioning, explore latent user needs, and reimagine their capabilities in new markets. Participation in *Opendive* demonstrated that SMEs can shift from a reactive innovation positioning (responding to immediate technical challenges) to a proactive exploration mode where they experiment with new business models, non-obvious partnerships, and future-oriented innovation trajectories. This recasts RTOs not merely as service providers, but as cognitive and strategic partners, that help SMEs to navigate uncertainty and discover new pathways for growth.

5.2.4. Policy implications

For policymakers, the findings highlight the importance of supporting neutral exploratory infrastructures such as Y.SPOT and *Opendive*. Unlike narrowly defined technology transfer initiatives, these infrastructures are designed to promote cross-sector collaboration, iterative exploration, and alignment with societal missions. Policy frameworks that fund and protect such exploratory spaces can amplify both SME competitiveness and ecosystem resilience, ensuring that public investment translates into innovation trajectories aligned with broader societal goals. These practical insights from our work demonstrate that RTOs can, and should, be architects of innovation ecosystems. They should cultivate the conditions under which stakeholders collaborate, experiment, and orient innovation toward long-term missions. Playing this role will reinforce their dual mandate: delivering impact to partners while securing their own adaptability and sustainability in a rapidly evolving environments.

Our findings emphasize the critical importance of legitimizing and supporting exploratory innovation infrastructures as key aspects of contemporary innovation policy. While traditional policies have often emphasized RTOs as technology suppliers and commercialization agents, the findings

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demonstrate that infrastructures such as Y.SPOT and *Opendive* primarily play a different role. They function as boundary-spanning platforms that bring together different stakeholders (including SMEs, corporations, universities, and public authorities) in regions that are often underserved by centralized or sector-specific innovation infrastructures. We highlight that these infrastructures are not simply laboratories for technical development. They are neutral, methodological, and collaborative spaces that enable relational exploration, cognitive alignment, and the collective re-framing of problems.

This insight has direct implications for the design of mission-oriented innovation policies. As societal challenges such as climate change, digital health, and territorial resilience become more urgent, innovation policy cannot rely solely on transactional funding schemes and downstream commercialization objectives. Instead, it must invest in exploratory, pre-competitive environments where stakeholders can collaboratively imagine, test, and align emerging innovation trajectories. RTOs, when supported in this role, act as governance infrastructures, not merely as organizational assets to be funded, but as *institutional orchestrators* capable of cultivating the conditions under which innovation can address shared societal missions. This perspective resonates with recent calls in the policy literature (Mazzucato, 2018; Schot & Steinmueller, 2018; Kuhlmann et al., 2019) to move beyond linear innovation support toward frameworks that emphasize experimentation, stakeholder participation, and directionality.

The methodological strength of our research reinforces the policy contribution. By adopting an embedded, longitudinal, and qualitative design, this dissertation captures innovation as a dynamic, uncertain, and continuously negotiated process, and not just a static set of outcomes and metrics. This provides a grounded, practice-oriented perspective that challenges more technocratic policy framings of innovation intermediaries. It reveals how orchestration, alignment, and directionality are enacted in everyday organizational practices, showing that the success of policies depends not only on resource allocation but on the cultivation of relational, methodological, and institutional capabilities in RTOs and their innovation ecosystems.

These insights suggest that policymakers rethink their relationship to RTOs to approach them as partners in governance and not just mere recipients of funding. By empowering RTOs to design and

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operate exploratory programs that embed directionality in practice, policy can better enable ecosystems to respond to uncertainty and societal challenges. We therefore support ongoing debates in innovation policy about how to design frameworks that foster systemic learning, cross-sector alignment, and long-term societal impact.

5.3. LIMITATIONS AND FUTURE RESEARCH

This dissertation acknowledges several limitations which in our view are less of shortcomings and more of opportunities for further research. First, our empirical investigation focused on a single RTO, CEA, and its activities in Occitanie, France. While this provides rich longitudinal and practice-oriented insights into the orchestration role of a major European RTO, the organization's size, mandate, and resources make it an atypical case. The findings may therefore not fully represent the strategies and practices of smaller, more resource-constrained, or privately funded RTOs embedded in different organizational and regional contexts. Comparative research is thus required to determine whether the orchestration practices identified here are specific to CEA or indicative of a broader transformation among RTOs globally.

Second, we adopted a qualitative and interpretative methodology. This approach enabled an in-depth account of how orchestration is enacted through tools, spaces, and practices. However, it does not capture longer-term or large-scale outcomes in quantitative terms, such as SME growth trajectories, commercialization performance, or measurable indicators of ecosystem-level transformation. Therefore, while the findings reveal how RTOs enact orchestration and directionality in practice, it cannot alone establish the durability or scale of such outcomes in quantitative terms. Future research could complement our work with a mixed-method or quantitative designs to assess the durability, scalability, and measurable impacts of RTOs' exploratory innovation support programs.

Third, our analyses prioritized the perspective of RTOs and SMEs, while other key ecosystem actors like universities, regional governments, funding agencies, and large corporations receive less sustained attention. We focused primarily on the role of RTOs, particularly as institutional orchestrators. We also strongly present the perspectives of SMEs; however, further research could extend our analyses by

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exploring how other ecosystem stakeholders respond, resist, or complement RTO orchestration efforts. In essence, the findings of our work offer a partial view of complex innovation ecosystems that should benefit from additional triangulation with perspectives beyond those of RTOs and SMEs.

Future research should hence consider extending our work from the perspective of other innovation ecosystem stakeholders to offer a thorough understanding of ecosystem-level dynamics. Future research could proceed along three main directions.

1. Comparative studies across governance regimes, countries, and sectors could reveal whether adaptive intermediation and orchestration practices represent generalizable dynamics or context-specific strategies.
2. Quantitative and mixed-method approaches could evaluate the tangible effects of exploratory support infrastructures, including their contributions to ecosystem resilience and mission-oriented innovation.
3. Finally, theoretical development is needed to refine the concept of directionality. Our work has shown that directionality can be embedded in practice through methodological scaffolding and relational alignment. However, future research would benefit from the examination of how design choices, cognitive tools, and governance structures shape the emergence and consolidation of directional innovation pathways.

In addition, longitudinal studies could trace how adaptive intermediation practices such as *brokering*, *framing*, *prospecting*, and *feedbacking* become institutionalized, or fail to, within RTOs. This line of inquiry would clarify the organizational conditions and incentive structures that sustain exploratory innovation practices over time and link them to broader ecosystem governance. By identifying these areas for further study, we acknowledge the limitations of our work and at the same time reveal potential avenues for advancing literature on innovation intermediation, dynamic capabilities, and ecosystem governance.

5.4. CONCLUSION

This dissertation examined how RTOs adapt their roles, practices, and strategies in order to balance three interrelated imperatives: delivering external impact for SMEs, capturing internal value, and embedding directionality to align innovation and ecosystems with broader public missions. The essays in this work are anchored in an in-depth longitudinal case study of CEA and its innovation infrastructures Y.SPOT and *Opendive*. Our objective was to throw more light on the evolving role of RTOs in contemporary innovation ecosystems. The overarching contribution of this doctoral dissertation work lies in reframing RTOs as *institutional orchestrators*, going beyond their current positioning in literature as passive service providers and neutral intermediaries.

By exploring how CEA deploys practices of adaptive intermediation (e.g., *brokering* and *framing*), value capture (through *prospecting* and *feedbacking*), and embedding directionality in innovation (through methodological scaffolding and relational alignment), this dissertation shows that RTOs actively shape the conditions under which innovation trajectories emerge. They carry out this function, not by prescribing outcomes or pushing predefined technological solutions, but by cultivating the collaborative infrastructures, cognitive frameworks, and relational alignment necessary for inclusive and transformative innovation. RTOs, thus, emerge as adaptive organizations that respond and contribute to configuring and reconfiguring the innovation ecosystems they serve.

From this perspective, we contribute to three key literatures. To innovation intermediation, we introduce the concept of adaptive intermediation and emphasize the interpretive and strategic work required to align heterogeneous stakeholders for collaborative innovation. To dynamic capabilities theory, we extend the framework beyond private firms by showing how, particularly public, RTOs develop sensing, seizing, and transforming capabilities through non-market routines of collaborative exploration and learning. To ecosystem governance, we demonstrate that directionality, often prescribed as an abstract policy objective, can be embedded in everyday innovation practices through the design and implementation of exploratory innovation programs, methods, and relational infrastructures.

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Empirically, our work offers one of the few longitudinal and practice-oriented accounts of how a leading European RTO reconfigures itself in real time to address ecosystem complexity. Practically, we provide lessons for managers, SMEs, and policymakers on how to design exploratory innovation support programs and open labs that foster collaboration across sectors, enable learning under uncertainty, and align innovation with the needs of the public.

To conclude, this dissertation work highlights that the future of innovation ecosystems depends on technological excellence and market incentives, but even more so today, on the stakeholders that cultivate their direction and coherence. By reconceptualizing RTOs as *institutional orchestrators*, our work highlights their critical role in navigating the dual challenge of maintaining relevance as innovation service providers while contributing to mission-driven societal transformations. This reconfiguration of the role of RTOs opens more avenues for further theoretical development, comparative research, and policy design. It also reaffirms the centrality of the role of RTOs in addressing the societal challenges of our time.

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APPENDIX

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INTERVIEW GUIDES

• PAPER 1: ADAPTING RTO STRATEGIES TOWARDS SMES

Study 1 - Interview Guide. 1: Internal CEA Stakeholders (Y.SPOT managers, project managers, researchers, etc.)

General background information and CEA – Y.SPOT activities	1. What is your role at Y-SPOT/CEA Tech? What activities do you routinely undertake? How do you go about these activities? 2. How long have you worked with Y-SPOT? What is it like to work for Y-SPOT? Your experience of the working environment. 3. When and how did you decide to venture into industrial research? What were your motivations? 4. What aspects of your educational background do you consider relevant to your current work and how? 5. How do you contribute to the overall mission and vision of the Y-SPOT?
Context of collaboration between CEA Tech and other regional actors	6. What do you think about the ecosystem of CEA Tech? How is CEA Tech's network of partners growing? Do you have a network of partners in Occitanie? 7. How are collaborations with partners developing? What is the CEA Tech's approach? Any peculiar observations. 8. What is your perception of CEA Tech's approach to partnering organizations within the region? 9. What kind of partnership does CEA Tech foster with its partners? Would you say that CEA Tech is growing its network of partners? At what growth rate? 10. How will you evaluate CEA Tech's framework for expanding its network of partners and collaborations?
Procedures and processes at CEA- Y-SPOT	11. Can you briefly describe the type of services or activities undertaken here at this organization? Please name a few that you are familiar with. 12. How do you provide these services? Are there any existing processes you follow, and how do you proceed in following them? 13. What are the various stages involved in the services you provide? How do the services or projects you undertake transit from one stage to the next? 14. Who is the major target population of your services and why? What type of activities do they undertake, and which industries do they operate?
Impact on actors within the region and the regional innovation system	15. What type of new partnerships, and networks, are you nurturing? What is your current approach to developing such new networks? 16. To what extent have you deepened the existing different types of your collaborations, networks and connections with other organizations? 17. How do you transfer the outcome of your collaborations to your partners? Any specific mechanisms? Briefly elaborate. 18. How do you apply these mechanisms? How does this impact or affect your network? Do you undertake initiatives to collect feedback from partners? How? Briefly describe your feedback mechanisms. 19. Briefly, elaborate on the type of feedback that you receive on the services you render. How do you evaluate the impact of your collaborations on your network of actors? 20. How does the collaboration with your actors/partners benefit your organization? How does it strengthen your position in the region, in which way? Briefly explain.

Study 1 - Interview Guide. 2: External stakeholders (SMEs, Startups, etc.)

General introductory questions	1. Tell us about yourself and your role at your company. What activities do you routinely undertake? What type of products do you offer? 2. How long have you worked with this firm? With your years of experience, what do you think of the work environment?
Collaboration with CEA Tech	3. What kind of partnership do you have with CEA Tech? Context or nature? 4. When did this collaboration start, and what set the tone? Why CEA Tech? Any criteria, and factors considered? 5. What services or products are at the center of this collaboration? What are your expected outcomes or expectations? 6. How would you describe your collaboration with CEA Tech since the onset of your partnership? Do you follow specific procedures? 7. What are some of the challenges you have encountered? How did you overcome them?
Context of collaboration	8. What do you think about CEA Tech and its ecosystems? What is your perception of CEA Tech's approach to engagement in the region? 9. What are some of the specific activities that you undertake with CEA Tech? How and where do they take place? Please describe.
Actual Impact (From perspective of partner organizations)	10. How does this collaboration with CEA Tech benefit your organization? What happens at the end of the collaboration? 11. How do you receive the outcome of this collaboration? If it is a product/service, how do you proceed to bring this back to your firm? 12. What is the intended use of the outcomes of this collaboration? How do you evaluate to know that the outcomes are effectively used? 13. How do you provide feedback to CEA Tech on the outcomes of the collaboration? 14. How does your relationship with the CEA Tech strengthen your position and influence in the region? 15. Please provide a general review of your collaboration with CEA Tech. Would you recommend CEA Tech? Why (or why not)?

Study 1 - Interview Guide. 3: External stakeholders (Follow-up interview)

Role and Engagement in Regional Innovation	<i>Role of CEA/Y.SPOT in Occitanie Innovation Landscape:</i> • How does your organization engage with the CEA and/or Y.SPOT? Can you describe any past or current collaborative projects? • What are the main goals of your organization when partnering with research and technology organizations like CEA? <i>Types of Collaborations:</i> • Could you provide examples of the types of projects or research areas you focus on when collaborating with CEA and/or Y.SPOT? • How are the projects structured, and what roles do each actor typically play?
Benefits to Regional Innovation System Actors	<i>Impact on Universities and Research Institutes:</i> • How does CEA and Y.SPOT's presence support your research institute in advancing your research? • What benefits do you gain? Access to resources, talent development, research funding, etc.? <i>Support for Businesses and Start-ups:</i> • In what ways does CEA-Y.SPOT help your business innovate? • Are there specific examples where CEA's technology transfer or research support has accelerated the innovation of your business? <i>Benefits for Regional Authorities and Economic Development:</i>

	• How does your organization (i.e., AD'OCC, SATT, CHU, etc.) benefit from CEA's presence? • How would you say that the CEA has contributed to your region's economic or industrial growth?
Value Generation and Knowledge Transfer	<i>Knowledge and Technology Transfer:</i> • How effective is CEA in promoting knowledge and technology transfer in Occitanie? • Are there any processes in place that make it easier for innovations at CEA to be shared with you or your partners? <i>Skill Development and Talent Retention:</i> • How do CEA and Y.SPOT contribute to skill development and talent retention in Occitanie? • Can you discuss any initiatives that attract and retain talent within the innovation ecosystem?
Challenges and Opportunities	<i>Challenges in Collaboration:</i> • What challenges do you encounter working with CEA or similar organizations? • How could collaboration be improved to better support innovation for you? <i>Future Opportunities:</i> • What additional support or services from CEA and Y.SPOT would be beneficial for your organization and the wider regional innovation system? • Are there emerging fields you hope to see in future collaborations?
Closing	<i>Concluding Thoughts:</i> • Is there anything else you would like to share about your experience with CEA and Y.SPOT or your perspective on their role in the regional innovation system?

• **PAPER 2: GENERATING INTERNAL VALUE IN RTOS**

Study 2 - Interview Guide. 1: Internal CEA Stakeholders (Follow-up interview with CEA Tech and Y-SPOT informants)

	1. Tell us about yourself, your role at CEA Tech, and how you came to join the Y.SPOT project. 2. Which platform of CEA Tech do you belong? How long have you worked with the platform? 3. What are the ongoing projects in collaboration with Y.SPOT? What is the current state of the project. Has there been any technologies adopted from your platform to advance this project? 4. What was your exact contribution? At the time you joined the project, was the problem already clearly defined?
	5. Tell us more about the role of Y.SPOT at CEA Tech. What are their contributions to the internal activities your lab at CEA Tech? 6. Have you worked on any projects with a SMEs previously? If yes, how different, or similar, was the development of the project compared to the project you are currently developing with Y.SPOT? 7. If not, how different were these interactions from those projects that you previously worked on at CEA Tech?
	8. Should the company return for further development, what would be the next phase? An R&D project? What can you say about this new phase?

	9. What specific contributions do you think Y.SPOT brought to the development of this project, that could have been difficult to achieve without the role of the Y.SPOT? 10. Is the project going to need some technological blocks or not? How is it going to evolve now? 11. How many people were involved in the project and how long did it take?
	12. Without Y.SPOT, how do you envision developing these types of projects? 13. What are the potential long-term collaborations envisioned as a result of the collaborations? 14. How is CEA Tech going to benefit from the collaborations you are engaged on? 15. Any ideas if there are issues related to intellectual property sharing?

Study 2 - Interview Guide. 2: Internal CEA stakeholders (Adapted to a specific project)

Context and general perceptions	1. From your experience, what does a project of this type (high clinical stakes, original technical solution, not yet industrially implemented) bring to mind? 2. Have you been approached for similar projects in the past? If so, how do you analyze this type of proposal? 3. What do you think are the elements that can make a project “interesting to follow”, even at an exploratory stage?
Analysis and engagement criteria	4. What are the criteria that guide your decisions regarding interest in a health innovation project today? 5. What place do you give to projects with low technological maturity but high medical stakes? 6. What role do the clarity of the target market, the potential for industrialization, or even regulatory visibility play in your choices? 7. At what point does a project become worthy of investment or strategic commitment for you?
Possible limits to the integration of a project like Myos	8. In your opinion, what are the obstacles or points of vigilance that could hinder the involvement of an industrialist in a project like this? 9. Does the fact that a project is led by an open lab or a public organization, without any private structure involved at this stage, change the way you evaluate it? 10. How does your company's current strategy align with projects like Myos? Is it a matter of priority, positioning, or business model?
Role of intermediaries and potential for development	11. What is your view on intermediary structures (such as open labs, RTOs, etc.) in setting up this type of project? 12. Do you believe that these structures can play a role in structuring projects to a level that would allow industrial interest? 13. What types of signals or advances do you think would be necessary for an early-stage project to become worthy of interest to an industrialist?
Strategic positioning and foresight	14. Do you think that industrial structures are today well positioned to capture innovations with high potential but low maturity? 15. Are you aware of any projects which, despite their interest, have not been able to find industrial support due to too great a gap with market or risk logic? 16. In your opinion, what measures could help bridge the gap between this type of innovation and traditional industrial logic?

Open conclusion	17. What do you think of the approaches taken by academic or hospital teams to bring this type of project to fruition? 18. What advice would you give to a team like ours to better align our approach with the expectations of an industrial player?
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Purpose: CEA is currently working on a healthcare project, a collaboration between a hospital and a research organization. The project relies on a breakthrough technology developed to address a currently unmet clinical need. It's still at an early stage (approximately TRL 3) and currently has no industrial backing. In this context, we'd like to better understand how a stakeholder like you perceives this type of project to better understand how an early-stage health innovation project fits (or not) into the criteria, logic and investment strategies of industry players in the sector.

• **PAPER 3: FROM INTERMEDIARIES TO ECOSYSTEM SHAPERS: THE ROLE OF RTOS IN DIRECTING INNOVATION TRAJECTORIES**

Study 3 - Interview Guide. 1: Internal CEA Stakeholders (Opendive program managers, facilitators, researchers)

Understanding the Opendive program's position and goals	1. Could you tell me about your role in the Opendive program and how it fits into CEA Tech's broader strategy? 2. What were the original goals or motivations behind Opendive? 3. How does Opendive connect with CEA's mission to serve society? 4. Have the program's priorities changed over time? Why?
Structuring and framing innovation trajectories	5. How do you go about selecting, framing, or shaping innovation projects within Opendive? 6. What criteria or methods are used to define innovation priorities? 7. What types of activities (e.g., workshops, foresight tools) support this framing? 8. How do you deal with uncertainty in the early stages of a project?
Ecosystem engagement and strategic steering	9. How do you engage with other actors in the innovation ecosystem through Opendive? 10. How do you identify relevant stakeholders (e.g., SMEs, researchers, public actors)? 11. Are there mechanisms in place to steer collaboration toward shared goals? 12. Have there been moments when the ecosystem dynamics changed the direction of a project?
Societal alignment	13. In what ways does Opendive try to align innovation efforts with societal challenges? 14. How do you define what "societal needs" are in concrete terms? 15. Can you share a project that reflected this alignment in practice? 16. How do you balance scientific/technological opportunity with public value?
Learning and reflexivity	1. What have you learned from running the Opendive program? 2. What worked particularly well, or not, in orchestrating these innovation trajectories? 3. How do you reflect and improve your internal processes? 4. What would you change or enhance in the program moving forward?

Purpose: Explore how CEA Tech internally designs and uses Opendive to orchestrate innovation trajectories aligned with societal missions.

Study 3 - Interview Guide. 2: External Stakeholders (SMEs, Startups, Universities, Local Authorities)

Entry Point and Engagement	1. Can you describe how your organization got involved in the Opendive program? 2. What drew your interest in participating? 3. What was your role in the project? 4. Was this your first collaboration with CEA?
Framing and Innovation Support	1. How did the Opendive process help you explore or develop your innovation idea? 2. What support did you receive, technical, strategic, organizational? 3. How did the process help clarify or evolve your needs? 4. Did it change the way you see your innovation potential?
Collaboration and Ecosystem Value	1. How would you describe the collaboration experience with CEA and other actors? 2. Did the program facilitate connections with other relevant stakeholders? 3. Did it help align your work with broader innovation goals? 4. Were you able to continue the collaboration or project afterward?
Societal Orientation	1. To what extent did your project in Opendive address societal needs or challenges? 2. Were themes like sustainability, health, or inclusion part of the framing? 3. Was the societal value of your innovation made more visible or important? 4. Did it help you think differently about the impact of your innovation?
Reflections and Outcomes	1. What are your main takeaways from participating in Opendive? 2. What value did it bring to your organization? 3. What could be improved in your view? 4. Would you participate again or recommend the program to others?

Purpose: Understand how external participants experience the Opendive program and how it shapes their innovation directions toward societal goals.

BIOGRAPHY

Prince Gilbert Fialor is a Teacher-Researcher at Université Toulouse Capitole and a final year Ph.D. student (whose research focus is at the intersection of innovation and corporate strategy) at Toulouse School of Management. He is co-supervised by Prof. Dr. Eric Michaël LAVIOLETTE (HDR) and Prof. Dr. Amadou Lô. Prince Gilbert received a University Degree in International and



Comparative Studies from Sciences Po Toulouse and a Bachelor of Arts in Political Studies from Kwame Nkrumah University of Science and Technology (KNUST). In 2012, he was awarded a Certificate in Environmental Management and Entrepreneurship from the Methodist University College, Ghana, with distinction. Following these achievements, Prince Gilbert obtained the support of TBS Education Research, Toulouse, and funding from the French Atomic Energy and Alternative Energies Commission (CEA) to carry out his PhD. He currently serves as a marketing and communications officer for the “Innovation” as Strategic Interest Group (SIG) of the European Academy of Management (EURAM).

His research focuses on emerging inclusive innovation ecosystems, particularly for small and medium-sized enterprises (SMEs), with concentration on the role of innovation intermediaries like research and technology organizations (RTOs) as case studies. More precisely, he investigates how public RTOs can promote and foster both early-stage and late-stage innovation for SMEs by adapting their strategies. He relies on qualitative methods to better understand how to strengthen collaborations between RTOs and SMEs by fostering RTO dynamic capabilities and adaptability. Prince Gilbert was employed and tasked as part of a research team to evaluate the role and impact of CEA and its open innovation strategy within the Southern French region of Occitanie/Midi-Pyrénées, particularly towards regional SMEs.

He has presented his work at several international conferences in management (EURAM, R&D Management, IPDMC, ICSB, etc.) and has completed an academic research visit at Aston University, Birmingham, UK, to improve and disseminate his research. He has also accumulated 70+ hours of teaching with Bachelor and Master students in various fields, including management and political

studies. The courses were taught and assessed in English. He has been involved in various research activities such as the organization of the RGCS symposium at TBS Education in 2024, but also as part of the communication team at the EURAM Innovation SIG.

Prior to his enrolment at TSM Doctoral Programme, Prince Gilbert worked as a Teaching and Research Assistant with the History and Political Studies Department at KNUST, and subsequently joined, as a Vendor Experience Management Team Lead in Ghana, Africa's e-commerce giant: Jumia Group. He is an advocate for innovation in SMEs and seeks to expand access to knowledge on innovation ecosystems, and to push for effective innovation policies that would foster the innovative capabilities of SMEs, particularly across West Africa.

ABSTRACT

Research and Technology Organizations (RTOs) have long played a central role in national and regional innovation ecosystems, primarily through technology development, knowledge transfer, and applied research. Yet, their ability to support upstream innovation for resource-constrained actors, such as small and medium-sized enterprises (SMEs), and to generate sustainable value for themselves remains underexplored. This dissertation addresses this gap by examining how RTOs adapt their strategies, practices, and roles to co-create and appropriate value in evolving innovation ecosystems, with a particular focus on their potential to shape innovation ecosystem trajectories.

Drawing on an in-depth case study of a French RTO, CEA (Commissariat à l'énergie atomique et aux énergies alternatives), its innovation lab Y. SPOT, and an embedded innovation support program, *Opensive*, this dissertation investigates how RTOs foster innovation for SMEs, generate internal value from collaborations, and steer innovation ecosystems toward broader societal goals. The dissertation comprises three interconnected studies, based on qualitative data including 138 semi-structured interviews, ethnographic observations, and document analysis.

The first study explores how public RTOs adapt their strategies to better support SMEs in the upstream phases of innovation, identifying two key intermediary practices, brokering and framing, that enable more responsive and inclusive collaborations. The second study examines how RTOs generate internal value through collaborative innovation by deploying dynamic capabilities, particularly through prospecting (sensing opportunities) and feedbacking (strategic learning), to adjust their internal processes and align with ecosystem shifts. The third study investigates how RTOs, through exploratory innovation support programs, act as orchestrators of innovation ecosystems by embedding methodological tools and relational strategies that foster directional innovation aligned with societal missions.

Together, the studies show that RTOs are evolving from passive technology providers into institutional orchestrators, actors that not only facilitate innovation but shape its direction and structure through deliberate programs, cognitive tools, and strategic partnerships. This shift requires RTOs to balance dual

mandates: serving the public good while ensuring organizational sustainability. The dissertation introduces the concept of “adaptive intermediation” to capture how RTOs respond to uncertainty, tailor support across actors and sectors, and align short-term projects with long-term ecosystem development.

By reconceptualizing the role of RTOs, this research contributes to innovation studies, intermediation theory, and ecosystem governance. It offers practical implications for RTOs, SMEs, and policymakers on how to design inclusive and exploratory innovation support structures and programs. Ultimately, the findings suggest that RTOs can play a more proactive role in addressing mission-driven challenges, such as climate transition, digital health, and resilience, by reframing their roles and impacts as both enablers and shapers of future collaborative innovation initiatives.

RESUME

Les Organismes de Recherche et de Technologie (ORT) jouent depuis longtemps un rôle central dans les écosystèmes d'innovation nationaux et régionaux, principalement à travers le développement technologique, le transfert de connaissances et la recherche appliquée. Toutefois, leur capacité à soutenir l'innovation amont pour des acteurs disposant de ressources limitées, tels que les petites et moyennes entreprises (PME), ainsi qu'à générer une valeur durable pour eux-mêmes, reste encore peu explorée. Cette thèse comble cette lacune en examinant comment les ORT adaptent leurs stratégies, leurs pratiques et leurs rôles afin de cocréer et d'approprier de la valeur dans des écosystèmes d'innovation en évolution, en mettant particulièrement l'accent sur leur potentiel à orienter les trajectoires de ces écosystèmes.

S'appuyant sur une étude de cas approfondie d'un ORT français, le CEA (Commissariat à l'énergie atomique et aux énergies alternatives), de son laboratoire d'innovation Y.SPOT et d'un programme d'accompagnement intégré, *Opendive*, cette recherche analyse comment les ORT stimulent l'innovation pour les PME, génèrent de la valeur interne à partir de collaborations et orientent les écosystèmes d'innovation vers des objectifs sociétaux plus larges. La thèse se compose de trois études interconnectées, fondées sur des données qualitatives comprenant 138 entretiens semi-directifs, des observations ethnographiques et l'analyse documentaire.

La première étude explore la manière dont les ORT publics adaptent leurs stratégies afin de mieux accompagner les PME dans les phases amont de l'innovation, en identifiant deux pratiques intermédiaires clés, l'intermédiation et le cadrage, qui favorisent des collaborations plus réactives et inclusives. La deuxième étude examine comment les ORT génèrent de la valeur interne par l'innovation collaborative, en mobilisant des capacités dynamiques, notamment à travers la prospection (détection d'opportunités) et le retour d'expérience stratégique (apprentissage), afin d'ajuster leurs processus internes et de s'aligner sur les évolutions des écosystèmes. La troisième étude analyse comment les ORT, par le biais de programmes exploratoires de soutien à l'innovation, agissent comme orchestrateurs d'écosystèmes d'innovation en intégrant des outils méthodologiques et des stratégies relationnelles qui favorisent une innovation orientée vers des missions sociétales.

Dans leur ensemble, ces études montrent que les ORT évoluent d'un rôle de simples fournisseurs de technologies vers celui d'orchestrateurs institutionnels, des acteurs qui non seulement facilitent l'innovation mais en façonnent également la direction et la structure grâce à des programmes délibérés, des outils cognitifs et des partenariats stratégiques. Ce changement exige des ORT qu'ils équilibrent un double mandat : servir l'intérêt général tout en assurant leur pérennité organisationnelle. La thèse introduit le concept « d'intermédiation adaptative » pour saisir comment les ORT répondent à l'incertitude, personnalisent leur soutien selon les acteurs et les secteurs, et alignent des projets de court terme avec le développement de long terme des écosystèmes.

En reconsidérant le rôle des ORT, cette recherche contribue aux études sur l'innovation, à la théorie de l'intermédiation et à la gouvernance des écosystèmes. Elle propose des implications pratiques pour les ORT, les PME et les décideurs politiques sur la manière de concevoir des structures et programmes de soutien à l'innovation inclusifs et exploratoires. Enfin, les résultats suggèrent que les ORT peuvent jouer un rôle plus proactif face aux défis liés aux missions sociétales, tels que la transition climatique, la santé numérique et la résilience, en redéfinissant leurs rôles et leurs impacts comme facilitateurs et architectes des futures initiatives de collaboration innovante.