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Ecosystem Collaboration and Absorptive Capacity in SMEs: Structures, Paradoxes, and Root Causes

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ABSTRACT:

Small and medium-sized enterprises (SMEs) play a significant role in economic development and regional innovation. Their ability to develop knowledge independently, however, is restricted by their consistent lack of resources. Ecosystem collaboration has been identified as a strategic mechanism through which SMEs can access external knowledge and resources to compensate for internal capability limitations. However, there is little understanding of the factors that enable collaboration to translate into absorptive capacity in SMEs, and what makes inter-firm ecosystem collaboration consistently fail for SMEs to deliver absorptive capacity benefits and the contradictions this creates. The study addresses two research questions: first, how different ecosystem collaboration structures and mechanisms promote absorptive capacity in SMEs; and second, why collaboration paradoxes arise within ecosystems and what factors prevent SMEs from converting collaborative engagement into absorptive capacity gains. The theoretical framework is based on absorptive capacity theory, the Triple Helix model and the SECI model of organisational knowledge creation. The study follows a qualitative research design. The empirical data consists of 23 semi-structured interviews across ecosystem actors (SMEs, higher education institutions, and intermediaries). The data was analysed using the Gioia methodology.

The findings reveal that when a set of structural and relational enabling mechanisms is present, ecosystem collaboration leads to substantive value for SMEs. A crucial distinction is found between the recognized collaborative value among SMEs and the realized gains of absorptive capacity among SMEs. Four collaboration paradoxes are found to happen systematically: Ungoverned and reactive collaboration patterns; an IP protection dilemma driven by competitive concern, cultural self-reliance, and IP literacy gaps; the misrecognition of surface-level interaction as meaningful collaboration; and an externalisation deficit in which collaborative learning is not converted into documented organisational knowledge. Six interlocking root causes underlying these paradoxes were identified: SME resource constraints acting as a structural limit on engagement depth; a temporal and incentive mismatch between HEIs and industry; knowledge loss through personnel instability; a governance vacuum in collaboration management; weak internal knowledge exploitation infrastructure; and an orchestration gap in which no ecosystem actor takes sustained responsibility for activating multi-party collaboration. Two emergent findings extend the framework: Customer relationships emerge as the primary channel for knowledge creation, and knowledge flows in HEI–SME collaboration prove bidirectional. The study concludes that the central barrier to absorptive capacity development in SMEs through ecosystem collaboration is the inability to translate the available resources. Addressing this requires both internal capability development within SMEs and the introduction of sustained ecosystem orchestration.

KEYWORDS: SMEs, absorptive capacity, ecosystem collaboration, collaboration paradoxes, HEIs, innovation ecosystem intermediaries

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Abbreviations

AI	Artificial intelligence
CEO	Chief executive officer
DIH/DIHs	Digital innovation hubs
GDPR	General data protection regulation
HEI/HEIs	Higher education institution(s)
IMS	Integrated management system
PACAP	Potential absorptive capacity
R&D	Research and development
RACAP	Realised absorptive capacity
SECI	Socialisation, Externalisation, Combination, Internalisation
SME/SMEs	Small and medium-sized enterprise(s)

1 Introduction

Small and medium-sized enterprises (SMEs) hold a significant value in the current economies. They are fast in adapting new changes, open to new ideas due to their less bureaucratic nature comparing to bigger organizations. They form a vast majority of all business organizations while contributing substantially to employment and economic output, and regional innovation capacity (Mei et al., 2019). In Europe, SMEs are categorized as firms that have less than 250 employees and a yearly turnover of below 50 million euros (European Commission, 2016).

Despite their significant role in the current modern economies, SMEs struggle with fundamental resource shortages while working towards independent innovation. They have limited financial resources, restricted access to specialised knowledge, and they find it challenging to attract and form a technical set of employees (Peirone et al., 2024; Shahzad et al., 2025).

Moreover, these fundamental limitations have brought serious challenges for SMEs in the context of digitalization and keeping up with the technological changes. The fast development of digital technologies, such as Industry 4.0 and broader digitalisation of production and service industries create both significant competitive opportunities and urgent adoption demand for SMEs. Staying competitive needs continuous investment in knowledge, infrastructure, and organizational capabilities required for development of digital solutions. SMEs find it challenging to sustain these investments independently given their resource shortages (Appio et al., 2024; Hafeez et al., 2025).

Ecosystem collaboration can be strategic response to this challenge. By collaborating with higher education institutions, public funding organizations, industry networks, and intermediary organizations, SMEs can gain access to all the resources they were missing such as knowledge, infrastructure and development support (Crupi et al., 2020; Shahzad et al., 2025). Ecosystem collaboration between SMEs, companies, universities, and public organizations offers shared knowledge, learning opportunities, co-creation possibilities

and, support for knowledge development and organisational learning. It therefore becomes the main mechanism for SMEs to encounter the internal limitations and take steps towards fulfilling the needs of digital transformation. This collaborative approach not only improves innovation performance but actively builds the absorptive capacity SMEs need to convert external knowledge into commercial outputs (Cassol et al., 2021; Shahzad et al., 2025).

Research gaps

The literature on ecosystem collaboration and absorptive capacity in SMEs leaves important gaps to be addressed. Although interorganisational learning has been shown to positively influence both potential and realised absorptive capacity in SMEs, the intraorganizational environment and its internal characteristics that determine how new knowledge is received and used have not been sufficiently explored (Cassol et al., 2021). Different levels of analysis are needed in innovation ecosystems, such as organisation-level factors influencing relationship-building choices and the consequences of these choices for the whole ecosystem (Radziwon & Bogers, 2019). More specifically, there is a lack of understanding about the way in which open innovation networks manage the tension between knowledge sharing and protection in a complementary manner, and how this management differs from what is generally discussed in the innovation literature (Jarvenpaa & Wernick, 2011). The simultaneous need for knowledge sharing and knowledge protection in interorganisational collaboration is a knowledge paradox and its relation with collaborative performance is empirically underexplored (Huang et al., 2025). Sharif & Senin (2026) also confirm that the field lacks a coherent framework to capture the core dynamics, tensions and paradoxes of collaborative innovation. Collaborative initiatives are systematically trapped in the exploration phase and do not move to the exploitation phase to translate collaborative learning into organisational capability. The present study addresses these gaps by investigating the organisational and structural foundations of ecosystem collaboration that facilitate absorptive capacity in Finnish manufacturing SMEs, the systematic emergence of collaboration paradoxes in

these ecosystems, and the organisational and structural underlying factors that inhibit SMEs from converting collaborative engagement into absorptive capacity.

Research questions and objectives

The study addresses the following research questions:

Q1- How do different ecosystem collaboration structures and mechanisms promote absorptive capacity in SMEs?

Q2- Why do collaboration paradoxes arise within ecosystems, and what factors prevent SMEs from converting collaborative engagement into absorptive capacity?

These research questions require an understanding of how ecosystem collaboration works in practice, including the processes, experiences, and organizational meaning. Therefore, a qualitative research approach is chosen for this study. The empirical study is shaped by three goals:

1. To understand which collaboration structures are most beneficial for SMEs in acquiring and utilising new knowledge.
2. To identify and analyse the collaboration processes that are key to successful organisational learning in SMEs.
3. To identify the factors that cause collaboration paradoxes across ecosystem actors and to examine the organisational and structural factors within SMEs that explain why these paradoxes persist and prevent absorptive capacity.

The focus of this research is Finnish manufacturing and technology SMEs as the primary source of data. It consists of 11 qualitative interviews conducted among 11 Finnish SMEs and is complemented by qualitative interviews from eight higher education institutions and four ecosystem intermediaries.

Scope of the study

This study investigates SME ecosystem collaboration in Finnish manufacturing and technology industries from the theoretical perspective of absorptive capacity, the Triple Helix, and SECI knowledge creation models. The analysis is formed around the SME's involvement with its innovation and knowledge ecosystem, shaped by higher education, public intermediaries, and the organisational prerequisites of whether that involvement results in improvement of absorptive capacity. It defines an ecosystem as an interdependent community of organizations that includes these kinds of actors and focuses on the relationships between them. The empirical focus of the study is restricted to Finnish SMEs, HEIs and intermediaries. The analysis focuses on relationships on the strategic and firm-level as carried by senior managers/owners and exclude the operational and the managerial level.

Structure of the study

The thesis is organized as follows: Chapter 2 examines the literature on SMEs , innovation ecosystems, absorptive capacity, and collaborative learning to build a theoretical framework and identify a research gap. Chapter 3 describes the research methodology and analytical methods. The empirical results are presented in Chapter 4; the research findings and theoretical framework contributions are discussed in Chapter 5; and conclusions, practical implications, limitations, and future research directions are presented in Chapter 6.

2 Theoretical background

The theoretical background is composed of five sections, each building upon the one before it to create the analytical framework used in this investigation. The first section examines four ecosystem categories and establishes the typological distinctions required to comprehend diversity in collaboration mechanisms across empirical data. The second section looks at the main players in these ecosystems, including the government, SMEs, higher education institutions, and intermediaries, as well as their individual responsibilities and limitations when it comes to ecosystem cooperation. The third section discusses the relationship between ecosystem participation and organizational learning, looking at co-creation procedures, knowledge transfer systems, and the function of trust as an enabling factor. The paradoxes that arise from cooperative learning within ecosystems are identified in the fourth section, with a focus on the conflicts between exploration and stability as well as between information sharing and protection. The fifth section outlines the three theoretical frameworks that together serve as the main analytical lens for the empirical analysis: The SECI model of knowledge creation (Nonaka et al., 1996), the Triple Helix model of university–industry–government interaction (Etzkowitz & Leydesdorff, 2000), and absorptive capacity as developed by Cohen & Levinthal (1990) and reconceptualized by (Zahra & George, 2002).

Ecosystem

Ecosystem in the field of innovation and strategy is defined as a group of individual companies that seek to collaborate for value-creation (Adner, 2017; Kohtamäki et al., 2019). Each company has specific characteristics that complement other partners. Both the actors and the interactions between different companies who are dependent on other partners actions are part of the ecosystem (Felin & Foss, 2023; Jacobides et al., 2018).

The difference in characteristics of ecosystems and what needs they are answering has led the literature to introduce different categorizations. Adner (2017), introduced categorization based on the approaches: Ecosystem-as-structure which focuses on value proposition and what actions lead to it, whereas ecosystem-as-affiliation's concentration is more towards ecosystem's actors and their roles being determined by their connections in the ecosystem (Adner, 2017). In this research both approaches are taken to answer the research questions. Ecosystems can be categorized into four individual types: Business ecosystems, innovation ecosystems, entrepreneurial ecosystems, and knowledge ecosystems each having their own specific goal for collaborations, ways of interacting, logic behind decisions, and participant roles (Scaringella, 2019; Valkokari, 2015).

2.1.1 Business ecosystems

The concept of business ecosystems was first introduced by Moore (1996), who used "ecosystem", a biological metaphor, in management and strategy research to characterize economic communities of interacting organizations that mutually develop their abilities and functions over time and typically centre around the direction of one or more core firms (Moore, 1996). Iansiti & Levien (2004) reinforced this definition by modelling business networks as ecosystems that revolve around a keystone species that are formed from many loosely connected members who rely on one another for longevity and mutual productivity.

2.1.2 Innovation ecosystems

The "innovation ecosystem" was introduced as a group of interdependent actors whose activities leads to bringing innovation to the market (Adner, 2006). Even technically superior innovations are likely to fail if there is not a perfect alignment present between adopters, complementors, and partners (Adner, 2017). Since then, the idea of an innovation ecosystem has gained significant attention in strategy research and policy discussions. The majority of research on innovation ecosystems has focused on the

chances they present for cooperative value creation (Granstrand & Holgersson, 2020). Understanding what each of the ecosystem's members achieve through these collaborations and how they achieve it has not attracted much attention. This study addresses part of that gap by examining how ecosystem collaboration structures shape absorptive capacity development in SMEs, and what conditions explain why this process systematically fails. Innovation ecosystems only lead to co-innovation when ecosystem's actors they jointly find innovation opportunities before starting any developments (co-discovery)(Klimas & Czakon, 2022). So, there are multiple factors affecting the success of innovation ecosystems.

2.1.3 Knowledge ecosystems

A knowledge-based ecosystem is a social and economic environment with focus on public research institutions and universities, whose main purpose is to produce and distribute technological knowledge to enterprises to continuously improve their performance and competitiveness. This type of ecosystem tends to be more structured and focused on a limited number of actors. (Clarysse et al., 2014; Van der Borgh et al., 2012). Järvi et al. (2018) identified two forms of knowledge ecosystem organizations: Prefigurative and partial forms. Prefigurative forms are based on informal co-creation and exploration of knowledge while partial forms are based on more formal ways of defining, structuring, and utilising areas of knowledge. They see those forms as stages of evolution for an ecosystem and require different styles of management and collaboration (Järvi et al., 2018).

2.1.4 Open innovation ecosystems

Open innovation ecosystems are a hybrid category in which the concepts of open innovation, the intentional management of information inflows and outflows across company borders, are integrated within an ecosystem logic of multidimensional interrelated logic that in (Radziwon & Bogers, 2019). Open innovation ecosystem is a set of collaborative agreements that companies use to combine their separate services into

a common, customer-facing solution (Adner, 2006). Open innovation is a process in which organizations willingly share and acquire knowledge from external resources. For open innovation to be successful, there is a need for management inside the firms and between organizations and all the actors across the ecosystem (Radziwon & Bogers, 2019).

2.1.5 Comparison of different ecosystems

In both business and innovation ecosystems, a large firm is responsible for the orchestration of collaborations. In these ecosystems, collaborations are industry-driven and the focus types are overwhelmingly industry-driven, with a central business directing the network's progress (Adner, 2006; Scaringella, 2019). On the other hand, in knowledge ecosystems, the focal point is the university or public research organisation. In this type of ecosystem, the main interest is creation of new knowledge in a pre-competitive environment through joint research projects, collaboration, and development of knowledge base (Clarysse et al., 2014; Valkokari, 2015). A well-developed knowledge ecosystem and publicly funded financial support network does not guarantee if business ecosystems form and local business would exchange mutual values. Clarysse et al.'s (2014)findings question the belief that growing knowledge ecosystems will naturally lead to business ecosystems. It also emphasizes how important it is to grasp how knowledge is transformed into commercial value (Clarysse et al., 2014). This is one of the topics that this study if trying to answer to in context of SMEs, how external knowledge can lead to digital product or services.

Ecosystem actors

2.1.6 Knowledge collaboration in small and medium-sized enterprises (SME)

Small and medium-sized enterprises are categorized as companies with less than 250 employees and an annual turnover lower than 50 million euros in Europe (European Commission, 2016). They form a major part of the business enterprises across developed

countries, and they are responsible for huge contributions to employment, output and economic development (European Commission, 2016; Mei et al., 2019). In contrast with larger enterprises, SMEs are more creative and adaptable than their larger counterpart and smaller size with more informal structure facilitates identification of innovation opportunities and response to signals more rapidly in compared to large bureaucratically structured enterprises (Brink & Madsen, 2016; Mei et al., 2019). However, this agility feature in SMEs cannot cover the fundamental resource imbalances they encounter in innovation. They suffer from lack of internal expertise and resources (Radziwon & Bogers, 2019). They are hesitant to invest in research and development activities (R&D) and have limited access to knowledge and innovation ecosystems (Deschamps et al., 2013; Shahzad et al., 2025).

The internal knowledge-base of an SME is inherently limited, and the market for technological knowledge remains underdeveloped, therefore access to external knowledge is not only beneficial but rather strategically crucial for SME to survive and stay competitive in the market (Hafeez et al., 2025; Ricci et al., 2021; Shahzad et al., 2025). By providing access to research infrastructure, specialized knowledge, market intelligence, and co-development capacity ecosystem collaboration helps cover for the internal resource deficiencies that most SMEs have. These would have been extremely costly for SMEs to create individually (Appio et al., 2024; Costa et al., 2023). This resource dependence means that SMEs present the extremely difficult paradox that they must possess external knowledge in order to acquire the absorptive capacity capable of acquiring external knowledge more effectively. If the collaborative environment is right, the ecosystem participation may be part of the solution to this bootstrapping problem (Grandinetti, 2016).

2.1.7 Role of higher education institutions (HEIs) in innovation ecosystems

Higher education institutions (HEIs) are one of the main actors in innovation ecosystems, particularly within the Triple Helix model, where universities, industry, and government operate as interconnected and co-evolving actors (Etzkowitz & Leydesdorff, 2000).

Universities have expanded their traditional academic role and now are combining research, innovation and economic development (Etzkowitz, 2003).

Innovation ecosystems can be categorized as industry-driven or university-driven. The centre of industry-driven ecosystems are usually multinational high-tech industries, whereas university-driven ecosystems are formed around research-intensive high educational institution and include actors such as joint research centres, and high-tech firms (Levchenko et al., 2018).

Although SMEs and HEIs have mutual interest in collaboration, there are some significant barriers between them during collaboration. HEIs usually work under incentive systems that value academic publication which require lots of time and resources. On the other hand, SMEs suffer from resource limitations and face difficulties engaging with the longer timeframes associated with academic research. Despite both actors valuing mutual knowledge transfer, they differ in how collaboration and knowledge-sharing processes should be organised (Lövsund et al., 2020).

Intellectual Property (IP) Management and technology transfer continue to be amongst the most significant barriers to university-industry collaboration. As a result of this lack of foundational understanding or infrastructure, the vast majority of SMEs manage their collaborations or IP-related issues in an ad-hoc manner with very little preparation and understanding of the formal processes associated with technology transfer. Another significant barrier to successful university-industry collaborations that support SMEs is the lack of sufficient tools, training, and standardised practices regarding IP management (Deschamps et al., 2013). Other factors affecting the success of collaboration between SMEs and HEIs are whether long-term commitment and strong personal relationships have been formed. Collaboration models must adapt themselves to the specific goals and needs of both HEIs and SME partners every time a collaboration is formed. If the collaborator can form a long-term commitment, then the need to adaptation is gone and collaborations can happen more quickly and effectively (Tereshchenko et al., 2024).

2.1.8 Innovation intermediaries in ecosystem collaboration

Intermediaries play a significant role in ecosystems. They directly support SMEs seeking innovation and help them build effective relationships with the main ecosystem organizations. They act as the bridge that facilitates knowledge transfer between ecosystem participants and SMEs (Yam et al., 2011). Different types of intermediaries cover different parts of the institutional work required for digital transition. A publicly mandated digital innovation intermediary participates in institutional work simultaneously at the organization, network, and ecosystem levels as well as across cultural-cognitive, traditional, and governing institutions (Colovic et al., 2025).

Intermediaries must have a set of strong capabilities for enabling SME digital transformation and ecosystem engagement. Three main types of dynamic capabilities were recognised by Hafeez et al. (2025). The first one is the ability to spot opportunities related to the development of new areas of technology, so that they can help SMEs find sources of public funding and secure long-term partnerships that SMEs themselves would otherwise not be able to do. Second one is the ability to co-create and support the development of new business models for SMEs in collaboration with customers, suppliers and competitors. Lastly, intermediaries can redesign the overall structure of ecosystems and help SMEs to develop and implement cooperation agreements and collaborate across multiple ecosystems so that they can continue to innovate digitally as they grow (Hafeez et al., 2025).

Intermediary enterprises in knowledge ecosystems acquire a unique set of active capabilities that allow them to assist SME innovation in an organized manner, rather than just connecting actors passively. Three such capabilities are identified by Shahzad et al. (2025): A sensing capability that allows intermediaries to recognize the needs and knowledge gaps of SMEs; a seizing capability that allows them to connect SMEs with pertinent knowledge sources and jointly develop solutions; and a transforming capability that allows them to support the long-term structural evolution of the ecosystem to

sustain SME innovation capacity over time. Shahzad et al. (2025) provided a theoretically informed account of how intermediaries convert the knowledge resources available within an ecosystem into concrete innovation support for SMEs by defining these skills within the dynamic capabilities' perspective (Shahzad et al., 2025).

2.1.9 Government's role in ecosystem collaboration facilitation

The government plays a vital role in innovation ecosystems through the Triple Helix model, which states that universities, industries and governments are inter-related and develop together (Etzkowitz & Leydesdorff, 2000). Universities generate new knowledge or innovative products; industries create jobs and market value. Government on the other hand make the balance between these interests, an important governance challenge, with public regulation and societal wellbeing (Brink & Madsen, 2016).

Additionally, government involvement impacts the intermediary structures that facilitate SME's innovation/collaboration efforts. For instance, France's Digital Innovation Hubs were purposefully created with financial backing from public policies to help SMEs who do not have access to digital knowledge or transformation (Colovic et al., 2025). This illustrates the fact that ecosystem intermediaries serve more than just as independent collaboration platforms, they also provide institutional mechanisms for achieving public innovation goals.

Ecosystems turned into collaborative learning

2.1.10 From collaboration to organisational learning

The act of participating in an ecosystem does not guarantee that the organisation will learn because the gains from cooperating depend on both the internal characteristics of the organisation as well as how well the ecosystem participants relate to one another.

In the context of the Triple Helix relationship, there are three key partners create a place where knowledge exists that allows small and medium enterprises (SMEs) and large organisations to learn from each other through mutual exchange (Brink & Madsen, 2016). This type of mutual learning occurs when organisations utilise their external relationships to gain access to knowledge and resources and develop their collaborative capability and reputation through their interactions with many other organisations (Powell et al., 1996). SMEs rely upon access to the market and the stakeholders of their industry for identifying and evaluating viable opportunities for innovation. As a result of the reciprocal learning amongst the three Triple Helix actors, SMEs are able to develop their knowledge and understanding from the activity of universities and government actors (Brink & Madsen, 2016).

Collaborative learning improves the absorptive capacity of SMEs by providing opportunities to acquire, assimilate and transform the knowledge they receive from external independent sources, as well as utilising that knowledge for new business opportunities (Cassol et al., 2021; Zahra & George, 2002) . The collaborative nature of interactions makes it possible for SMEs to establish strong collaboration with other organizations throughout the Triple Helix, while at the same time indicating that knowledge transfer through collaborative networks or ecosystems will only enhance opportunities for acquiring knowledge. Consequently, this suggests that collecting knowledge through collaboration supports the potential absorptive capacity of SMEs, while the collective value of using this knowledge may only help improve the entrepreneur's ability to commercialize or use the knowledge practically (Cassol et al., 2021).

In addition, collaboration between SMEs and other Triple Helix actors will result from the orientation of the SME towards learning. A strong orientation towards learning increases the SME's capability and ability to develop collaborative relationships with universities, thereby resulting in the development of innovation capability (Imanto et al., 2019). Meanwhile, merely providing governmental support is insufficient to increase the

connection between networking capability and innovation capability, but when governments actively participate in coordination, market access and facilitation, this will increase positive SME performance outcome through their participation in Triple Helix ecosystems (Noya et al., 2023).

2.1.11 Knowledge sharing and knowledge transfer mechanisms

Several mechanisms for knowledge transfer in innovation ecosystem are documented in literature and the concept of formal and informal process of knowledge transfer were discriminated. Clear objectives and strategies from both parts are prerequisite for a successful HEI-SME collaboration and an institutional standardization is likely to lower the barriers of the collaboration depth and continuity (Lövsund et al., 2020).

Informal interaction mechanism is usually associated with tacit knowledge transfer process. The "socialisation" and "internalisation" processes, derived from SECI model introduced by (Nonaka et al., 1996), appear to be spontaneous and voluntary activities, and hence are characteristic for informal process. On the other hand, "externalisation" and "combination" seem to be related to formal/structured process. Formal interaction mechanism such as contract, joint project, and training course is mostly dedicated to explicit knowledge transfer, and thus tacit knowledge transfer heavily depends on the informal interaction and person-to-person communication. Therefore, informal interaction mechanism is an important source of organizational learning in an ecosystem collaboration (Hoe, 2006).

The role of institutional intermediaries is also an important channel for knowledge transfer. Italian Digital Innovation Hubs (DIH) is not only knowledge intermediary providing information access for SME's to the outside expert but it's also a knowledge provider which affect how SME treats digital transformation process. DIHs' technological orientation, partner network and knowledge base play an important role in guiding the SME's access to knowledge, their interpretation and their usage of knowledge over time.

Therefore, the intermediary plays an active role in an ecosystem learning process rather than being a passive connector (Crupi et al., 2020).

2.1.12 Co-creation and collaborative learning processes

The most intensive form of collaborative learning available within ecosystems is Co-creation. Co-creation is the process of jointly developing value, material and symbolic, in a concerted and parallel, similar fashion way and with the participation of more than one ecosystem stakeholder. For this co-creation process to occur, two prerequisites are necessary: Shared values and vision of the actors and, facilitating mechanisms which will enable the stakeholders to contact and exchange knowledge in concrete ways. While diversity of stakeholders positively affects innovation potential in co-creation, it is also one of the major challenges that they face (Ketonen-Oksi & Valkokari, 2019).

Collaborative innovation which is identified as one kind of co-creation contributes to SME financial performance while absorptive capacity is established to positively mediate the relation. Mechanisms for absorbing capacity development are different from mechanisms for strategic responsiveness, since customer knowledge management capability mediates the relation between collaborative innovation and strategic agility, but does not mediate absorptive capacity. Intellectual capital spanning from human, organisational and social capital further mediates the relation, as it strengthens the effect of absorptive capacity returns on the relation, given higher intellectual capital level (Mata et al., 2023).

2.1.13 Trust as an enabling factor for ecosystem collaboration

Trust and the relationship between formal and informal collaborative structures are both identified as critical enabling factors for effective ecosystem collaboration. Scaringella (2019) identifies invariants that exist in all ecosystem types, namely trust and sense of community, variety of actors, explicit and tacit knowledge interplay, coopetition, uncertainty management and social innovation as an ongoing process. In the context of

innovation ecosystems specifically, the members within the system are interdependent on each other, the organizations involved share their resources and knowledge base while competing as well as cooperating and usually there is a hub member controlling the partnerships (Adner, 2006; Jiang et al., 2022; Scaringella, 2019).

Paradoxes of collaborative learning in ecosystems

2.1.14 Knowledge sharing and protection in ecosystems

One of the most deeply rooted paradoxes in ecosystem collaboration is a dilemma between preserving knowledge to keep a competitive advantage and sharing it to promote co-creation. Huang et al. (2025) define it as the knowledge paradox, where organisations must share and protect knowledge simultaneously while collaborating with other actors. Although some organisations might not be aware of this paradox, it exists naturally as a part of interorganisational collaboration (Fortes et al., 2023). Organisations do not have a choice between sharing and protecting knowledge, as they are both essential for them and have to manage both at the same time. Knowledge sharing leads to value creation for them, and the valuable knowledge needs to be protected from unintentional disclosure (Huang et al., 2025).

This paradox is more noticeable in innovation ecosystems than it is in traditional innovation networks. The reason behind this is the structure of networks, in which actors know who they are working with and can accordingly decide what knowledge they want to share. Whereas in ecosystems, actors could be less aware of every other innovation actor, making it structurally difficult to fully control the extent of knowledge sharing. Due to lack of structural opacity, ecosystem members face significant knowledge management challenges. This results in another layer of governance complexity that neither bilateral contracts nor traditional IP contracts can properly solve (Paasi et al., 2020).

Actors in different ecosystem roles have completely different approach regarding knowledge sharing and knowledge protection, which are directly affected by their business objectives and structural position within the ecosystem. Openness is preferred by solution integrators who develop new solution into the systemic solution of ecosystem. As it helps them achieve their business objective of delivering a systemic solution that incorporates the specific knowledge of several ecosystem actors to market. Usually, solution providers join the ecosystem with prior technology and knowledge, therefore, they highlight having formal IP protection of innovations under development while staying open and flexible to new business possibilities. As a result, they are the most hesitant to share their knowledge, fearing that it would leak out during collaboration, especially when they may be competing with other actors in the same ecosystem. Universities and research institutes create additional stress regarding knowledge sharing since they usually are interested in publishing their findings which is directly conflicting with other ecosystems actors' need for business confidentiality. Inter-personal trust is more important in supporting knowledge sharing in ecosystems than in networks. Ecosystem-level regulations are needed for managing the paradox of openness. They can promote trusted knowledge sharing among participants who are not mutually connected to one another (Paasi et al., 2020).

Businesses on the other side, seek to share knowledge while still protecting their own commercial interests, causing problems especially in matters related to confidentiality agreements and intellectual property rights. Handling the issue of different knowledge-sharing preferences demands a flexible approach to task organization, a shared focus on shared objectives, and a mindful and adjustable use of legal agreements. This results in possibility for organizations to work together while maintaining clear boundaries for the protection of sensitive information (Jarvenpaa & Wernick, 2011). Sharif & Senin (2026) argue that effective governance of this knowledge paradoxes must be based on a combination of formal controls and relational flexibility. They say that governance

paradoxes are still unresolved as collaborative ecosystems need to achieve both efficient coordination through rules and the flexibility required for genuine co-creation.

2.1.15 Exploration, exploitation and collaborative stability

Beyond the knowledge protection paradox, open innovation ecosystems generate a further set of interlocking tensions related to how collaboration is organised, how diversity and cohesion are balanced, and how stability and flexibility coexist. Jarvenpaa and Wernick (2011) identify three paradoxes in this domain. The conflict between short-term commercial relevance and long-term knowledge discovery can be observed in the boundary paradox between internationally competitive disruptive innovation and industry-driven slow research. The relationship paradox indicates a trade-off between the trust that familiar ties bring and the depth of perspectives that varied collaboration allows. The conflict between the freedom needed for creative invention and the coordination that formal structures offer is reflected in the organizing paradox. This conflict happens between emergent flexible processes and preset bureaucratic governance. All of these paradoxes are interlocking meaning the same cultural, institutional, and structural factors that intensify one paradox simultaneously reinforce others. This interlocking nature explains why no single governance mechanism can resolve the tensions inherent in open innovation networks and why effective management requires a complex and simultaneously deployed repertoire of approaches such as paradoxical thinking, dual leadership integrating industry and research perspectives, shared problem focus, and improved collaborative process design (Jarvenpaa & Wernick, 2011).

Theoretical frameworks

This section presents the theoretical frameworks that support the analysis in this study: The SECI model of knowledge conversion created by (Nonaka et al., 1996), Triple Helix

model by (Etzkowitz & Leydesdorff, 2000), and absorptive capacity as developed by Cohen & Levinthal (1990) and reconceptualized by Zahra & George (2002).

2.1.16 Absorptive capacity: Cohen & Levinthal (1990)

Cohen and Levinthal (1990) define absorptive capacity as a firm's ability to recognise the value of new external information, assimilate it, and apply it to commercial ends. Absorptive capacity is heavily dependent on related knowledge. Therefore, an organization's ability to absorb and use external knowledge depends on the diversity and depth of the knowledge base it already possesses. The two main components of absorptive capacity are internal knowledge dissemination and external knowledge acquisition. Internal knowledge dissemination involves distributing acquired knowledge throughout the organization in formats that numerous actors can access and utilize. On the other hand, external knowledge acquisition requires searching for and identifying valuable external knowledge (Cohen & Levinthal, 1990).

The development of absorptive capacity in SMEs occurs through two interconnected processes. The first one is tacit knowledge management, which is the management of non-codifiable knowledge flows through socialization, mentoring, and experiential learning. The second one is the management of explicit knowledge flows through systematic documentation, storage, and retrieval, known as codified knowledge management. A unique aspect of absorptive capacity in SMEs is the relational dimension of SME knowledge management, which is the management of inter-organizational relationships through which external knowledge is accessed. This dimension is formed by the quality of external relationships rather than just internal capability (Grandinetti, 2016).

2.1.17 Absorptive capacity reconceptualised: Zahra & George (2002)

Zahra & George (2002) reframed absorptive capacity as a dynamic capability and defined the difference between potential absorptive capacity (PACAP) and realised absorptive

capacity (RACAP). PACAP consists of knowledge acquisition, which is the identification, valuation, and acquisition of external knowledge, and assimilation, which is the routines and processes by which a firm analyses, interprets, and comprehends externally obtained knowledge. On the other hand, RACAP consists of exploitation and transformation. Exploitation is the refinement and leveraging of existing competencies by integrating acquired and transformed knowledge into the firm's operations. Transformation is the combination of existing and newly acquired knowledge to develop new knowledge (Zahra & George, 2002). Interorganizational learning has a more beneficial impact on PACAP than on RACAP, suggesting that ecosystem collaboration is more successful at improving information access and comprehension than at facilitating knowledge transformation and exploitation (Cassol et al., 2021). The level of efficiency with which firms convert potential into realized absorptive capacity is determined by how much organizational members share common frameworks, communication norms, and integrative processes. This makes the social integration mechanism as a critical moderator of the PACAP-RACAP interface (Zahra & George, 2002). The relationship between collaborative innovation and absorptive capacity is moderated by intellectual capital, including human, organizational, and social capital (Mata et al., 2023; Zahra & George, 2002). Furthermore, the relationship between collaborative innovation and strategic agility is moderated by customer knowledge management capability, but not the relationship between collaborative innovation and absorptive capacity. This suggests that distinct pathways from ecosystem collaboration to firm-level learning outcomes are governed by different capabilities (Mata et al., 2024).

2.1.18 The Triple Helix model: Etzkowitz & Leydesdorff (2000)

Etzkowitz and Leydesdorff (2000) conceptualise innovation dynamics as evolving from national innovation systems in which each institutional sphere performs distinct and non-overlapping functions toward a Triple Helix arrangement. This arrangement consists of universities, industry, and government develop increasingly hybrid functions through coevolutionary interaction(Etzkowitz & Leydesdorff, 2000). The knowledge space produced through Triple Helix interaction is the zone of hybrid functions where

universities perform industry-relevant research, industry engages in quasi-academic knowledge development, and government enables and coordinates rather than directs (Brink & Madsen, 2016). Noya et al. (2023) extended the Triple Helix framework by introducing the SME community as a fourth element mediating between the three institutional helices and individual SMEs, finding that the SME community partially mediates the Triple Helix–SME performance relationship (Noya et al., 2023).

2.1.19 The SECI model: I. Nonaka et al. (1996)

SECI model introduced by I. Nonaka et al. (1996) includes four types of knowledge transfer: Socialisation, externalisation, combination and internalisation. Sharing implicit information through firsthand encounters and group activities is referred to as socialization. Externalisation is the process of converting implicit knowledge into written or explicit notions. Combination is the process of arranging and incorporating explicit knowledge into a larger body of knowledge. Internalisation happens when people learn by doing and gain practical experience, they internalise explicit knowledge and turn it into tacit knowledge (Nonaka et al., 1996).

Knowledge creation in entrepreneurial firms corresponds to the four SECI phases: Internalization through iterative improvement of business models in practice, externalization through articulation of market intuitions in strategic documents, combination through integration of research and operational planning, and socialization through direct customer and industry interaction(Bandera et al., 2017).

In terms of formality, socialization and internalization are primarily informal knowledge processes since they develop organically as a result of voluntary engagement and experience. Externalization and combination, on the other hand, are more formal, structured procedures that depend on systems, organized actions, and documentation (Hoe, 2006).

2.1.20 The frameworks as a combined analytical lens

The Triple Helix model, absorptive capacity, and the SECI model each address a specific analytical layer of the research problem. Together, they provide an interrelated multi-level perspective for the empirical analysis of the study. The Triple Helix model defines the structural framing at the ecosystem level, which is formed of institutional actors and the collaborative space provided for SMEs. Then on the process level, SECI model defines the concepts for examining how the knowledge is shared in collaborative ecosystems, moves or fails to move through socialisation, externalisation, combination, and internalisation. Absorptive capacity and specifically the PACAP-RACAP distinction, dive into a firm-level analysis lens. It determines if the knowledge that moved through the SECI process is captured, retained, and used by SMEs. Ecosystem structure defines what collaborative knowledge exchange opportunities are available. On the other hand, the SECI model decides how much of that flow is processed, and lastly, absorptive capacity determines how much of the knowledge and learning that is processed becomes organizational capability. The study's layered design provides a chance to investigate if ecosystem collaboration benefits SMEs, and also a chance to investigate at what level and by what mechanism the collaboration succeeds or fails.

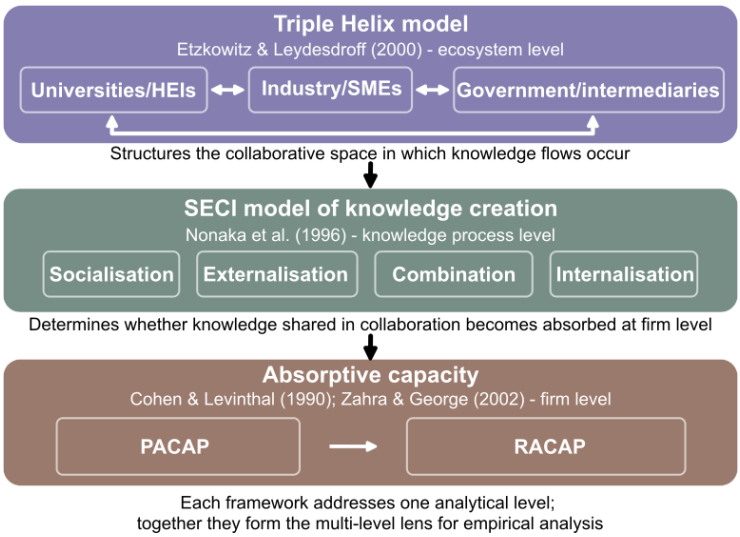

Figure 1. The multi-level analytical framework. The downward arrows indicate how each level feeds into the next analytically.

3 Research material and methods

Research design and approach

This study was done in a form of a qualitative, interview-based study. The goal of this study was to understand how Finnish manufacturing and technology SMEs participate in ecosystem collaboration, how such collaboration promotes their absorptive capacity, and what collaboration paradoxes and structural root causes explain why this process systematically fails to generate absorptive capacity gains. A qualitative approach was chosen as it helps gather a real understanding of processes, experiences, and meanings from the point of view of people who are involved directly (Fossey et al., 2002).

The research study employs an interpretive approach and is consistent with the study's objective of understanding Finnish SMEs' experience regarding ecosystem collaboration. It follows an abductive logic which begins with established frameworks while remaining genuinely open to findings that require those frameworks to be extended or refined (Timmermans & Tavory, 2012).

Data Collection

3.1.1 Sampling strategy

This study adopts purposive sampling, meaning the SMEs were selected based on their suitability to contribute to the research question and topics (Tajik et al., 2025). In a few cases, participants recommended or assisted in getting in touch with more appropriate coworkers within their organization. While there were aspects of snowball sampling in this (Noy, 2008), the selection of participants was based more on whether they have the right and relevant experience than the convenience of the sampling.

Companies were intentionally chosen to confirm the EU regulation for SME size, defined as fewer than 250 employees. Companies from different industry backgrounds were selected based on having proven collaborations or at least funding from ecosystem bodies such as Business Finland and were contacted by email or phone call. An interview invitation email containing study's objectives and privacy notice in Finnish was sent to almost 90 companies, following with follow-up emails and calls to persuade them for participation. Out of 90 contacted companies, 11 SMEs finally agreed to the interview.

Existing data collected from HEIs, and intermediaries were collected by the research group for another larger research project and used for this research study. Participants were selected from a group who play direct support roles in helping SMEs engage with the ecosystem. Those include: HEIs who offer knowledge, resources, infrastructure and research co-operation; intermediaries who support SMEs accessing co-operation projects and public funding, respectively. These three categories offer the sum up knowledge that cannot be obtained by individual perspective alone.

Altogether 23 participants were interviewed. These participants consist of 11 individuals from Finnish manufacturing and technology SMEs, 8 participants from higher education institutions and 4 participants from an ecosystem intermediary organisation. SME interviewees were owners, chief executive officers, and senior managers with experience of, and responsibility for, an ecosystem collaboration. The participants from HEI were involved with industry collaboration as innovation managers, researchers or academics. The interviewees from an intermediary organization worked on a strategic and operational level in the context of an innovation support body at regional or national level.

3.1.2 Interview process

Primary data were collected through semi-structured interviews with eleven Finnish SMEs. Interviews were done using a set of guiding questions in a flexible environment to allow the conversation to develop naturally according to each participant's responses.

Additional follow up questions were asked to get as close to the answers to each question. This was highly important for gathering more in-depth, personal and sensitive data that might not appear in structured interviews environments (Adams, 2015; Brinkmann & Kvale, 2018).

The semi-structured interview guide (see Appendix 1) provided structure in all the interviews. SME interviews consisted of eleven questions, starting with the first three, which asked about their company, what they do, how many employees they have, what their yearly revenue is, interviewees' roles and histories in the company, and how external relationships with industries, intermediaries, and HEIs were handled in real life. The second set of questions was designed to study experienced, perceived, and governed. Questions 4 and 5 addressed the perceived value of collaborations and the networks through which the knowledge exchange happened, aiming to understand what interviewees saw as beneficial and what gaps remained. Questions six to eight focused on the governance of collaborative learning, how intellectual property and related conflicts were managed, and whether prior collaboration experiences shaped future collaborations or affected them. The last three questions' focus was on the internal capabilities of SMEs that turned external knowledge into absorptive capacity. The progression throughout the questions indicated the study's goal of understanding the whole pathway through which ecosystem collaboration either turns into positive impacts or, in some cases, falls short in generating absorptive capacity.

All interviews with SMEs were conducted using Microsoft Teams between March and April 2026 and the conversations, carried out either in Finnish or English, were transcribed automatically then transcribed with reference to the audio recording where necessary. Most interviews lasted roughly half an hour and were supplemented by researcher field notes that were taken immediately following the interview to record background detail and initial thoughts of analysis. Before each interview, participants were informed about the study and assured of their anonymity including a verbal consent that was recorded at the time of interview.

HEI and intermediary stakeholders were supplemented with similarly structured semi-structured interview data collected by members of the wider research group concerning their role in ecosystem composition; methods to foster SME engagement; and views on enablers of, and barriers to, the development of meaningful interactions. The resulting data were provided to the current research in both transcript and anonymised formats.

Table 1 below describes the interview participants, their positions, their roles, the language of the interview, duration of interview, date of interview and interview identifiers used throughout this study

Table 1. Interview information.

Company	**Position**	**Role**	**Language**	**Duration**	**Date**	**Participants Identifier**
SME 1	R&D director and team manager	Responsible for all external collaborations	English	53 minutes	27/03/2026	I1
SME 2	CEO	Primary decision-maker for all external collaboration and funding applications	English	35 minutes	30/03/2026	I2
SME 3	CEO	Primary decision-maker for all external collaboration and funding applications	English	35 minutes	31/03/2026	I3
SME 4	CEO	Primary decision-maker for all external collaboration and funding applications	English	34 minutes	01/04/2026	I4
SME 5	Managing director	Primary decision-maker for all external collaboration	English	30 minutes	02/04/2026	I5

		and funding applications				
SME 6	Sales manager and Manager of customer projects	One of responsible people for external collaborations	English	42 minutes	02/04/2026	I6
SME 7	CEO	Primary decision-maker for all external collaboration and funding applications	English	30 minutes	09/04/2026	I7
SME 8	Managing director	One of responsible people for external collaborations	English	30 minutes	10/04/2026	I8
SME 9	Project manager	One of responsible people for external collaborations	English	37 minutes	10/04/2026	I9
SME 10	CEO	Primary decision-maker for all external collaboration and funding applications	Finnish & English	35 minutes	13/04/2026	I10
SME 11	Head of Sales	One of responsible people for external collaborations	English	32 minutes	15/04/2026	I11

Data analysis

The analysis was conducted using the Gioia approach (Gioia et al., 2013, p.16) and accordingly the findings are grouped in three levels of abstraction: 1) first-order themes, described by the language of the interviewees; 2) second-order themes, based on theoretical concepts; 3) aggregate dimensions, hinting at higher-order constructs. This method was selected since it has been a common method in management and organization studies and enables theory to be built on second level and at the first level

the interviewees' voices to be heard. However, extending the Gioia frame, abductive logic (Timmermans & Tavory, 2012) has been used and research design alternated between theory and empirical data. Data from all three actors-SMEs, HEIs, and intermediaries-was triangulated to allow findings from the primary SME data to be corroborated, extended and, where necessary, constructively contradicted with both intermediary and HEI data.

In order to preserve informant language at the first-order level, initial coding was done inductively. Theoretical frameworks were applied at the second order and aggregated levels to interpret emergent patterns. Where findings emerged that were not anticipated by the initial analytical framework, most notably the role of customer relationships as a primary ecosystem knowledge channel and the bidirectional nature of HEI-industry knowledge flow, these are reported transparently alongside the theoretically organized dimensions.

Three theoretical frameworks are applied retrospectively at the second-order and aggregated levels: Absorptive capacity model (Cohen & Levinthal, 1990), providing the primary conceptual lens; the Triple Helix model of university-industry-government interaction (Etzkowitz & Leydesdorff, 2000), framing the ecosystem structure; and SECI model of knowledge creation, informing the analysis of tacit-explicit knowledge dynamics (Nonaka et al., 1996).

The data resulting from coding have been depicted in the form of Gioia data structure which is given in Table 2. Throughout this study, participant quotations and references are identified using a group and identifier number notation. SME participants are coded I1 through I11, HEI participants are coded H1 through H8, and intermediary participants are coded INT1 through INT4.

Table 2 provides a comprehensive overview of the whole Gioia data structure using data from all the sources where it moves from descriptive first-order codes to second-order themes and overall dimensions.

Table 2. A summary of the Gioia data structure across all data.

Source	First-order themes (Interviewee language)	Second-order themes	Aggregated themes
I2	"Team sessions, face-to-face sessions or seminars, cooperation with schools. There are many kinds of these environments"	knowledge exchange in structured knowledge-based activities	Ecosystem Collaboration as a Value-Creating Mechanism
I3	"Quite active also in advisory boards in different projects"		
I10	"Business Turku's networking session regarding energy industry. They can recommend us to certain companies on big projects."		
INT2	"We organize 40 to 50 different networking events per year, combining people and companies is one of our biggest roles"		
I5	"T***** university has been doing some measurements for us, and they are publishing this article. It brings big value for us and also, we get publicity"	HEI collaboration as multi-level resource	
I9	"We cannot study the new technology by ourselves, so we ask for resources from universities by getting students with new knowledge working for us"		
H1	"University has a lot of infrastructure including labs. Great way for the industry to access machinery and test ideas, even more relevant to SMEs."		
H5	"Companies need to have capabilities to absorb new knowledge and skills. We can give our research and knowledge to utilize for company purposes."		
I3	"We got funded from Business Finland to finish this R&D project. Now we have a new testing system in place, and we are selling it to our customers."	Public intermediaries enabling market access and R&D	
I3	"Local communities have funding opportunities and networking opportunities. We can join them and see potential customers."		
INT1	"We have a very important role to link these actors together and get the right type of		

	projects that companies need to level up their innovation capacity"		
INT3	"Our role is just to find a match between the company and the university. If they find mutual benefits, they will be quite successful"		
I2	"We have been in business since the 1970s. We have very high-level trusted partnerships with no issues or challenges"	Trust as the foundation of knowledge depth	
I6	"If we have made a successful project, it is easier to start a new one because you have done something earlier and it is working out great"		
I7	"Now that we have the contact person, we know who to contact and of course they know who to contact further"		
INT2	"Almost everyone knows each other. That makes us less vulnerable. Someone does something wrong, they are not in the ecosystem after that anymore"		
I2	"We can learn all the time from other companies, and it makes us faster in the market"	Collaborative learning accelerates competitiveness	
I11	"Making it more efficient all the time. Learning is one of the most important factors when speeding up productivity"		
I2	"We designed a study on new technology using ecosystems collaborations. It involved reference visits, university professionals, calculations, pilot project, lessons learned reports"		
H3	"Industry research and innovation activities are on such high standards that researchers can learn a lot. Knowledge transfer goes both ways"		
I2	"It is more or less case by case working at the moment. It is not maybe so systematic as we hope that it is"	Reactive and ungoverned collaboration patterns	The Collaboration Paradox: Acknowledged Value, Unrealized Benefit
I5	"We have both informal and a little bit ad hoc activity"		
H1	"At the moment it is still pretty much ad hoc and pretty much at personal level. We must institutionalize those"		
H3	"In Finland a lot of our networks are very informal, and they lack clear governance structures and clear leadership"		
I10	"We want to keep everything we know to ourselves because they are like IP."		

I8	"We'd like to keep the knowledge inside. We are afraid that the knowledge goes out of the company and to our competitors."	The IP Protection dilemma	
I4	"There is a risk that they will steal the IP. The key know-how is kept in-house and shared only on project-by-project basis."		
H1	"Principles and basics of patenting are not that well known, starting from very low levels. A lot of education we need to do."		
I10	"We will contact the teachers and they share our information. But no active relationship beyond that."	Surface-level participation mistaken for collaboration	
I4	"We normally just search from the Internet or sometimes from some industrial fairs."		
H7	"Events throughout the year which try to foster relationships, but they are like pointed events. There is no continuance after that."		
INT2	"SMEs are kind of even afraid of being in contact with HEIs. They don't know what to do, how to do it. To get those that do not collaborate to be more active is the challenge"		
I8	"It is not transparent where ideas go after that and the timelines take too long. Those new ideas should be listed, and we should openly see how those are proceeding."	Collaboration without internal learning capture	
I1	"Lessons many times do get written down somewhere. But maybe our data handling is not the best. We have to rely on people's memories quite a bit."		
I11	"We write memos, but the hectic day makes it impossible to go back to the notes. If we do not immediately fresh it, then it may be forgotten."		
I3	"We are so small a company that we don't have the time to think about new research projects. It is mostly that we are asked to join an application they have in mind."	SME resource constraints as structural ceiling	Root Causes of Ecosystem Under-performance in SMEs
I2	"Time is limited. I unfortunately need to prioritize different platforms."		
INT1	"SMEs have limited time to work with this kind of thing. It needs orchestrator especially when working with SMEs."		
H5	"Small companies, they have very limited resources and time for their development work."		
I3	"Research organisations ask industrial partners to join at a very late stage of the application. We basically don't have time to respond within one week."	Structural mismatch between HEI	

I6	"Sometimes it takes too long time from university to answer us. We are used to same day or next day. If it takes a few weeks that is too slow."	and industry logics	
H7	"For many SMEs things like energy optimization with digitalization still feel very futuristic. That is the misalignment."		
H1	"Companies are looking at it more short term. University should be looking almost a decade ahead. That is how it should be, but it creates the gap."		
I1	"A lot has been lost over the years even though it would have been digitized. We have to rely on people's memories."	Knowledge loss through personnel instability	
I8	"We make the same mistakes in the next project. Too many changes in employees."		
H3	"It helps if there is continuity in terms of people or organizational structures for developing this work."		
I1	"Many are informal. Typically, when money comes into play there has to be some formalities."	Governance vacuum in collaboration management	
I7	"There is no general rule, so they are handled case by case. Rarely we have any research projects."		
H8	"Don't just expect that you sign an agreement and then it works. Both sides have to put in time and work and review and make adjustments"		
INT1	"We need some kind of orchestrator to pull things together and make sure all central actors are involved and can get their voice heard."		
I3	"We don't have any specific project management tools. We are using Excel and basically people."	Weak internal knowledge exploitation infrastructure	
I8	"We should invest in document management. It will not solve all problems but will help in many ways."		
I1	"We have an R&D idea form and IMS system. But the problem might be the execution and prioritization, even with processes in place ideas can be forgotten."		
H6	"Different departments collaborate in isolation with firms. Nobody really goes across and says why do we not do this together."		
INT1	"We need some kind of orchestrator to pull things together. Not only leave it for	The orchestration	

	companies especially SMEs who have limited time."	gap-no actor takes sustained responsibility for ecosystem activation	
H8	"You need to bring also the doers together. Not just high-level meetings over coffee with big plans where nothing happens."		
INT3	"Our role is to find the match. If they find mutual benefits, they will be quite successful. But our role is just to find the match."		

Trustworthiness of the study

Trustworthiness criteria developed by Guba (1981) were used to establish the quality of the study. The criteria included credibility, transferability, dependability and confirmability. Even though the criteria were formulated over twenty years ago, it is still commonly accepted framework used in qualitative studies and has been further refined in more recent publications (Nowell et al., 2017).

3.1.3 Credibility

Credibility of research is determined by the confidence in the truth of the data and the interpretations drawn from it. It is an equivalent for the internal validity concept in quantitative research, but for qualitative studies (Lincoln & Guba, 1985). In this study, credibility was established by prolonged engagement in the data in terms of watching the recordings and checking the transcripts accuracy, writing reflective notes. Multiple actor perspectives were included to provide an actor group perspective on the phenomena and thus reducing risk of confirmation bias of a single actor perspective study (Fossey et al., 2002). Patterns emerging from SME data where they were corroborated, extended or contradicted by the HEI and intermediary data, are explicitly acknowledged in the result section.

3.1.4 Transferability

The extent to which the results of a qualitative research can be applied or recognised as relevant in other contexts defines the transferability of the research (Lincoln & Guba, 1985). To achieve transferability of findings, a detailed account of the research context, actors' roles, actors' groups covered and general setting of the Finnish manufacturing and technology SME ecosystem were given, and anonymity of participants was assured. Detailed quotes from participants, the Gioia data structure tables, and cross-actor coverage table provide richer information for reader to determine the extent to which the findings could be applicable to other SME ecosystems (Guba, 1981).

3.1.5 Dependability

Dependability of a study is the degree to which data and processes remain consistent over time. Dependability is the qualitative equivalent of reliability in quantitative research (Lincoln & Guba, 1985). Dependability was addressed by using a similar interview guide throughout for the SME participants and retaining all coded and named transcripts. The formal records of interview protocols, along with analytical steps, were stored. A summary document made of all the quotes from interviews that led the coding process was also kept as a part of the analytical record.

3.1.6 Confirmability

Confirmability means how much the research finding represents the information contributed by participants rather than the researchers' prior bias and motivation (Lincoln & Guba, 1985). Confirmability was achieved through direct quotations in the text, and through an audit trail which illustrates how final themes are developed from the raw data. An additional layer of confirmability is available to readers through the cross-actor coverage document, which provides a quote for every instance of second-order themes across the three actor groups, hence readers may verify the accuracy of second-order theme coverage count (Table 3) against the interview material (Nowell et al., 2017).

Ethical considerations

Ethical research seeks to do good and avoid harm (Orb et al., 2001) which means that protection of participant was the utmost consideration in this study. Ethical approach of autonomy, beneficence and justice were implemented in this study to respect participant's rights and minimize the risks. Ethics is also considered a critical measure of qualitative research, and encompasses empathy for participants, good relationships and ethical conduct throughout the study (Tracy, 2010).

All interviews followed the General Data Protection Regulation (GDPR) and ethical research guidelines (Voigt & Von dem Bussche, 2017). Interviewees were guaranteed full anonymity: Their name, and company remain undisclosed in this thesis. The study focuses only on general experiences related to ecosystem collaboration, knowledge management, and organisational learning processes.

To make sure that all participants are participating voluntarily, all participants were asked to read interview questions in advance. They were also informed about the purpose of the study, confidentiality of the interview, before the interview started. They were encouraged to use their examples of situations as descriptive as possible while being assured that only a summarized, non-identifiable version of their examples would be presented. Participants' verbal consent to record the interview was acquired at the outset of each interview session. Recordings were handled confidentially and used only for transcription accuracy purposes.

The data gathered from HEIs and intermediaries by the larger research group was utilized based on that larger group's procedures for data sharing and consent protocols. Those participants had agreed to the use of their interview data for related research activities.

4 Results

The results are presented in four subsections. Section 4.1 presents evidence from the data showcasing how ecosystem collaboration creates value for SMEs. Section 4.2 identifies cases in ecosystem collaboration where they failed in value-creation in practice. Section 4.3 investigates the root causes behind these failures. Two additional findings that emerged beyond the initial analytical framework are presented in Section 4.4. The chapter closes with a comparative analysis of how the three actor groups confirmed, refined, or challenged each other's narratives.

Ecosystem collaboration as a value-creating mechanism

When structural and relational enabling factors are in place, ecosystem collaboration acts as a multi-level mechanism that enables SMEs to access, create and utilize knowledge which could not otherwise be generated with internal resources alone. Five value creation mechanisms are discovered from the data: structured ecosystem collaboration activities mediated access to knowledge, multi-level HEI resource mobilization, public intermediary catalysis, relational trust determining knowledge-depth, and collaborative learning affecting competitive velocity. None of the five mechanisms function individually. They positively leverage each other if they occur, and lack of many of them simultaneously explains direct cause to the paradoxes in Section 4.2.

4.1.1 Knowledge exchange in structured knowledge-based activities

The sector clusters, advisory networks and sector-specific events represent the mechanisms whereby the "technically able and resource-poor" SMEs can be kept informed of the newest developments and the state-of-the-art without committing permanent resources to formal R&D activities. What the data points to is not merely the attendance of SMEs to events and the assimilation of knowledge but that participation

in structured ecosystem activities permits a maintenance of absorptive capacity at the periphery of the organization. For those firms that do not have the capacity within their own team to span the multiple relevant technology boundaries, the ecosystem structured activities allow them to keep their knowledge boundary at the cutting edge of their sector. Instead of the in-ward construction of absorptive capacity via internal R&D (the route unavailable to the resource-constrained firm), these firms construct absorptive capacity out-ward, via the distributed knowledge-monitoring functionality of the ecosystem activity.

> “The 6 cluster. Finnish companies working on moving machines and telecommunications are having networking sessions on a monthly basis where they invite different companies and share information. That is very meaningful for companies like ours. Our organisation is not so big that we have our own department on these topics.” -I5

> “There are these networking sessions and gatherings, different types of things. So, we participate in these events. Let's say quite active also in this advisory boards in different projects. So, this is one thing. So, both are relevant to our company. Not so much online. It's more like these face-to-face meetings.” - I3

One of these quotes highlights the underlying mechanism quite clearly: It is the cluster that fills in the internal gap within the department. In terms of absorptive capacity, ecosystems structured knowledge-based activities have become the principal means by which SMEs can satisfy the knowledge acquisition component of potential absorptive capacity, discovering and acquiring access to outside knowledge pertinent to their innovative goals (Zahra & Gerard, 2002). Lacking consistent and structured knowledge-based activities, the presence does not permit reliable entry into the PACAP pipeline for those firms lacking an internal source capable of producing comparable knowledge.

The data also point to an important quality difference that could evolve into valuable ecosystem-level interactions. Both intermediaries and HEIs consistently draw a distinction between large, general-topic fairs (generating early connections, but not much relational substance) and smaller, topic-specific gatherings including institutional follow-up, that generate the cognitive engagement on which follow-on knowledge transfer can build.

> "The most meaningful events are ones that have a very specific topic and agenda and are not too generic. You get a first introduction at big fairs, but you still need to find ways to turn that into more meaningful discussions." -H8

> "Formalized strategy meeting once a year and board meeting once a month. Formal discussion sessions are useful to steer activities in the right direction." -INT3

This quality differentiation can be explained theoretically with accuracy. According to Hoe (2006) explanation on SECI model, big and general events facilitate knowledge combination process-exchange of explicit and codified knowledge by presentations and displays. Small and dedicated meetings facilitate knowledge socialisation process-transfer of tacit knowledge via experiential and interactive practices not produced in structured meetings.

4.1.2 HEI collaboration as multi-level resource

Each of the 11 SMEs has had some kind of engagement with HEI, but the data indicate that not all HEI engagement forms are equal, representing (at least) four qualitative levels of collaboration: Facilities use, student work placement, partnership in the research process and longer-term knowledge collaboration. The benefit of such engagement depends, in the final analysis, upon which of these forms of engagement an SME can achieve and maintain. This fills a gap identified by Tereshchenko et al. (2024),

who documented eight types of university-industry collaboration. They, however, did not analyse the extent to which SME constraints dictate attainable HEI collaboration levels or what the innovation implications of remaining in lower-level engagement types are.

The most common form of HEI collaboration reported was student placements, suggesting this is the form most accessible to resource-constrained SMEs rather than the least preferred.

> "We cannot study the new technology by ourselves. So, we ask for resources from universities by getting students with new knowledge working for us." -I9

> "The collaboration mechanism is typically that people are doing their PhD thesis and master's thesis with the companies, solving small problems all the time. That is very beneficial to the regional ecosystem." -INT3

This can be understood in absorptive capacity terms as the knowledge generation aspect of potential absorptive capacity, in a sense that SME utilizes student placement to acquire/assimilate knowledge it is unable to generate internally (Zahra & Gerard, 2002). This is a viable, hands-on response to the bootstrapping paradox described by Grandinetti (2016) as SMEs require external knowledge to develop the absorptive capacity needed for further absorption of external knowledge. Therefore, recruiting students represents the most accessible way of collaboration with HEIs for SMEs, which provides easy access to the knowledge cycle at comparatively lower costs.

Higher engagement with HEIs however, becomes a source of market credibility and something that SMEs can translate into commercial advantage; a quantitatively different type of value than student placement alone can create.

> “Collaboration with universities is quite important for us because our approach is to provide evidence-based solutions. How do you get evidence? Obviously by doing research. And universities are the key players there.” -I1

> “T***** university has been doing some measurements for us and they are publishing this article. It brings big value for us and also we get publicity.” -I3

These examples demonstrate both the transformation and appropriation aspects of realized absorptive capacity, pointing out that SME is doing more than simply taking on knowledge. It is using that knowledge to produce outcomes that will generate economic value, fact-based service proposals, and external credibility (Zahra & Gerard, 2002). This is the PACAP to RACAP transformation that Cassol et al. (2021) do not believe that ecosystem cooperation can reliably bring, but that it has been evidenced to occur although it appears to require high level cooperation that SMEs do not typically achieve. The HEIs themselves confirm the vast richness of the available resource encompassing all at once, research knowledge, physical resources, and human knowledge.

> “University has a lot of infrastructure, for instance labs. It is a great way for the industry to access machinery and test ideas which is even more relevant to SMEs.” -H1

> “Companies need to have capabilities to absorb new knowledge and skills. We can give our research and knowledge to utilise for company purposes.” -H5

4.1.3 Public intermediaries enabling market access and R&D

Seven out of eleven SMEs named either *Business Finland* or another public intermediary as important and actively involved players in the ecosystem which is the most utilized value creation path among all available in the data and broader than either HIE partnerships or clusters networks. The nearly ubiquity of intermediary utilization itself constitutes a notable finding: It vindicates the claim that intermediaries, at least in public funded innovation ecosystems, are not simply "auxiliary support organizations", but are structural components of these ecosystems (Colovic et al., 2025). This finding suggests that the firms in our sample are not acting in a completely free choice market of collaboration, but within an institutionally structured ecosystem where public intermediaries represent the gatekeepers of formal R&D collaboration.

> “Local communities have funding opportunities and networking opportunities. We can join them and see potential customers.” -I3

> “We have been deepening the relationship with Business Finland. We started many different projects with them.” -I10

How intermediaries create value is entirely different to how HEIs are involved in collaboration. Intermediaries do not create value through offering knowledge but through providing project legitimization, co-funding architecture and market access scaffolding that cannot be mobilized by the resource-depleted SMEs on their own. According to the dynamic capabilities framework by Hafeez et al. (2025), this corresponds to the peripheral opportunity spotting capability of intermediaries which is finding public funds and long-term partners. That is too large-scale and too credibility-demanding to be obtained by an individual SME. For most SMEs in this research, *Business Finland* collaboration is not one of a choice of several possible types of collaboration, but the means that enables other types of cooperation within the ecosystem. Data from HEIs and intermediaries confirms this structural position but also sheds light on its limitations.

> “We have a very important role to link these actors together and get the right type of projects that companies need to level up their innovation capacity.” -INT1

> “There is a tool for every situation almost, such as Business Finland, Academy of Finland.” -H1

4.1.4 Trust as the foundation of knowledge depth

Long-term, trust-based relationships were a crucial factor for SME absorptive capacity in ecosystem cooperation with eight of the eleven SMEs. This finding is validated externally by HEI and intermediaries' participants, as they witnessed the same from an external position relative to the SME. While Grandinetti (2016) recognized the relational facet of absorptive capacity, the extant literature emphasizes trust as a collaborative prerequisite, yet none of the studies empirically explain why trust caps knowledge depth and not cooperation quality at its margins.

> “We have been in business since the 1970s. Very high-level trusted partnership. No issues or challenges.” -I2

> “If we have made a successful project, it is easier to start a new one because you have done something earlier and it is working out great.” -I6

What these quotes show, is more than the simple idea that trusts make partnerships enjoyable, rather, relational history enlarges the repertoire of knowledge to which the SME is willing, and thus capable, of sending and receiving.

The operation works in the following way: Relational history lowers the SME’s IP defensiveness; reduced defensiveness increases the SME’s knowledge-sharing span; increased sharing increases the partner’s absorptive capacity process input quality;

increased input quality increases the partner's absorptive capacity process outcome quality. This is in line with Deschamps et al.'s (2013) finding that a lack of trust creates a knowledge-sharing feedback loop whereby each partner refuses to send knowledge simply because neither partner possesses the relationship mechanism that can define and delimit how knowledge can be shared.

> "Trust is a very big issue. Company needs to trust that partner is capable to solve the problem and has enough knowledge and skills." -H5

The confirmation of HEI is crucial for analysis in that it proves HEI to be a two-sided requirement: SMEs must trust that HEI partners possess knowledge that is both appropriate and proficient. Relational trust then becomes not simply a condition for depth of collaboration but a structural gatekeeper of the absorptive capacity process itself.

4.1.5 Collaborative learning accelerates competitiveness

Five out of the 11 SMEs do not conceptualize collaborative learning as a general capability-building endeavour, but rather as a distinct competitive device: Ecosystem engagement will allow us to speed up to market beyond our internal capabilities. The operating principle here is the distribution of collective intelligence. No single SME is able to watch every important technological change and so, as each actor contributes to a collectively maintained knowledge space, they each benefit from a pool of intelligence.

> "We can learn all the time from other companies, and it makes us faster in the market." -I2

> "Making it more efficient all the time. Learning is one of the most important factors when speeding up productivity." -I11

What these comments reflect is not merely a perception of the importance of learning, but of speed as the primary business output attributed to collaborative learning. SMEs engaged in a learning process that involves ecosystem knowledge flows are not storing up a repository of information; they are maintaining a market responsiveness critical for success.

These findings directly correlate with Imanto et al. (2019) work that suggests that learning orientation will have a direct, positive influence on networking capability, which in turn enhances innovation performance. The respondents here who frame collaborative learning as a competitive velocity mechanism are clearly demonstrating a learning orientation that emphasizes the value of the business output (market speed) derived from ecosystem engagement, rather than the act of ecosystem engagement itself as a means of simply filling a business need.

The collaboration paradox: Acknowledged value, unrealized benefit

The second aggregated theme shows four paradoxes where SMEs were unable to take advantage of ecosystem collaboration, while being aware of the value it brings. Each of the paradoxes can be defined from the SMEs point of view with data obtained through them but also verified by HEIs and intermediaries. These complementary data help validating the trends described by SMEs are actually happening in real cases.

4.1.6 Reactive and ungoverned collaboration patterns

Of the 11 SMEs, eight state their collaboration is ad-hoc, event-driven and relies on individual initiatives, not organizational design. This goes beyond simply being informal, to illustrating the lack of a collaboration strategy; an intentional posture of the firm toward the ecosystem to deliberately direct external knowledge to address specific capability gaps. Lacking strategy, the knowledge coming into the firm via participation with the ecosystem is what it happens to offer not what the firm's knowledge acquisition

needs require. Although Radziwon & Bogers (2019) and Jarvenpaa & Wernick (2011) discuss open innovation ecosystem governance challenges, they do not represent the lack of a collaboration strategy as a persistent and institutionally supported state but as an initial stage that can be overcome by more formal collaboration. The evidence here suggest it is indeed the enduring state.

> “It is more or less case by case working at the moment. It is not maybe so systematic as we hope that it is.” -I2

> “There is no general rule so they are handled case by case.” -I7

There is major theoretical implication: As noted in Cohen & Levinthal (1990), absorptive capacity theory assumes the firm is strategically pursuing relevant knowledge, i.e., information acquisition is intentional and goal-directed. The ad-hoc collaboration we document fundamentally challenges that assumption by providing evidence that the firm is passively collecting whatever external knowledge becomes available as it operates rather than proactively seeking out relevant external knowledge to meet specific innovation goals. That means that the PACAP pipeline identified by Zahra & George (2002) is not being filled by a planned inflow of knowledge but by an unexpected one which is not consistent enough to support a stable absorptive capacity development.

What makes the current evidence analytically consequential is that the HEI data shows the state of ad-hoc collaboration is not just confined to individual SMEs but is systemic to the institutional layer of the ecosystem itself, extending the governance deficit upward into the network.

> “In Finland a lot of our networks are very informal, and they lack clear governance structures and clear leadership.” -H3

> "At the moment it is still pretty much ad hoc and pretty much at personal level. We have to institutionalise those." -H1

This cross-level convergence is critical. While Jarvenpaa & Wernick (2011) advocate that managers can deal with paradoxes of open innovation network governance by embracing flexible approaches to task organization and careful use of formal contracts, they still approach governance paradoxes as issues amenable to individual managers and at the firm level only. The present data suggests this is a phenomenon that exists simultaneously at multiple levels (SME, HEI, network), making resolution impossible at the individual manager level.

4.1.7 The IP protection dilemma

All 8 SMEs mention a contradiction between their desire for external knowledge and their aversion to sharing internal knowledge with other ecosystem partners. As a single issue this may well be rational strategy; but as an emergent phenomenon the data point to three analytically distinct and separately addressable phenomena each with its own implications for ecosystem governance. First, the existence of genuine competitive protection is confirmed. For some SMEs they are in highly specialized technology niches, where their core know-how forms the critical competitive advantage, and protecting it from others within the ecosystem is rational strategic behaviour.

> "We want to keep everything we know to ourselves because they are like IP. We are in a very niche area. That know-how is not well known by many companies, and we want to keep it that way." -I10

Second, there exists what might be called *cultural self-reliance*. This is specific to the Finnish situation and reflects an inclination to withhold even from non-competitors because of a disposition rather than a strategy.

> “The Finnish mentality is that we can do this by ourselves. Kind of afraid of giving additional information. Not directly competitors, but kind of working in the same business areas. That ideology is behind not sharing so much.” -I5

This conforms with findings by Jarvenpaa & Wernick (2011) in their study of Finnish open innovation networks where early-stage network partners were very interested in private ownership and believed sharing knowledge means loss of control and as a result cooperation was very limited and sometimes reduced even between non-competing actors. The present data confirms that this is not an early-stage issue; it continues well into established ecosystem relationships.

Third, and most importantly, there exists gaps in IP literacy. Many SMEs do not question whether to protect their IP but rather whether their current practices successfully do so.

> “I'm not sure if those contracts and NDAs are working the way those should be working.” -I8

This is the language of the organization that lacks the concepts necessary to distinguish what they are revealing and what they are withholding from what the effective strategy is rather than a sophisticated IP strategist. Indeed, Deschamps et al. (2013) find just this level of unawareness: Even among highly innovative firms there is no real sense of urgency to improve IP management; and only few of intermediaries practice sophisticated IP tools for open innovation. The present study reinforces this finding, extend the same argument not only to the SME side of the ecosystem but to the HEI level as well:

> “Principles and basics of patenting are not that well known. Starting from very low levels, a lot of education we need to do.” -H1

This cross-level evidence is significant theoretically. Paasi et al. (2020) argued that to ensure effective open innovation at the ecosystem level there is a need for regulation beyond individual bilateral agreements because networks will comprise actors without mutual ties to each other. The present data is evidence for why such regulation is indeed necessary: When there is simultaneity of both SME and HEI IP illiteracy, it is impossible for bilateral contracts to compensate because the participants lack the knowledge to create or enforce them.

Together the three phenomena feed off of each other, forming a vicious cycle: Lack of IP literacy gives rise to overzealous protectionism which prevents SMEs from gaining experience through sharing and from which they could better identify where protection is appropriate; restricted sharing makes their external partners seem more inherently risky; and the cycle continues. Only by distinguishing between these three issues and developing appropriate responses to each can the obstacles to ecosystem-level IP be overcome.

4.1.8 Surface-level participation mistaken for collaboration

All five SMEs define their practice of ecosystem collaboration by performing such actions as sometimes searching on the Internet for potential partners, occasionally contacting university departments and participating in industry fairs. Such activities do not involve the reciprocal knowledge exchange, relational continuity and mutual investment that the literature argues must be in place for absorptive capacity development to occur. The paradox is not that they are passive but that they think they are collaborating already and thus do not feel that they need support to collaborate more deeply. It is a misrecognition which has real implications for the ecosystem; because a set of SMEs doing little actual collaboration define themselves as ecosystem actors, a distorted image of effective collaboration emerges that neither intermediaries nor HEIs are easily able to contest.

> “We normally just search from the Internet or sometimes from some industrial fairs.” -I4

> “We will contact the teachers and they share our information. But no active relationship beyond that.” -I10

Information gathered via web searches and teacher data requests is superficial and explicit in nature and can be substituted for nothing by the direct collaborative engagement that would facilitate more important learning. These superficial ecosystem participant SMEs occupy precisely such a structurally peripheral position while believing themselves to be deeply involved.

> “SMEs are kind of even afraid of being in contact with HEIs. They don't know what to do, how to do it. To get those that do not collaborate to be more active is the challenge.” -INT2

There appears to be a lack of a clear mental map of what productive collaboration with the HEIs looks like, what steps they need to take to achieve it, and what returns such an activity could deliver.

> “Events throughout the year which try to foster relationships, but they are like pointed events. There is no continuance after that.” -H7

The HEI interviewees shed light on a structural component that reproduces the misrecognition: Most ecosystem events lack follow-up structures to convert first contacts into relationships, which in turn facilitate collaborative learning. In its absence, the socialisation component of the SECI cycle fails to be engaged, the fear of intellectual property infringement is not dissipated by accumulated trust, and the cycle of superficial participation continues. This does not make events ineffective; they actively recreate the problem they are intended to solve.

4.1.9 Collaboration without internal learning capture

Seven SMEs claimed some sort of problem in getting hold of collaborative learning, so that the organisation could use and build upon the knowledge. This is the most critical paradox of the dataset, for it describes a failing even where genuine knowledge sharing is occurring: Learning is acquired through collaborative activity, yet not converted into explicit, organisationally accessible knowledge, so that it cannot be retained, shared, or built upon within the organisation.

> “It is not transparent where ideas go after that and the timelines take too long. Those new ideas should be listed, and we should openly see how those are proceeding.”-I8

> “The problem might not be that we don't have enough ideas. It might be more about the execution and prioritisation.” -I1

> “Lessons many times do get written down somewhere. But maybe our data handling is not the best. We have to rely on people's memories quite a bit.” -I1

What is visible here is not a lack of collaborative input into the organisation but the inability of a structural mechanism to leverage it. The knowledge is gathered at the event but not institutionalised; thus, it remains a set of memories to be lost, rather than an asset to be combined, enhanced and re-used within organizational systems. In terms of absorptive capacity, the consequences are clear: Absorptive capacity is being built by obtaining knowledge via ecosystem engagement (potential absorptive capacity), but cannot move to its realisation, knowledge transformation and exploitation, as the appropriate infrastructure is missing (Zahra & Gerard, 2002). HEI observations point to this failing occurring across the ecosystem's institutional layer as well as knowledge management across institutions which is a systemic issue.

> “Different departments collaborate in isolation with firms. Nobody really goes across and says why do we not do this together and simplify the communications.” -H6

> “We need to understand more about our own capabilities and what we are doing already, and where we are good at.” -H2

Both HEI observations capture precisely the same structural failure, but at the institutional level. They show knowledge being harvested at the point of collaborative activity, but not captured, shared or processed to create organizational knowledge and systems. In H6, departments within the HEI collaborate individually with firms, forgetting about coordinating and consolidating collaboration activities. In both cases knowledge is concentrated in particular individuals or teams rather than embedded in organisational processes, making it vulnerable to loss when personnel change or organisational restructuring occurs. This cross-institutional verification is theoretically relevant: It suggests that the externalisation deficit is not an isolated capability gap that could be filled through, for example, management training; rather, it appears to be a feature of how knowledge-intensive collaboration is organized in the Finnish innovation ecosystem as a whole.

Two of the SMEs (I2 and I5) do not evidence this deficit. Their interview responses suggest a structured, internalized approach to knowledge management, where knowledge governance is embedded into systems through cross-functional, regular idea reviews, and formal CEO-led processes for approval and development commitment, where the output of collaborative work is tracked. Their digital innovation outcomes reflect this, with more robust and commercialised results compared to others.

Root causes of ecosystem under-performance in SMEs

Six underlying causes are found which explains why the paradoxes in Section 4.2 consistently arise. The SME's primary dataset provided five root causes. The sixth, the orchestration gap, was not noticeable from the SME perspective alone and only emerged through HEI and intermediary complementing data.

4.1.10 SME resource constraints as structural ceiling

Time and lack of personnel serve as a structural ceiling on the extent to which SMEs can maintain engagement with the ecosystem, a point unanimously agreed upon by all three stakeholder groups. This is not an issue of temporary circumstances but a constant state. Small companies remain small by keeping low staffs and relying on cost advantages for their financial competitiveness. Hence, collaboration activities must compete with day-to-day operational concerns for the same limited pool of time and personnel resources, with daily operation taking priority.

> "Writing project applications is like 2% of the workload which we have as an industry. Our main goal is basically to serve our customers and do our business." -I3

> "Time is limited. I unfortunately need to prioritise different platforms." -I2

> "We have to keep our hands tied to the actual project work. We don't have so many persons for additional development work." -I7

In terms of absorptive capacity, this resource ceiling impacts the knowledge acquisition dimension of the potential absorptive capacity. The SME is structurally inhibited from committing the time and personnel resources necessary to initiate, manage and sustain a collaborative relationship through which knowledge from outside can be absorbed in

PACAP (Zahra & Gerard, 2002). SMEs need the knowledge input from the outside to develop their absorptive capacity, yet their internal resource constraint prevents them from engaging with the outside to obtain the knowledge they need. This situation creates a vicious cycle where resource scarcity limits ecosystem engagement which restricts knowledge acquisition which in turn perpetuates the internal skill gaps that make their resources seem so scarce in the first place. This structural reading is reinforced by supplementary data from across the ecosystem.

> “SMEs have limited time to work with this kind of thing. They need an orchestrator especially when working with SMEs.” -INT1

> “It is many times a hurdle for smaller companies, both time and knowledge or resources to be involved in projects. But it is very important. And SMEs can gain a lot of expertise from universities through this cooperation.” -INT2

> “Small companies have very limited resources and time for their development work.” -H5

The concordance among the perceptions of SMEs, intermediaries and HEIs is analytically significant. It confirms that the nature and severity of resource constraints is not subject to one's position in the ecosystem but universally seen as the fundamental barrier to deeper SME engagement. Perhaps more importantly, intermediary perception identifies a solution implication: Orchestrated access, whereby a third party takes on the administrative burden and management of a collaborative project on behalf of the SME This should not be considered a supplementary service, but rather a structural prerequisite. Without orchestrators, a resource constraint represents an insurmountable problem.

4.1.11 Structural mismatch between HEI and industry logics

Four SMEs and seven HEIs refer to a persistent disconnect between the way operating speed and knowledge priorities within HEIs are structured and those in manufacturing SMEs. Temporality is the most salient superficial manifestation of this mismatch, late-stage invitation to join projects, sluggish response processes and multi-week communication delays being ill suited for the real-time nature of manufacturing.

> “Research organisations ask industrial partners to join at a very late stage of the application. We basically do not have time to respond within one week.” -I3

> “Sometimes it takes too long time from university to answer us. We are used to getting an answer the same day or next day. If it takes a few weeks, that is too slow for our demands.” -I6

> “There is still some mismatch between the research organisation's perspective and the industry's perspective. It has improved but there is still some mismatch.” -I3

However, the data indicates that there is a structural reason for the temporal symptom, which cannot be fixed through the management of relationships on a bilateral level. An incentive misalignment between the two institutional systems is taking place above individual goodwill.

> “University staff is measured on publications. They need to find the research contributions from industry projects as well. Because if they cannot publish from it, it does not count for them.” -H3

> “For many SMEs things like energy optimisation with digitalisation still feel very futuristic. That is the misalignment.” -H7

This incentive misalignment represents exactly the structural mismatch that Lövsund et al. (2020)observe: HEIs work with institutional incentive mechanisms that favour publications above industry engagement, while SMEs are constrained by resources that do not allow the development of lengthy cooperation cycles inherent in academic research. While both rank the exchange of knowledge with each other as the most desirable result from a collaboration, the institutional logics under which each party operates systematically draws the knowledge production of each towards different poles: Towards theoretical novelty and publishable results for HEIs and towards context-specific, applied and commercially valuable knowledge for SMEs.

4.1.12 Knowledge loss through personnel instability

One common trend in the SME data is the concentration of collaborative knowledge – network relationships, past projects, and tacit understanding from long periods spent in an ecosystem within individual employees, not organizational systems. Such knowledge exits the organization with employees and effectively restarts the organization's actual ecosystem position, no matter the duration of formal collaboration.

> "A lot has been lost over the years even though it would have been digitised. We must rely on people's memories quite a bit. Luckily, we do have people who have been in the company for many years, but that is of course a risk as well. No one is here forever." -I1

> "We have too many changes in employees especially in the director position. We should stabilise these personnel and then do the following project with the same team. That way we could learn more." -I8

The lost knowledge is the implicit understanding of partner capacities, relationships and know-how built through direct contact over years of collaboration which cannot be retrieved, because never externalized. Employee turnover therefore removes not only

an individual but a portion of the organization's relational absorptive capacity, or trust, partner knowledge and network position which influences access to deeper levels of collaboration. After a critical departure, recreating these relationships through re-engagement takes years, leaving the organization's effective position as an industry newcomer no matter the years of prior engagement. The HEI data provides evidence that this vulnerability is not confined to SMEs but affects the whole ecosystem similarly in both directions of the HEI-SME interaction.

> "It helps if there is continuity in terms of people or organisational structures for developing this work." -H3

> "If that person is for some reason leaving, what do we do. We need an account manager function, otherwise we are in trouble." -H1

This symmetry in personnel dependency is significant. If both the SME and HEI side of the relationship are at risk of simultaneous personnel-based knowledge loss, collaboration can break down on either side. An individual departure from either partner simultaneously demolishes accumulated tacit know-how and relationship trust that both parties did not formally capture. This across-level symmetry builds upon Deschamps et al. (2013) finding that the collaboration management gap exists not only at the SME level but among intermediates as well. Here the problem is found to extend equally to HEIs.

4.1.13 Governance vacuum in collaboration management

In 10 of the 11 SMEs, there is an account of an informal, unwritten governance framework governed by relationships rather than routines. Since no formal record of what has been collaborative between the firms exists, the collaborative activity does not result in increasing organisational capability. Each interaction starts anew without the knowledge of what occurred in prior interactions, who participated in them, and the commitments that were made. Where the proactive collaboration discussed in Section 4.2.1 describes a lack of strategy toward collaboration at the ecosystem level, the

governance vacuum described here relates to a lack of processes managing the collaborative relationships which do occur. The two requirements are mutually reinforcing. Where there is no strategy there will be no initiative. Where there is no governance there is no trail of interaction.

> “There is no general rule so they are handled case by case. Rarely we have any research projects.” -I7

> “We are going in the direction of systematic but not there yet.” -I2

From an absorptive capacity perspective, a direct consequence of the governance vacuum is that the transformation phase of realized absorptive capacity cannot take place.

> “Don't just expect that you sign an agreement and then it works. Both sides have to put in time and work and also review and make adjustments.” -H8

The HEI observation precisely states the lack of what is required of a governance framework; a formal process including ongoing management through review, adjustment and follow up through institutionality, and not simply the start of interaction through the execution of agreements.

4.1.14 Weak internal knowledge exploitation infrastructure

The immediate reason why collaborative learning fails to convert into realised absorptive capacity (RACAP) is the lack of infrastructure for knowledge exploitation (i.e. systems for structured assessment of ideas, their documentation, management review, and control of their implementation). The two SMEs that possess functional exploitation infrastructure explain how they systemically manage the conversion of knowledge from acquisition to commercial results.

> “We have these product management meetings. So, everybody in sales, technical support, or R&D can bring up ideas, and we go through all those ideas in this monthly meeting. We are asking: What is the customer need, what is the business case, how much would it cost? We get CEO approval to proceed on this kind of project.” -I5

> “We have yearly management team level must-win battles, monthly sessions reviewing if they have proceeded as planned, and an employee idea system that management reviews.” -I2

Monthly cross-function meetings serve to enable the manifestation of tacit knowledge in a social context, turning this implicit knowledge into explicit material via structured evaluation of ideas and into business cases. The combination phase, where new ideas merge with current strategy, is performed through management's decision making. The final phase of internalisation happens through monitoring implementation efforts which translate knowledge into the operational routines of the commercial result (Nonaka et al., 1996). The aforementioned is a structural mechanism that supports the SECI spiral, helping it reach the commercial exploitation stage rather than breaking down at the point of externalisation. Zahra & George’s (2002) study supports this by showing that social integration mechanisms are essential to translate potential absorptive capacity into actual absorptive capacity. In the absence of such infrastructure, the majority explain the reasons for externalisation failure discussed earlier in Section 4.2.4.

> “We don't have any specific project management tools. We are using Excel and basically people.” -I3

> “We have Teams, different kinds of folders. No strict instructions on where to file things. It is very difficult to find documents.” -I8

These comments reveal an environment where no central repository for knowledge exploitation exists. Ideas that come from the ecosystem get briefly internalized at individual levels before disappearing because no system exists to review, analyse or implement them.

The practical implications are obvious: All the SMEs use the same infrastructure in Finland, utilize the same support providers and HEIs, and have the same budget constraints. It is not their access to the ecosystem, which is a limitation, but their internal capability to manage collaboration and convert what they have learned into organisational knowledge and capability. Addressing the exploitative infrastructure gap is, therefore, not just a managerial suggestion for improvement, but the key organizational factor that allows for the value creation of ecosystem collaboration that already exists.

4.1.15 The orchestration gap - no actor takes sustained responsibility for ecosystem activation

The sixth root cause was only evidenced by HEI and intermediary data and is completely invisible from the SME viewpoint which is, in itself, an analytical point. SMEs experience the ecosystem as something they use intermittently and do not have the reference point to recognize what sustained utilization would look like from an external perspective. HEIs and intermediaries see the ecosystem from a viewpoint which exposes a collective action problem of the highest order: Everyone willing to participate, but no actor taking ownership of kickstarting, enabling, and sustaining multi-party engagement throughout the ecosystem. As a result, collaboration opportunities regularly fail to materialize into collaborative activities, not due to a lack of resources, not due to a lack of willingness, but due to the activation function to convert the two to active activity being structurally vacant.

> “We need some kind of orchestrator to pull things together. Not only leave it for companies, but especially SMEs also who have limited time.

> Someone who is in charge of the cooperation process and knows where we are heading, structuring input from everyone and making sure all central actors are involved.” -INT1

> “There needs to be a resource that actually facilitates the project writing step by step because everyone is busy all the time. Although you would find a really interesting joint project interest, what often happens is it collapses or does not go forward because everyone is so into their own thing.” -H3

The orchestration gap shows that an ecosystem structure is a prerequisite for a functioning ecosystem but an activation function to make things happen is equally so, and that while there has been significant effort in the Finnish manufacturing ecosystem in developing structure, little effort has been done to develop the activation function.

> “You need to bring also the doers together. Not just high-level meetings over coffee with big plans where nothing happens. That is exactly the role the university can take, to make sure these things are actually happening.” -H8

The distinction between connection and coordination identified previously is here revealed as the distinction between an ecosystem that generates collaboration opportunities and one that converts them into collaborative activities. Noya et al. (2023) argue that SME communities offer a distinct mediating function in a Triple Helix system funnelling institutional support into something that an individual firm can act upon-but the present data suggest that even this intermediary function itself needs an actor to initiate and orchestrate it before it can be transmitted to the SME, or else the entire chain of transmission fails before reaching its target.

Emergent findings beyond the initial analytical framework

Two findings that were not anticipated by the initial framework surfaced because of the abductive analytical approach of the study: Customer relationships as the primary ecosystem knowledge channel, and bidirectional knowledge flow in HEI-SME collaboration.

4.1.16 Customer relationships as the primary ecosystem knowledge channel

This study found two SMEs who considered the customers to be more important knowledge channel compared to HEIs, cluster or public intermediary as the primary knowledge acquisition channel for SMEs. This result was not predicted from the theoretical model, but we learned it inductively from the data. The data suggests that the customer relationships serve as one major source of acquiring new knowledge for digital solutions for the SMEs. Existing studies on collaboration in ecosystems emphasize HEIs, intermediaries and industry networks as sources of new knowledge for the SMEs and customers are taken as an element of markets and not as a knowledge acquisition resource.

> "We do cooperation with customers. For result of that cooperation, maybe we get new innovations we can use in our future products. When we meet customers, they tell us about their desires. If it requires new technology, we have no choice but to study and implement it." -I9

> "Customer need that did not take place but then there was the idea. If they needed this, there must be a need in the market also. We decided to build this and got funded from Business Finland." -I3

The interviews demonstrate a reversed knowledge acquisition sequence to what the analytical framework assumed. The SMEs do not approach HEIs or intermediaries to look for relevant digital knowledge but scan for relevant information by engaging with

customers. Customers raise technological needs or new possibilities for the firm that the firm later may utilize formal ecosystem channels and resources for further research and development. The formal ecosystem becomes a secondary resource pool that is activated after a commercial demand has emerged.

> "If you look from a company viewpoint, when you find a mutual customer or mutual business interest or market. That is a very good carrot for co-creating." -INT4

The confirmation by an intermediary in the ecosystem is an important finding as it shows that this pattern of knowledge acquisition is a recognized practice of commercial companies operating within this ecosystem. This is also in line with Mei et al. (2019) that found SMEs improving their innovation performance by developing links with both the key organisation groups (customers, suppliers) and the service provider groups (universities, public agencies), which both impact on innovation performance and also supported that the customer groups contributed to innovation regardless of formal cooperation between firm and provider organisation.

This result goes one step further and argues that for a significant subset of Finnish manufacturing SMEs, this interaction is not only the enabling part but the trigger part that initiates the activation of other elements in the ecosystem. The implication of the result is important to absorptive capacity concept. Cohen & Levinthal (1990) argue that absorptive capacity partly stems from customer and market interaction. Firms can identify what information is necessary for their innovation activities from interactions with markets. Hence, customer-driven innovation is a means to build a firm's absorptive capacity, and this customer-driven pattern of learning happens informally alongside the formal, research-focused collaboration described in the literature.

4.1.17 Bidirectional knowledge flow in HEI-SME collaboration

The initial framework for analysis which reflected the implicit assumption within the bulk of absorptive capacity literature, was that the majority flow of knowledge would be from HEIs and other actors in knowledge intensive ecosystem toward SMEs. The HEIs, however, provided compelling and consistent evidence against this assumption; all eight HEIs interviewed spoke of real, significant learning benefits derived from industry collaborations which went far beyond confirmation of current academic knowledge into new research questions, application focused problem formulation and access to operational data unavailable via academic approaches.

> "Industry, especially if you work with big companies, their research and innovation activities are on such high standards that researchers can learn a lot from that. So there is knowledge transfer both ways." -H3

> "Through the collaboration, the researchers have the opportunity to get their hands on relevant data that they usually would have a hard time to access. Companies sit on a lot of data that is completely unused. These are the most critical things to spur more innovation and research in higher education." -H8

The most salient observation to emerge from these quotes is that the most beneficial HEI-SME collaborations are not knowledge transfer rather than knowledge creation. In joint knowledge creation both the firm and the HEI are contributing and receiving knowledge, and in this case, neither partner can achieve that which would be unattainable if conducted individually. The benefit for HEIs is not simply validation of current academic knowledge but is the acquisition of raw operational data, commercially grounded research problems, and empirical realities that make theory applied forms of knowledge previously unattainable from purely academic means.

It is precisely the reciprocal nature of these outcomes that cannot be encompassed by current absorptive capacity theory. Cassol et al. (2021), Grandinetti (2016) and Zahra & George (2002), all conceive of and measured absorptive capacity as a property of an individual firm and even Grandinetti's (2016) notion of the relational aspect conceptualizes absorptive capacity as one organization's development in relation to another organization. However, the data in this study provides some observations indicating that in some effective HEI-SME collaborations, knowledge forms at the level of partnership rather than inside individual organisations.

To facilitate cross-level analysis, Table 3 summarizes the major themes identified during the interviews and presents the frequency of observations across different actors (SME, HEI, and INT). The frequency counts indicate how often a particular theme or finding emerged within each interview group.

Table 3. Summary of themes and frequency of observations across organizational levels.

#	Theme	SME	HEI	INT
Ecosystem collaboration as a value-creating mechanism				
1	Knowledge exchange in structured knowledge-based activities	11/11	8/8	4/4
2	HEI collaboration as multi-level resource	11/11	8/8	3/4
3	Public intermediaries enabling market access and R&D	7/11	5/8	4/4
4	Trust as foundation of knowledge depth	8/11	4/8	3/4
5	Collaborative learning accelerates competitiveness	5/11	7/8	3/4
The collaboration paradox: Acknowledged value, unrealized benefits				
6	Reactive and ungoverned collaboration patterns	8/11	6/8	2/4
7	The IP protection dilemma	8/11	4/8	1/4
8	Surface-level participation mistaken for collaboration	5/11	3/8	2/4
9	Collaboration without internal learning capture	7/11	4/8	2/4
Root causes of ecosystem underperformance in SMEs				
10	SME resource constraints as structural ceiling	8/11	4/8	4/4
11	HEI-industry structural mismatch	4/11	7/8	1/4
12	Knowledge loss via personnel instability	3/11	3/8	-
13	Governance vacuum in collaboration management	9/11	6/8	3/4
14	Weak internal knowledge exploitation infrastructure	4/11	3/8	2/4

	Orchestration gap	-	4/8	4/4
Emergent findings beyond the initial analytical framework				
15	Customer relationships as the primary ecosystem knowledge channel	2/11	-	1/4
16	Bidirectional knowledge flow	-	8/8	2/4

5 Discussion

This study examined how manufacturing and technology SMEs engage in ecosystem collaboration in Finland, how this collaboration facilitates absorptive capacity, and what collaboration paradoxes and structural root causes explain why the potential value of this engagement so consistently fails to be realised. Finnish manufacturing and technology SMEs operate in an ecosystem that offers abundant collaborative resources, from universities with research infrastructure and knowledge, public intermediaries with funding and access to markets, industry networks with sector knowledge, to learning from peers. The data are unequivocal that the value such resources can offer, are not being harvested. It is not a question of access, but of absorption; SMEs gain access to the ecosystem, but they are not able to efficiently translate what they encounter there to organizational learning. The reason as to why they are not able to absorb, and the structural factors that enable successful absorption, is the core of this study's contribution.

This discussion has been structured into four subsections: Section 5.1 discusses how ecosystem collaboration generates value for SMEs, and under what circumstances it can generate value. Section 5.2 analyses the paradoxes that make it impossible for SMEs to actually capture the value they realize it is there; the conversion failures that lie between ecosystem engagement and absorptive capacity realisation. Section 5.3 discusses the underlying reasons for how and why these paradoxes are structurally reproduced, with a special emphasis on the orchestration gap as the most theoretically important finding. Finally, Section 5.4 introduces the two emergent findings which develop the analytical framework beyond what was initially anticipated.

Ecosystem collaboration as a value-creating mechanism: Enabling factors and limits

The results show that the value of an ecosystem to SMEs depends not just on the structure of that ecosystem, but on a number of enabling factors which appear complementary rather than additive. Each factor gains greater value in the presence of others. While engagement in structured knowledge-exchange activities, HEI collaboration, public intermediary engagement, relational trust and learning all individually contributes to SME absorptive capacity development, each factor is individually insignificant and gains it utility only when combined with others. The context-dependent and not uniformly productive nature of ecosystem collaboration, the mechanism which enables it and the uneven distribution of these enabling factors amongst the SME population are the most crucial findings of this dimension.

The most universally applied value-creation channel is engagement in structured knowledge-exchange activities. All eleven SMEs surveyed had participated in some industry network, cluster or sector event as part of knowledge acquisition strategy. This finding is aligned with Grandinetti's (2016) argument that the relational dimension of SME knowledge management is a unique element of absorptive capacity which stems not solely from internal capability, but primarily from external relations. Structured knowledge-exchange activities are how SMEs accomplish the knowledge acquisition facet of potential absorptive capacity without relying on the R&D infrastructure that larger firms utilize. The data introduces an essential qualitative distinction that the literature does not adequately address: Not all engagement in knowledge-exchange activities is equal. Large generic fairs generate combination-phase knowledge exchange, explicit, and broadly accessible as per Hoe's (2006) SECI framework. Small, focused sessions foster socialisation-phase exchange tacit, relational, and dependent on the informal interaction that formalised events cannot guarantee. The SMEs who access only the former are maintaining ecosystem presence without realising ecosystem value.

All eleven SMEs reported engagement with HEIs; however, these engagements vary significantly in both depth and value. Analysis of the dataset identifies four qualitatively distinct levels of HEI engagement: Infrastructure access, student placement, evidence-based research partnership, and long-term knowledge-intensive collaboration. The level of innovation value generated is critically dependent on the specific level of engagement an SME attains and maintains. Most SMEs remain at the lowest levels due to resource limitations and governance challenges. In contrast, the two SMEs that achieved the highest levels evidence-based research partnership and long-term collaboration, demonstrate qualitatively distinct digital innovation outcomes. This supports Cassol et al. (2021) findings that ecosystem collaboration influences potential absorptive capacity more than realised absorptive capacity but further suggests that this relationship is contingent on the depth of collaboration. Deep HEI collaboration facilitates the conversion to realised absorptive capacity, whereas shallow collaboration results in stagnation at the potential stage.

Public intermediaries, with *Business Finland* as the primary example, represent the most widely accessed value-creation channel among the SMEs studied. Seven out of eleven SMEs identified these intermediaries as active collaborators. The support provided by intermediaries differs structurally from HEI collaboration; rather than contributing knowledge, intermediaries offer project legitimation, co-funding structures, and market access support. This aligns with Hafeez et al. (2025) concept of ancillary opportunity spotting, whereby intermediaries secure funding and partnership opportunities that resource-constrained SMEs are unable to obtain independently. Nevertheless, the data highlights a limitation of this mechanism: Intermediaries facilitate connections but do not provide ongoing coordination. The absence of a coordination function to sustain collaboration beyond the initial match constitutes a structural gap, which Section 5.3 addresses as the orchestration gap.

Relational trust emerges as the structural factor that determines the ceiling of knowledge depth rather than merely influencing collaboration quality at the margins.

We extended Grandinetti's (2016) relational dimension of absorptive capacity from an implicit understanding to an explicit operationalization: The mechanism is IP defensiveness. Relational history leads to decreased IP defensiveness which allows for broader knowledge sharing, greater PACAP inputs, and greater RACAP conversion. Without trust, the SECI socialisation phase through which the most valuable tacit knowledge moves between actors collapses into the more guarded combination phase, cutting off the knowledge type that produces the most consequential learning outcomes. Relational trust is thus not a soft enabler, but a structural prerequisite for an absorptive capacity process of significant quality.

The collaboration paradox: Why acknowledged value goes unrealised

The second dimension of findings relates to the most analytically salient pattern of the dataset, which is the perpetual discrepancy between the value SMEs attribute to ecosystem participation and the value they can gain. Four conversion mechanisms repeatedly fail, and together they explain why the enabling factors detailed in Section 5.1 do not predictably lead to absorptive capacity outcomes even among those SMEs that are active within the ecosystem.

Eight of the eleven SMEs demonstrated a reactive and ungoverned pattern of collaboration, an issue verified at the ecosystem level by the HEI data. This pattern is characterized by the lack of a collaboration strategy which runs counter to a core assumption of absorptive capacity theory. Cohen & Levinthal (1990) assume that knowledge acquisition will be proactive and targeted: Firms pursue external knowledge relevant to their own innovative ends. Most of the SMEs in the study do not; the acquisition of knowledge through ecosystem participation is opportunistic to ongoing operations. The process is driven by what the informal network yields rather than by what specific knowledge needs require. Based on this, PACAP is populated as an opportunity not a planned portfolio, and that the knowledge flowing into the PACAP pipeline is determined by the shape of the network, not the need for new knowledge. It

is noteworthy that, according to the HEI complementary data, this lack of governance is not an individual phenomenon of SMEs; it is a shared ecosystem-wide feature of innovation networks, suggesting that it is a characteristic of the ecosystem's structure rather than a developmental stage.

The existing literature treats IP protection in ecosystems as a single structural phenomenon. Paasi et al. (2020)frame it as a paradox inherent to ecosystem collaboration, and Deschamps et al. (2013) locate it in management gaps between SMEs and intermediaries. However, neither work distinguishes between the underlying drivers of protective behaviour. The present analysis disaggregates IP protection into three analytically distinct components: Rational competitive self-interest, Finnish cultural self-reliance, and IP literacy gaps. This distinction matters because the three components converge to produce over-protection not as a conscious strategic choice, but as an outcome of institutional ignorance. The resulting withdrawal from deep interaction is therefore not inevitable. If SMEs engaged more substantively with ecosystem partners, they would develop more accurate IP management practices and, in turn, more realistic assessments of actual IP risk.

That surface-level interaction is misread as genuine collaboration is evidenced in five of the SMEs and points to a cognitive dimension of ecosystem participation that remains under-addressed in the literature. Radziwon & Bogers (2019) observed that SMEs commonly disagree over what innovation means; the data here extends that finding to what collaboration means. SMEs who report internet searches and isolated conversations with teachers as ecosystem collaboration are not deliberately misrepresenting their activities. They genuinely understand these to be meaningful forms of engagement. The consequence for ecosystem development is that SMEs will not seek out support services designed to deepen collaboration because they already consider themselves collaborative. The structural factor enabling this misrecognition is visible in the HEI data where ecosystem events function as introductions without the follow-up mechanisms which is needed to convert an introduction into the sustained

relationship. Without that continuity in relationship, Hoe's (2006) socialisation phase cannot take hold, and the surface interaction pattern reproduces itself.

The externalisation deficit is a particularly consequential paradox in the dataset because it occurs even when genuine knowledge sharing takes place. Seven of the SMEs reported an inability to convert collaborative learning into documented organisational knowledge. I. Nonaka et al.'s (1996) SECI model identifies externalisation as the process of converting tacit knowledge into explicit knowledge but does not specify the cases during which that phase fails. The present data identifies three such cases: The absence of formal knowledge governance roles, the mobility of personnel who carry tacit knowledge, and the persistent treatment of documentation as a secondary priority. This is not a soft management issue, but it is a hard structural one.

The implications for absorptive capacity are direct. Cassol et al. (2021) find that inter-organisational learning exerts a substantially stronger influence on PACAP than on RACAP. The externalisation deficit proposed here explains that asymmetry: PACAP develops through ecosystem socialisation, but without the organisational infrastructure to externalise what has been learned, the SECI spiral stalls and RACAP cannot form.

Root causes: Why the paradoxes persist

Six structural conditions underlie the paradoxes identified in Section 5.2. They do not operate independently, but they form an interlocking system in which each condition reinforces the others, and no single intervention can resolve the pattern the system produces.

Resource constraints function as a structural ceiling on ecosystem engagement depth, confirmed unanimously across all three actor groups. The lean operational model that characterises manufacturing SMEs (a genuine competitive advantage in market contexts) becomes a liability in the ecosystem context, where strategic engagement competes

directly with operational responsibilities for the same limited bandwidth. The resulting paradox is precise: SMEs require external knowledge to develop absorptive capacity, but the resource constraints that make such knowledge necessary are the same constraints that prevent systematic access to it. This has a critical implication for intermediary design for orchestrated ecosystem access where an external actor carries the overhead of initiating and managing collaboration. That is not a supplementary service but a structural prerequisite for meaningful SME participation.

The HEI–industry structural mismatch operates above the level of individual goodwill. The late-stage project invitations, multi-week response cycles, and incompatible deliverable formats are symptoms of a deeper institutional logic conflict. HEIs are rewarded through publications; SMEs require applied, contextually specific, and often commercially sensitive knowledge. These logics are fundamentally opposed, and they ensure that what HEIs find easiest to produce is structurally misaligned with what SMEs find most useful. The consequences extend into absorptive capacity: Zahra & George's (2002) transformation dimension of RACAP requires that externally acquired knowledge arrive in a form the SME can work with, and when HEI-produced knowledge arrives in academic form, that transformation step is blocked before it begins. Individual collaboration managers on both sides have already attempted timeline and framework adjustments and found them insufficient. Therefore, resolving the mismatch requires intervention at the institutional level.

Knowledge loss through personnel instability follows directly from the externalisation deficit. Because tacit collaborative knowledge is not converted into organisational systems, it resides in individuals, and when those individuals leave, it leaves with them. Critically, the HEI data confirms this as a bilateral vulnerability: Researcher turnover disrupts HEI–SME relationships in precisely the same way that SME manager departures do, leaving collaborative relationships simultaneously fragile on both sides.

The governance vacuum and weak exploitation infrastructure are examined together because they function as the proximate mechanisms through which all five preceding root causes translate into the innovation outcome gap. Nine SMEs describe collaboration that is informal, undocumented, and ungoverned. This directly impairs the transformation dimension of RACAP: Without governance structures that track, review, and build on previous collaborative episodes, each new collaboration starts from zero rather than from an accumulated knowledge base. The contrast between the two SMEs with integrated knowledge exploitation systems and those without provides the dataset's most direct empirical operationalisation of the PACAP–RACAP distinction. Identical ecosystem participation produces dramatically different absorptive capacity outputs depending solely on whether internal exploitation infrastructure is present. The structured processes, review mechanisms, and cross-functional communication norms that I2 and I5 describe are the social integration mechanisms that convert potential absorptive capacity into realised absorptive capacity. The exploitation infrastructure is not a management convenience; it is the organisational mechanism that determines whether the PACAP–RACAP conversion occurs at all.

The orchestration gap is the study's most theoretically significant root cause. Its invisibility from the SME perspective is also the dataset's most methodologically revealing feature. SMEs cannot perceive the orchestration gap because they experience the ecosystem episodically, as a resource they access on demand, and have no reference point for what sustained activation from above would look like. HEIs and intermediaries, by contrast, describe a collective action failure where every actor is willing to collaborate, but no actor takes sustained responsibility for initiating, facilitating, and maintaining multi-party engagement. The existing literature does not resolve this. The Triple Helix model (Etzkowitz & Leydesdorff, 2000) theorises ecosystem architecture; (Colovic et al., 2025; Hafeez et al., 2025)document what intermediaries do when they function effectively. But none of these frameworks addresses the activation problem: Who ensures that the collaboration begins? The orchestration gap finding establishes ecosystem architecture and ecosystem activation as analytically separable conditions

that are equally necessary. Finland has invested substantially in the former without adequately addressing the latter.

Emergent findings: Extending the analytical framework

Two findings that emerged abductively from the data extend the initial analytical framework in directions the existing literature does not anticipate and that carry implications beyond the present study's empirical context.

Customer relationships as a primary ecosystem knowledge channel challenge the implicit assumption in ecosystem collaboration models that HEIs, intermediaries, and industry networks are the principal knowledge sources for SMEs. For two SMEs in the present data, the knowledge acquisition sequence runs in the opposite direction: Commercial customer interactions surface technology gaps, which then activate formal ecosystem resources (HEI partnerships, Business Finland funding) as secondary responses. The formal innovation ecosystem is mobilised by commercial signals rather than engaged proactively. This is consistent with Mei et al. (2019) finding that customer-type and service intermediary-type actors contribute independently to SME innovation performance but extends it by establishing that for a subset of SMEs the customer relationship is antecedent rather than complementary. This triggers formal ecosystem engagement rather than operating alongside it. Cohen & Levinthal's (1990) original argument that absorptive capacity develops partly through customer, and market interaction is confirmed here, and sharpened: The customer-driven knowledge acquisition pattern is not a deviation from absorptive capacity development but one of its primary informal mechanisms.

Bidirectional knowledge flow in HEI–SME collaboration challenges the unidirectional transfer assumption embedded in both absorptive capacity theory and most ecosystem collaboration models. All eight HEI participants described genuine, consequential learning gains from industry collaboration allowing access to operational data, grounded

research problems, and applied feedback. That constituted qualitatively new knowledge rather than confirmation of existing academic understanding. Cassol et al. (2021); Grandinetti (2016); Zahra & George (2002) all conceptualise absorptive capacity as a firm-level property, implicitly framing HEI–SME collaboration as a transfer arrangement in which knowledge moves from source to recipient. The bidirectional finding unsettles that framing to: The most productive collaborations in this dataset are not transfer arrangements but joint knowledge creation processes, in which the relationship itself is the site where new knowledge forms.

6 Conclusion

This chapter presents the study's contributions to research on ecosystem collaboration, absorptive capacity, and collaboration paradoxes in SMEs, and draws out their implications for managerial and policy practice. The first section relates the findings to prior work and articulates four theoretical contributions. The chapter then presents practical implications for SME managers, higher education institutions, intermediary organisations, and policymakers, before closing with an acknowledgement of the study's limitations and directions for future research.

Theoretical contributions

This study makes four main contributions to the literature. Together, they address the gaps identified in the literature review and provide empirically grounded answers to both research questions.

6.1.1 Relational trust as a structural determinant of absorptive capacity

One of the central gaps identified in the literature review was the shortage on specification of the relational dimension of SME absorptive capacity. Grandinetti (2016) acknowledges that this relational dimension constitutes a distinctive component of absorptive capacity in SMEs but does not specify the mechanism through which it operates. The present study fills this gap by showing that relational trust determines the ceiling of knowledge exchange depth rather than merely modulating collaboration quality at the margins.

The mechanism operates as follows: Accumulated relational history reduces IP defensiveness; reduced defensiveness expands the range of knowledge sharing; expanded sharing enriches PACAP inputs; richer inputs enable the RACAP conversion that produces digital solutions. This chain is confirmed across eight of eleven SMEs and

validated from the HEI and intermediary perspectives. The finding repositions trust from a soft relational factor to a structural gatekeeper of the absorptive capacity process. This directly answers Research Question 1 by identifying the relational conditions under which ecosystem collaboration promotes absorptive capacity development.

6.1.2 The orchestration gap as a structural extension of the Triple Helix model

A second gap in the literature was the absence of any account of the activation problem in Triple Helix ecosystems: The question of who ensures that the collaboration the structural architecture makes possible occurs. The Triple Helix model (Etzkowitz & Leydesdorff, 2000), the intermediary capability literature (Colovic et al., 2025; Hafeez et al., 2025), and the broader ecosystem collaboration literature all theorise ecosystem architecture without treating ecosystem activation as a separately necessary condition. The present study fills this gap by identifying the orchestration gap: A collective action failure in which every ecosystem actor is willing to collaborate, but no actor takes sustained responsibility for initiating, facilitating, and maintaining multi-party engagement. This finding establishes ecosystem activation as an analytically separable condition. The Finnish manufacturing ecosystem has invested substantially in networks, funding instruments, intermediaries, and HEI–industry relationship functions without equivalent investment in activation mechanisms. This is the study's most directly policy-actionable contribution and addresses Research Question 1.

6.1.3 The externalisation deficit as a condition-specific SECI extension

The SECI model (Nonaka et al., 1996) describes the knowledge creation spiral without specifying the organisational conditions under which the externalisation phase systematically fails. The present study identifies the externalisation deficit as a structural condition specific to resource-constrained SME environments: The governance roles, documentation routines, and management review processes required for externalisation to function as a reliable organisational routine are absent, and tacit collaborative knowledge consequently remains unrecorded and unaccumulated.

This finding is theoretically significant because it provides a mechanism-level account of why the SECI spiral breaks and offers a probable explanation for Cassol et al. (2021) empirical finding that interorganisational learning affects potential absorptive capacity significantly more strongly than realised absorptive capacity. The externalisation deficit is the organisational condition that produces that asymmetry: PACAP builds through ecosystem socialisation, but RACAP conversion requires the externalisation infrastructure to function, and without it the spiral cannot complete.

6.1.4 Relational absorptive capacity as a partnership-level construct

The final contribution challenges the firm-level framing of absorptive capacity that runs through the literature from Cohen & Levinthal (1990) through Zahra & George (2002) to Cassol et al. (2021) and Grandinetti (2016). Each of these frameworks conceptualises absorptive capacity as a property of a single organisation. The bidirectional knowledge flow finding (confirmed by all eight HEI participants) reveals that the most productive HEI–SME collaborations are not knowledge transfer arrangements but joint knowledge creation processes in which neither party is simply a source or a recipient.

This study proposes the construct of relational absorptive capacity to describe the joint capacity of a collaborative pair to recognise, generate, and exploit knowledge that neither partner could produce independently. The construct carries two theoretical implications. First, firm-level absorptive capacity measures will systematically underestimate the knowledge capacity of SMEs embedded in high-quality collaborative partnerships. Second, HEI–SME collaboration models designed as unidirectional knowledge transfer are structurally misaligned with the form of collaboration that produces the greatest learning value for both parties. Together, these implications extend the answer to both Research Questions 1 and 2: The enabling conditions for absorptive capacity development and the relational conditions that sustain or resolve collaboration paradoxes are not located solely within the SME but reside in the quality of the collaborative relationship itself.

Practical implications

6.1.5 Implications for SME managers

The most consequential investment an SME can make before deepening ecosystem engagement is in knowledge exploitation infrastructure. The data shows clearly that the return on ecosystem participation is determined more by the internal capacity to convert collaborative learning into organisational knowledge than by the quantity or variety of external engagement. A minimal knowledge governance system, e.g., monthly cross-functional idea review meetings, a simple idea-tracking mechanism, and quarterly reviews of what external collaboration has produced, is likely to yield better absorptive capacity outcomes and collaborative learning returns than expanding ecosystem participation without this foundation.

A knowledge audit can also resolve much of the IP uncertainty that currently suppresses collaborative depth. The data reveals that many SMEs restrict their engagement not from strategic calculation but from uncertainty about what is safe to share. Working with an intermediary, IP attorney, or HEI mediator to identify which elements of the firm's knowledge are legally protectable, practically protectable, and freely shareable would enable substantially deeper collaborative exchanges at lower perceived risk.

Relational continuity deserves more deliberate investment than event attendance. The data consistently show that ecosystem value derives from the depth of relational engagement rather than the frequency of participation. Maintaining a small number of high-trust relationships produces substantially more absorptive capacity development than attending many generic events. It would be more beneficial for SMEs to further enhance the collaborative relationships that have already provided valuable outcomes, instead of spreading their resources among various knowledge-sharing initiatives.

Finally, SMEs should proactively request sustained facilitation from intermediaries rather than accepting one-off project matches. This means explicitly asking intermediaries to carry collaborative opportunities from identification through to active project implementation. It does not require additional SME resources, but it requires making the coordination need visible to the intermediary rather than assuming it will be provided by default.

6.1.6 Implications for higher education institutions

The temporal mismatch between HEI project timelines and SME operational rhythms cannot be resolved through individual relationship management but it requires institutional redesign. Faster-turnaround collaboration modalities, standing SME engagement protocols, and project initiation pathways that do not require SMEs to navigate academic application timelines would significantly reduce the operational friction that prevents meaningful collaboration from starting. Same-day or next-day response norms for SME enquiries represent a practical and achievable starting point.

HEIs also have grounds to reframe collaboration as mutual learning investment rather than knowledge transfer. The data confirms that HEI participants gain access to operational data, grounded research problems, and applied feedback that constitute genuinely new knowledge. Realising this requires changes to project design, IP consent frameworks, and internal indicators of collaboration value, but the productive collaborative relationships already present in the dataset demonstrate that the model is viable.

On IP literacy, HEIs are well-positioned to take institutional responsibility for a gap that currently operates on both sides of the collaboration. Practical IP management support, for example workshops, template agreements, and accessible guidance on what can be shared without commercial risk, can be delivered as a standard component of HEI–SME engagement programmes rather than as an optional add-on. This positions HEIs as active

contributors to the ecosystem conditions that make deep collaboration possible, rather than passive participants in them.

6.1.7 Implications for intermediary organisations and policy makers

The orchestration gap finding points to a specific investment shortfall: Finland's innovation support infrastructure is well-designed for connection but not for coordination. Replicating and scaling activation models, in which dedicated facilitation resources carry collaborative opportunities step by step from identification through to operational implementation, is likely to produce higher returns on existing ecosystem investment than building additional architecture without addressing the activation deficit.

The binding constraint on absorptive capacity development is not access to external knowledge but internal SME capacity to convert that knowledge into organisational capability. Policies that subsidise internal knowledge governance capability, such as structured review processes, documentation systems, and collaboration management training, may produce greater absorptive capacity returns than further expanding the already substantial external access infrastructure.

Finally, the IP inhibition loop documented in this study cannot be resolved through firm-level interventions alone. Limited IP literacy on both the SME and HEI sides makes bilateral contracts insufficient as the primary governance mechanism. Intermediary organisations are best positioned to develop simple, standardised ecosystem-level IP sharing frameworks that define what knowledge can be shared without commercial risk.

Limitations

This study has four clear limitations that should be considered when interpreting the findings.

First, the geographical and sectoral scope is relatively narrow. The empirical material was collected from Finnish manufacturing and technology SMEs operating in specific industrial domains. While the Finnish innovation ecosystem provided analytically rich context, the findings may not transfer fully to SMEs in other national settings, particularly those with less developed public innovation support systems or different IP cultures.

Second, the sample size and composition reflect the scope of a master's thesis. Primary data were collected from eleven SMEs, complemented by eight HEI and four intermediary participants. The perspectives predominantly reflect senior management and owner-level actors with direct responsibility for ecosystem engagement decisions. Middle managers, operational staff, and others involved in the day-to-day execution of collaborative projects were not included, and their perspectives might add important dimensions to the findings.

Third, the study relies on a qualitative, interview-based approach, which is well-suited for exploring processes, mechanisms, and experiences but depends on participants' accounts. These may be shaped by recall bias, social desirability effects, or selective presentation. Triangulation across SME, HEI, and intermediary perspectives partially mitigates these risks, but the findings should be understood as interpretive propositions grounded in qualitative evidence rather than statistically confirmed causal relationships.

Fourth, the cross-sectional design prevents causal inference. The study identifies associations and mechanisms but cannot establish, for example, whether knowledge exploitation infrastructure investment causes better digital innovation outcomes, or whether more innovative SMEs are simply more likely to invest in governance structures in the first place.

Directions for future research

Three research directions follow most directly from the findings and theoretical contributions of this study.

1. A longitudinal study tracking the same SMEs over three to five years would enable causal testing of the relationships identified here. A natural experiment in which some SMEs adopt structured knowledge exploitation infrastructure during the study period and others do not would allow researchers to isolate the causal effect of governance investment on digital innovation outcomes, and to address the reverse causality concern that more innovative SMEs may simply be more inclined to invest in governance structures.

2. Comparative cross-national research on the orchestration gap is needed to determine whether the activation failure documented here is specific to the Finnish context or a structural feature of Triple Helix ecosystems more broadly. Countries with more directive ecosystem governance models would provide the most theoretically informative comparisons. Identifying the design features that prevent the orchestration gap from emerging in some contexts but not others would generate policy recommendations applicable well beyond Finland.

3. The relational absorptive capacity construct proposed in this study requires operationalisation and empirical testing. Developing measurement instruments for partnership-level rather than firm-level absorptive capacity and testing whether relational absorptive capacity predicts digital solution outcomes above and beyond firm-level measures would either confirm or challenge the theoretical claim made here.

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Appendix

Interview Questionnaire

1. Could the participant briefly describe the organization, including its primary field of activity, organizational size?

2. What is the participant's role within the organization, and what are the main responsibilities associated with this position?

3. How are relationships with local communities, industries, and higher education institutions (HEIs) managed within the organization?

4. What value does the organization perceive in strengthening collaboration with local communities, industries, and higher education institutions (HEIs), and what aspects require improvement?

5. What platforms, events, or mechanisms (e.g., networking sessions, industry advisory boards, joint initiatives) are primarily used to facilitate interaction within the regional ecosystem?

6. What processes are used to manage intellectual property (IP) and technology transfer between the organization, higher education institutions (HEIs), and other external partners? Could the participant provide examples where applicable?

7. Have any conflicts related to technology sharing or intellectual property ownership emerged during collaborative activities, and how were these situations resolved?

8. How does the organization utilize knowledge and experiences gained from previous collaborations when initiating new partnerships?

9. When new knowledge is acquired through collaboration, how is it transformed into practical solutions, improvements, or innovations within the organization? Could the participant provide an example?

10. What internal skills, tools, resources, or capabilities support the organization in applying newly acquired knowledge in practice?

11. What organizational practices or conditions support the implementation of new ideas into digital solutions or operational improvements, rather than allowing them to remain unutilized? Additionally, what role does management play in this process?