Igniting a knowledge renaissance: revolutionising entrepreneurial ecosystems with transactive memory systems

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Abstract

Purpose – *Prior research has extensively explored the dynamics of knowledge creation and transfer within entrepreneurial ecosystems (EEs). However, the research on knowledge integration within EEs, particularly by entrepreneurs, remains scant. Garnering and effectively using knowledge in such a dynamic and complex environment can provide entrepreneurs with a valuable asset for gaining a competitive advantage. To address this gap, this study aims to explore how entrepreneurs garner and capitalise on knowledge within the EE environment by using a transactive memory system lens.*

Design/methodology/approach – *This study is based on 26 semi-structured interviews with different actors and members of the same ecosystem – the northern Finnish health tech ecosystem. The data were analysed using the Gioia methodology.*

Findings – *This study results found that transactive memory processes (i.e. knowledge specialisation, credibility and coordination) and structures (i.e. differentiated-, shared- and meta-knowledge) influence knowledge organising in EEs.*

Originality/value – *This study provides a conceptual interplay between the EE and the transactive memory system's processes and structures.*

Keywords *Entrepreneurial ecosystems, Transactive memory processes, Transactive memory structures, Knowledge management*

Paper type *Research paper*

(Information about the authors can be found at the end of this article.)

1. Introduction

The entrepreneurial ecosystem (EE) has recently gained popularity among academia, practitioners and policymakers (Theodoraki *et al.*, 2022; Stam and Van de Van, 2021). EEs are complex networks of stakeholders, including entrepreneurs, investors, government agencies, educational institutions and support organisations (Neumeyer and Santos, 2018) that foster entrepreneurial development and growth. Thus, EEs inhabit critical entrepreneurial resources such as capital, knowledge, networks and mentorship (Stam and Van de Van, 2021). Entrepreneurial knowledge is crucial for entrepreneurs to create and operate their ventures successfully. This includes knowledge related to starting and growing a business, identifying and assessing opportunities, developing a business plan and raising capital (Spigel and Harrison, 2018). Autio *et al.* (2018) argued that EEs are often characterised by explicit and tacit entrepreneurial knowledge spillovers (Qian, 2018), which occur when information is voluntarily shared between actors.

Contrary to explicit entrepreneurial knowledge, which is easily codified, stored and retrieved (Elia *et al.*, 2020), a significant portion of entrepreneurial knowledge is tacit, including personal wisdom, practical experience and intuitive insights that are hard to express, extract and transfer (Smith, 2001; Yi *et al.*, 2021). Moreover, the transferability of tacit

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knowledge largely depends on spatial closeness and thus becomes easier to share it within small (and close) groups (Wurth *et al.*, 2022). Even so, sharing and retrieving tacit knowledge from distant or diverse groups becomes more challenging. Consequently, this creates significant and novel problems for entrepreneurs when managing entrepreneurial knowledge within and across large, loosely connected entities such as EEs (Roundy, 2020). Furthermore, Ratten (2021) pointed out that the success of an EE highly depends on the degree of interaction and knowledge sharing among its members. Therefore, exploring entrepreneurial knowledge dynamics and management within and beyond the EEs becomes crucial for shaping our understanding of entrepreneurship mechanisms and related factors contributing to its success.

Despite extensive research on knowledge management (KM) and spillovers, the significance of knowledge within EEs has been relatively understudied (Fotopoulos, 2023; Jones and Ratten, 2021). Moreover, Roundy (2020) emphasises the need for a comprehensive framework to explain this phenomenon within the context of EEs. More precisely, previous research on the importance of knowledge in the EEs has tended to treat it as a single element. For instance, Stam and Van de Van (2021) argued that the systemic nature of EEs requires a more integrated approach to studying knowledge as an interconnected component of this complex system. Therefore, it is essential to investigate the knowledge phenomenon in the context of EEs comprehensively and systematically.

Drawing from Roundy (2020), we use the entrepreneurial transaction memory system (ETMS) theoretical lenses to study how entrepreneurs garner and capitalise (use/apply) the knowledge available within EEs. We exemplify the ETMS framework using an entrepreneurial health tech ecosystem case in Northern Finland. The article provides both theoretical and practical contributions. The study contributes to the existing research on EEs by documenting the role of KM within EEs. It also sheds light on the EE players and mechanisms (conducive environments) that enable effective knowledge sharing and usage within EEs.

The rest of the article is organised as follows. First, we provide the theoretical foundations in Section 2, highlighting knowledge's role in the entrepreneurial process. We also highlight the nexus of knowledge and EEs drawing from a transactive memory theory. We further document the materials and methods used in Section 3. We present the findings and discussion in Section 4. Finally, we conclude our paper by offering the implications and avenues for further research in Section 5.

2. Theoretical foundations

2.1 Knowledge as central to entrepreneurship

Knowledge has long been recognised as a crucial factor in entrepreneurship and can be categorised as explicit and tacit knowledge (Jones and Ratten, 2021). Explicit knowledge, such as scientific principles or technical skills, is codified knowledge that can be easily communicated and transferred (Roundy, 2020). Tacit knowledge, on the contrary, is more challenging to articulate and transfer, such as intuition, experience and relationships (Smith, 2001). Nevertheless, tacit knowledge is essential in entrepreneurship because it is often gained through experience and can provide a competitive advantage (Roundy, 2020). As entrepreneurship is fundamentally about identifying and exploiting opportunities, explicit and tacit knowledge is essential to recognising and acting upon those opportunities (Lemaire *et al.*, 2023). A commonly used framework for understanding the entrepreneurial process is the opportunity identification and exploitation model, which proposes that entrepreneurs identify and exploit opportunities based on their knowledge and expertise (Audretsch *et al.*, 2020). The framework suggests that entrepreneurs must be knowledgeable about their industry, customers and competitors to recognise and evaluate opportunities (Li *et al.*, 2023; Yi *et al.*, 2021).

Knowledge centrality can also be viewed from its importance in spurring entrepreneurial innovations. Innovation is a critical component of entrepreneurship, as entrepreneurs must create new products, services or processes to exploit opportunities (Belitski *et al.*, 2019). Knowledge is essential to innovation as it provides the foundation for creativity and problem-solving (Bhardwaj, 2019). Entrepreneurs with deep expertise in their industry or domain are more likely to develop novel solutions to problems and be able to identify unmet needs in the market. Moreover, knowledge can help entrepreneurs manage risks and uncertainties such as market volatility, technological change and competition (Caiazza *et al.*, 2015). Entrepreneurial knowledge can help entrepreneurs navigate these risks by enabling them to make more informed decisions and anticipate and adapt to environmental changes (Ferreira *et al.*, 2017). For example, knowledge about industry trends and customer preferences can help entrepreneurs develop products better aligned with market demand.

Furthermore, knowledge is critical to entrepreneurial teams and networks (Fotopoulos, 2023; Hayter, 2013) as they consist of individuals with different backgrounds, experiences and expertise. Effective team (network) functioning requires its members to communicate and share knowledge effectively (Argote and Guo, 2016). Knowledge sharing can improve team performance by enabling team members to leverage each other's strengths and overcome individual limitations. Thus, entrepreneurs must continuously acquire and apply knowledge to remain competitive and thrive in today's fast-paced business environment.

2.2 Knowledge management within entrepreneurial ecosystems: mapping the current state of art

We followed Tranfield *et al.* (2003) and Kansheba and Wald (2020) to perform a thorough literature review of the main contributions of KM, particularly in the context of an EE. We purposefully restrict our review to EEs, given the focus of our study and the distinction between the EE concept and other prior (traditional) concepts such as industrial districts and clusters (Spigel and Harrison, 2018; Stam and Van de Ven, 2021). Research trends on KM in EEs reveal three major themes, which will be further discussed in the following sections.

2.2.1 Entrepreneurial ecosystems and knowledge creation. The first emerged research theme (cluster) explores the dynamics of knowledge creation mechanisms within EEs. Scholars (Grande *et al.*, 2023; Yang *et al.*, 2022) asserted that knowledge creation in ecosystems entails the production of novel (innovative) ideas, understandings and intellectual capital. According to Bhardwaj (2019), knowledge generation inside an EE is essential for maintaining competitiveness, adjusting to market changes and promoting a culture of ongoing learning and innovation. Studies under this theme address unique viewpoints on the dynamic mechanisms underpinning knowledge creation – predominantly intellectual capital—in ecosystems. They stress the role of innovation in technology, intellectual capital and creative efforts in fostering sustainable growth and development within the ecosystem.

For example, Mikic *et al.* (2021) delved into the regional intellectual capital landscape within an EU EE, emphasising geographical variations' impact. Meanwhile, the impact of human capital on EEs in emerging economies, with a specific focus on India is also examined (Chaudhuri *et al.*, 2023). In this emerging economies' context, the authors highlighted the role that digital knowledge and innovative capability play as a focus point, highlighting the importance of technological proficiency and human capital in influencing knowledge development. Further research examines the factors that allow for both explorative and exploitative intellectual capital to exist inside EEs, demonstrating a sophisticated comprehension of the ways in which these two aspects converge (Grande *et al.*, 2023).

Furthermore, Canestrino *et al.* (2023) investigate the creation of "humane" EEs in various cultural contexts using a distinct cultural lens. This adds a cultural component and

highlights the close relationship between cultural quirks and the production of intellectual capital. The latter has been further discussed through the origins of an innovation-based EE (Marinelli *et al.*, 2023). This study complements Fischer *et al.* (2022), who adopt a multifaceted viewpoint on performance determinants in knowledge-intensive entrepreneurial enterprises. Together, these articles show how knowledge formation in EEs is complex and diverse, demonstrating that it is not a one-dimensional process but rather is influenced by various circumstances.

2.2.2 Entrepreneurial ecosystems and knowledge transfer. A rich tapestry of insights into the dynamics of knowledge transfer (spillovers) mechanisms within EEs is unveiled by another wide array of articles contributing to the second emerging research cluster. Scholars such as Cetindamar *et al.* (2020) and Secundo *et al.* (2021) referred to knowledge transfer (in EEs) as the process of sharing and exchanging knowledge among multiple actors in the ecosystem. It entails sharing knowledge, skills and insights among investors, start-ups, entrepreneurs, academics and other players. The dissemination of knowledge is widely seen as essential to an EE because it encourages creativity and teamwork. According to Calabuig-Moreno *et al.* (2021), effective knowledge transfer also helps to create a common understanding, best practices and lessons learned, all of which increase the capabilities of both individual players and the ecosystem as a whole. The articles in this cluster emphasise that knowledge transfer within ecosystems is a multifaceted process impacted by various elements, including institutional frameworks, regional traits and the involvement of international corporations.

To illustrate how institutional settings and voids affect knowledge spillovers, Bendickson *et al.* (2021) and Calabuig-Moreno *et al.* (2021) provide insight into how the presence or lack of supportive structures affects knowledge spillovers inside EEs. They also emphasise how critical it is to comprehend the institutional frameworks that support and impede information flow, as doing so is essential to the long-term viability of entrepreneurial endeavours. Other researchers have also highlighted the significance of regional perspectives by revealing the complex relationship between regional heterogeneity and knowledge spillovers within EEs (e.g. Cetindamar *et al.*, 2020; Bhawe and Zahra, 2019; Prencipe *et al.*, 2020). These studies demonstrate how the distinct qualities and dynamics of various locations are crucial in determining the type and magnitude of knowledge transfer. The necessity for tailored methods in fostering EEs is highlighted by the significance of regional diversity and, therefore, emphasising the incapacity of a one-size-fits-all approach to capture adequately the complexities of knowledge dynamics.

Furthermore, digital innovation is woven intimately into the fabric of knowledge spillovers within EEs, emerging as a revolutionary force (Colombelli *et al.*, 2023). The investigation of the function of digital innovation represents the dynamic character of knowledge transfer processes driven by technology breakthroughs. The authors contend further that, by recognising the current impact of digital transformations, the digital dimension adds a dynamic layer to our understanding of the knowledge flow within EEs. The relationship that has formed between worldwide open innovation and knowledge spillovers is another factor that has emerged and contributes to the global interconnectedness of EEs. Prior research (Ferreira *et al.*, 2021; Yi *et al.*, 2021) emphasises that knowledge transcends national borders and highlights the importance of a global viewpoint in understanding and using knowledge flows.

Another line of research by Andrade *et al.* (2022) and Bhardwaj (2019), among others, documents the imperatives of KM capabilities, illuminating the critical role played by intentional strategies and capabilities in shaping knowledge spillovers within EEs. This research highlights the crucial role that purposeful strategies and capabilities play in influencing knowledge spillovers inside EEs. Furthermore, Roundy (2020) made clear that the emphasis on efficient KM highlights the proactive steps that can be done to improve knowledge diffusion and usage, which in turn increases the resilience and capacity for innovation of EEs.

2.2.3 Entrepreneurial ecosystems and knowledge integration. The last cluster, that emerged with limited yet impactful studies, explores knowledge integration within EEs. To establish a unified and productive environment, knowledge integration in ecosystems alludes to the assimilation and incorporation of various information sources, both internal and external (Malecki, 2011). It involves the process by which actors explore, identify, organise, blend and ultimately apply tacit and explicit knowledge in various contexts. Ecosystems that integrate knowledge well are more collaborative, less redundant and more efficient (Roundy, 2020). Still, there are not as much studies in this cluster as there were in the prior two. The contributions in this cluster recognise the interdependence of knowledge processes and the necessity of a comprehensive strategy to use the variety of knowledge assets in the ecosystem fully.

The focus placed on linking regional EEs to international innovation networks makes such work particularly noteworthy (Malecki, 2011). It highlights the need to integrate knowledge of both local and global scales by introducing the concepts of open innovation and double networks. This viewpoint, which emphasises EEs' connectivity with more extensive innovation networks, is consistent with the modern characteristics of EEs. Another perspective of this cluster highlights how KM can improve EEs, primarily through corporate entrepreneurship and strategic intent in high-tech companies (Bhardwaj, 2019; Yang *et al.*, 2022; Bhawe and Zahra, 2019) both add to the conversation by examining how EE affects urban economic growth and how multinational companies influence local ecosystem heterogeneity. Contributions under this theme highlight the structural diversity and wider economic ramifications, offering a framework for comprehending knowledge integration as an essential component of EEs. Roundy's (2020) transactive memory theory provides insights into knowledge integration inside EEs. Roundy (2020) presented the notion of the wisdom of ecosystems with a focus on the mechanisms of knowledge sharing and collective memory that facilitate knowledge integration in entrepreneurial settings.

Overall, it is evident that, compared to the first two components covered, the aspect of knowledge integration inside EEs still receives less focus, underscoring the need for further research. While the few existing studies covered under cluster three do not go into deep detail about the complexities of knowledge integration, taken as a whole, they offer a more comprehensive framework for understanding how knowledge is entwined within EEs. These studies emphasise the role of global linkages, structural diversity and transactive memories, underscoring the interconnectedness of knowledge processes in EEs.

Therefore, the current study aims to advance the conversation on KM in EEs, emphasising the area of knowledge integration that has received less attention. In particular, we use the transactive memory system (TMS) lens to investigate how entrepreneurs garner and capitalise the knowledge within EEs. Prior studies have extensively explored KM (particularly knowledge creation and transfer) among other ecosystem actors such as universities and incubators. Nonetheless, there is still a dearth of research on knowledge integration, particularly regarding entrepreneurs who operate as key ecosystem actors (Ratten, 2021). As a result, the TMS is essential for examining how entrepreneurs organise and capitalise on the knowledge and comprehending the complex mechanisms by which knowledge is disseminated, preserved and applied within the collective memory of an EE. The transactive memory lens offers a comprehensive perspective, highlighting how collaborative and interrelated knowledge processes are inside EEs. The TMS perspective is essential for deciphering knowledge dynamics' intricacies and for advancing the creation of successful KM tactics in entrepreneurial environments.

2.3 Knowledge and entrepreneurial ecosystems: a transactive memory perspective

Knowledge integration is a crucial aspect of the EE and is critical to the success of new ventures and start-ups (O'Connor and Audretsch, 2023). The EE differentiates itself from other concepts, such as cluster and regional innovation systems, emphasising the role of

the entrepreneurial knowledge process apart from technical and market knowledge (Spigel and Harrison, 2018; Qian, 2018). Entrepreneurial knowledge includes the challenges facing entrepreneurs as they scale, how to design business plans and pitch ideas to angel investors and venture capitalists and how to overcome the liability of newness when working with potential clients and suppliers (Spigel and Harrison, 2018). Drawing on social capital, building a sustainable EE requires a knowledge system of interacting structural, cognitive and relational dimensions (Theodoraki *et al.*, 2018). The interacting structural dimension refers to the ecosystem's structure and how the actors are connected. Moreover, the cognitive dimension refers to the cognitive aspects of the ecosystem, such as the culture and common languages used to communicate and increase the interaction within the ecosystem. Finally, the relational dimension refers to the relational aspects such as trust, obligations and identifying who does what in the ecosystem (Theodoraki *et al.*, 2018). Likewise, optimising the interactions between these dimensions enables the fluidity of information and knowledge spillovers between ecosystem members.

The focus of the EE is on the cultivation of interaction among its actors (Ratten, 2021) which highlights the significance of knowledge exchange among them. Spigel and Harrison (2018) emphasise that such knowledge sharing encompasses technical, market and entrepreneurial insights. This exchange occurs at various levels, ranging from individual experiences at the micro-level to the sharing of knowledge between start-ups and intermediaries at the meso-level, and finally, involving entrepreneurial education and public policies at the macrolevel (Andrade *et al.*, 2022).

The intricate dynamics of knowledge exchange across these various levels contribute to the inherent complexity of the EE (Stam and Van de Ven, 2021) potentially giving rise to conflicts of interest (Andrade *et al.*, 2022; Cunningham *et al.*, 2019). However, the success of EEs relies on collective effort, with actors contributing individually and aligning goals harmoniously (Malecki, 2011). In this multifaceted setting, recognising potential conflicts of interest emphasises the need for a collaborative approach (Roundy, 2020). Fostering a shared vision and aligning individual aspirations with collective goals enables actors to contribute to a thriving entrepreneurial landscape (Mason and Brown, 2014). This commitment ensures a sustainable and dynamic ecosystem adept at navigating complexities from diverse knowledge-sharing interactions.

The TMS, a group-level sociocognitive structure, refers to a system where participants collectively store, encode and retrieve information (Argote and Ren, 2012; Lazar *et al.*, 2022; Lewis and Herndon, 2011). Based on their expertise and skills, individuals feed the system that leads to the collection of diverse information and knowledge (Lewis, 2003; Wegner, 1987). As a result, ecosystem members can take advantage of differences in expertise and knowledge within the ecosystem (Bachrach and Mullins, 2019). In this system, the participants can identify who knows what (Roundy, 2020) and who is the best in a particular matter in the ecosystem (Bachrach and Mullins, 2019). As a result, entrepreneurs can use each other's strengths and expertise, leading to better performance and outcomes (Andrade *et al.*, 2022). Likewise, the perception of the EE may lead entrepreneurs to adopt the elaborated strategies that enable efficiency, better performance and a balance between individual and collective benefits gained by participating in the EE (Theodoraki *et al.*, 2022).

Consequently, Roundy (2020) introduced the EE-TMS, highlighting the importance of knowledge sharing and collaboration among entrepreneurs, investors and other key participants during entrepreneurial processes (Rashid and Ratten, 2022). The success of an EE depends on effective knowledge sharing, including differentiated, shared and meta-knowledge (Roundy, 2020). Differentiated knowledge is the idea that everyone has unique knowledge or expertise within a group that distinguishes them from others (Roundy, 2020). This includes specialised skills, knowledge of specific topics or familiarity with processes. Shared knowledge, on the contrary, refers to information or understanding common to all

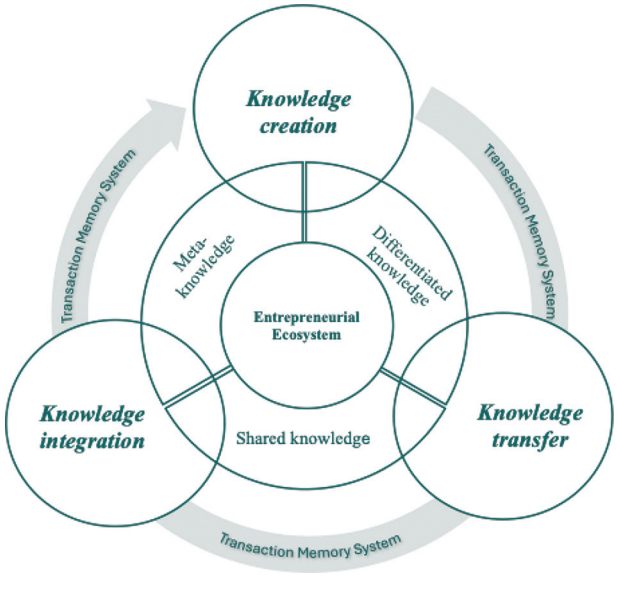
group members (Zhang and Guo, 2019). According to Bachrach and Mullins (2019), shared knowledge is essential for group coherence and can facilitate collaboration by providing a common understanding of the group's goals and objectives. Finally, meta-knowledge refers to knowledge of who knows what (Mell *et al.*, 2014). It refers to an individual's understanding of the knowledge and expertise of other group members. This type of knowledge enables individuals to know whom to turn to for specific information and helps the group allocate and coordinate their knowledge more effectively. Based on what has been discussed, Figure 1 provides a schematic framework to understand the dynamics of knowledge creation, transfer and integration within EEs.

3. Research methodology

3.1 Research setting

Several factors contributed to the selection of the Finnish health tech context. First, the health-care sector is a heavily regulated industry, which can make it challenging for small businesses to establish themselves. Health tech firms must comply with complex regulations and standards governing the development, testing and marketing of medical devices and software. This includes knowledge of the Conformité Européenne (CE) mark, the Food and Drug Administration (FDA) approval process, Health Insurance Portability and Accountability Act (HIPAA) and other relevant regulatory frameworks. Second, the complex nature of the industry also demands a wide range of specialised medical knowledge. Health tech firms must deeply understand medical science and clinical practice to develop effective and safe solutions. This includes knowledge of anatomy, physiology, pathology, pharmacology and medical terminology. Third, the industry is primarily dominated by a few large companies holding a significant market share. Despite Small and medium-sized enterprises (SMEs) representing the majority in number, they have a relatively small market share compared to the few large companies. The Finnish start-up report (2019) states that health-care technology exports exceed more than 2.3 billion. Given the small size of the market and the need for specialised knowledge, joining an ecosystem is crucial for their

Figure 1 Conceptual framework



Source: Authors' own creation

survival and growth. Furthermore, the success of these SMEs leads to more employment and economic growth.

The primary focus of this research lies within the health tech ecosystem situated in Northern Finland, which was established in 2012. The technologies developed by companies within this ecosystem impact the wellbeing of 2.6 billion people globally. The ecosystem's goals include creating new business opportunities, providing a unique environment for health tech businesses and delivering more advanced health services for the benefit of citizens. The ecosystem includes companies from medical technology and wellbeing. In 2022, the value of health technology products exports exceeded €2.7bn, and the trade surplus was more than €1.2bn (Health-tech Finland, 2022). The sector contributes to 13,000 employment and has generated over 16 billion in revenue over the past 20 years.

This study uses an explorative qualitative method to understand how entrepreneurs use an EE to garner and use knowledge. We followed a purposive sampling technique (Patton, 2002) by focusing on one ecosystem in the health tech sector in North Finland to understand how the EE affects the group's entrepreneurial cognition. A study about an EE micro-foundation enables a better understanding of EE dynamics (Wurth *et al.*, 2022). As argued by Roundy (2020), the EE is composed of individuals and insight from the collective cognition enables a better understanding of the entrepreneurial KM system.

This study used an explorative qualitative methodology to understand how entrepreneurs use their entrepreneurial experiences within an EE to gain entrepreneurial knowledge. Specifically, the study focused on the health tech sector in North Finland, selecting a single ecosystem to investigate how the EE influences the cognitive effects of entrepreneurship. As suggested by Theodoraki *et al.* (2022), it is essential to shed light on the perceptions of individuals that shape EEs and how they create and absorb the knowledge produced. Moreover, Roundy (2020) argued that an EE consists of individuals who bring their unique cognitive experiences, knowledge and skills to the collective, which can impact the EE's effectiveness overall.

3.2 Data collection

The study used semi-structured interviews to collect data from SMEs (European Commission, 2003) in a health tech ecosystem in Finland. The interviewees were selected based on their knowledge, experience and willingness to participate. The sample included a diverse group of informants, such as the health tech CEO, general manager, an investor and two coordinators, selected based on their knowledge, experience and willingness to participate in the study. Entrepreneurs play a central role in the health tech ecosystem. Given the heightened sensitivity of knowledge sharing in the health-care sector, top management, as the primary decision-makers, is predominantly involved in knowledge dissemination. We collected vital information about the companies and other informants from the ecosystem website and used that information to identify potential interviewees. In more than 70 emails, 26 potential candidates were willing to participate in an interview. The interview was a mixture of online and onsite; 17 semi-structured interviews were conducted face to face and 9 were conducted via Zoom. The interviews accommodated the participants' preferences and circumstances using in-person and online methods. This approach can also increase the diversity of the sample, as some people may be more willing to participate if they can do so remotely. Thus, we reached saturation after conducting 26 interviews when the data started to repeat, and no further insights could be gained from conducting more interviews. In Table 1, we present an overview of sampled firms. Secondary data such as websites, official reports and press releases were also used to enrich the primary data, an increasingly common approach in qualitative research (Javadian *et al.*, 2020; Fisher *et al.*, 2020).

Table 1 Description of participants

No	*Role*	*Year of establishment*	*Company's sector*	*Interview mode*
Ent-1	Executive vice president	2009	Health and wellness	Face-to-face
Ent-2	CEO	2010	Health and wellness	Face-to-face
Ent-3	CEO	2009	Health and wellness	Face-to-face
Ent-4	CEO	2004	Health and wellness	Face-to-face
Ent-5	CEO	2002	Health and wellness	Face-to-face
Ent-6	CEO	2008	Health and wellness	Face-to-face
Ent-7	CEO	2015	Health and wellness	Face-to-face
Ent-8	CEO	2014	Health and wellness	Face-to-face
Ent-9	CEO	2015	Health and wellness	Face-to-face
Ent-10	CEO	2105	Health and wellness	Face-to-face
Ent-11	CEO	2016	Health and wellness	Online
Ent-12	CEO	2000	Health and wellness	Online
Ent-13	CEO	2014	Health and wellness	Face-to-face
Ent-14	CEO	2016	Health and wellness	Online
Ent-15	Vice president, sales and marketing	2004	Health and wellness	Face-to-face
Ent-16	Chief sales officer	2003	Health and wellness	Face-to-face
Ent-17		2013	Consulting	Face-to-face
Ent-18	CEO	2012	Health and wellness	Face-to-face
Ent-19	CEO	2013	Health and wellness	Face-to-face
Ent-20	CEO	2018	Health and wellness	Online
Ent-21	CEO	2018	Health and wellness	Online
Ent-22	CEO	2002	Health and wellness	Online
Ent-23	Chief marketing officer	2000	Health and wellness	Online
EC-1	Coordinator	–	–	Online
EC-2	Coordinator	–	–	Online
FP-1	Managing director	1994	Finance	Online

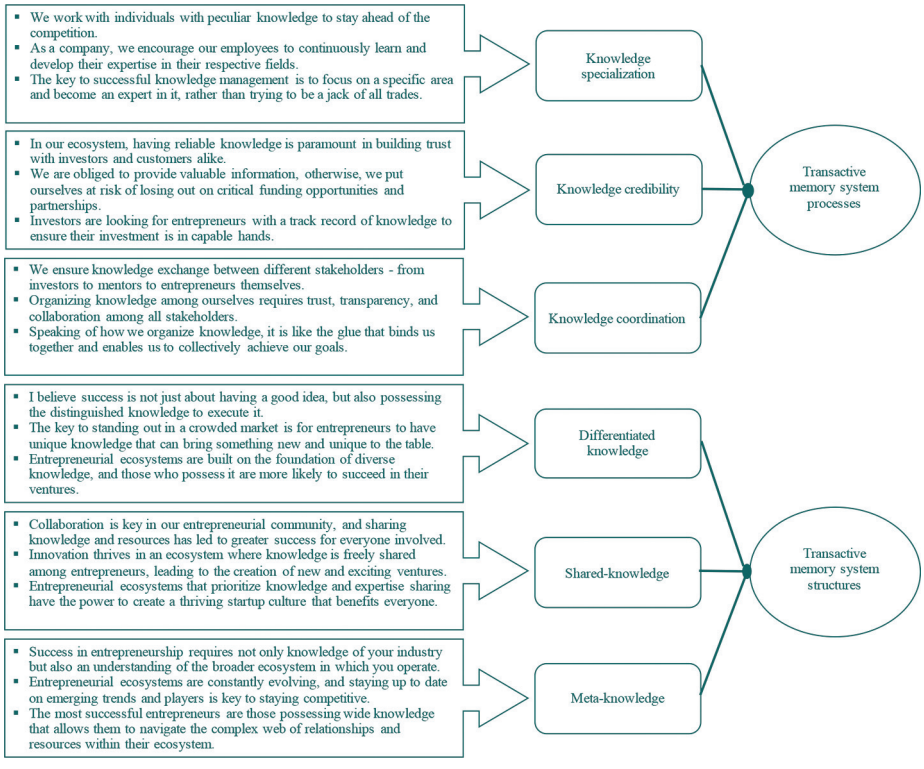
Notes: *Ent* = entrepreneurial actor; *FP* = financial provider; *EC* = ecosystem coordinator
Source: Authors' own creation

3.3 Data analysis

All interviews were recorded and later transcribed. This approach can be beneficial for ensuring high accuracy and completeness in the transcription process and providing a detailed and complete record of the data for analysis. We used the Gioia *et al.*'s (2013) method, a systematic and standardised approach for conducting content analysis. The process assumes that the informant is *knowledgeable* (Magnani and Gioia, 2022). This bottom-up and data-driven method moves from data to theoretical understanding, allowing the identification of similarities and differences in the data (Gioia *et al.*, 2013). The approach describes these findings in categories or themes, with increasing levels of abstraction and interpretation.

Each researcher in this study independently coded data to ensure coding consistency and reliability. In the first step, the researchers familiarised themselves by reading each transcribed interview data source multiple times to get a general sense of the content and identify any patterns or themes that may emerge from quotations, resulting in the emergence of the first-level concepts. Next, the research team met to discuss the emerging concepts by comparing each other's concepts. In this stage, the team came to a consensus about the agreed and disagreed points that resulted in the theoretical saturation point (Glaser and Strauss, 1999). This step generated a first-order concept with the quotations obtained from the data. The second step is identifying and developing higher-order themes by reducing the concepts from the first step. It is a crucial step because it allows the researcher to see the big picture and identify the main themes or patterns in the data. It also helps to identify patterns or themes that are more general or overarching than the categories identified in the first step while providing insights into how the data structure is formed. By doing so, the researcher can better understand how the data is structured and how the concepts are related. Figure 2 illustrates the final data structure, presenting the

Figure 2 Data structure



Source: Authors' own creation

codes and theoretical dimensions we developed from our results and the relationships between them.

Finally, we developed an integrative (conceptual) model of the causal interactions between the EE transactive memory processes and structures based on a rigorous, iterative procedure grounded in the qualitative data derived from our empirical study. As detailed earlier, the systematic bottom-up Gioia *et al.* (2013) method, enabled us to identify key aspects of the TMS processes and structures within EEs as shown in our data structure (see Figure 2). These findings were instrumental in development of our propositions, as depicted in Figure 3, illustrating the causal interactions between TMS processes and structures in EEs. The development of this model was informed by existing literature (e.g. Lewis, 2003; Argote and Guo, 2016; Theodoraki and Messeghem, 2017), alongside insights garnered from our data analysis. This integration of theory and empirical findings underscores the dynamic interplay between TMS processes and structures as further discussed under Section 4.3.

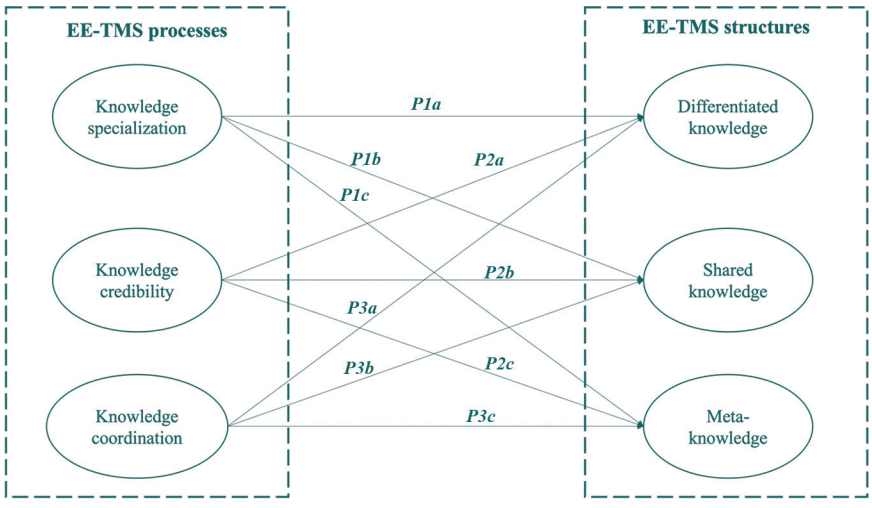
4. Findings and discussion

In this section, we provide the findings and discussion regarding how knowledge is organised within EEs.

4.1 Entrepreneurial transactive memory system processes

4.1.1 Knowledge specialisation. Accessing specialised knowledge can be immensely valuable for SMEs struggling with limited resources. However, such knowledge is often

Figure 3 An integrative model of the causal interactions between the EE transactive memory processes and structures



Source: Authors' own creation

intricate and may require considerable effort and expense. Furthermore, expertise in health technology is typically concentrated among a select few individuals or organisations. To access this knowledge, SMEs can use various strategies, such as collaborating with other companies that can complement their products. The interviewee below sheds light on the company's approach to gaining access to specialised knowledge:

> *From the knowledge side, we exchange ideas and even ideate features within our products that could complement other company products. For example, we can get X company specialising in the application of heart rate monitoring and implement it within our application, so that kind of thing is information exchange. We know much about breathing, and these other companies may need to learn more about it, so we share transparent information.* (Ent-22)

4.1.2 Knowledge credibility. Having accurate, reliable and trustworthy knowledge is crucial in an EE for making informed decisions, improving efficiency, enhancing collaboration and boosting performance. One critical aspect of making accurate decisions is selecting the right partners for a company. A manager of a firm explained the importance of precise knowledge in choosing potential partners:

> *One of the key challenges is to understand with whom you should partner. Who are the big ones today, and who are the ones that might be big tomorrow? Are you betting on the right horses? Because there are tons of horses out there. Specialist companies cannot, because of resource constraints, take on more horses. You need to bet on the right one. We need horses.* (Ent-1)

The ecosystem is a combination of various firms in their various stages of growth. Despite their differences in goals, they are united in following the overall goal of the ecosystem:

> *We had a common cafeteria where everybody came; unlike other cafeterias, we talked about our business. Therefore, we talk about how to build our networks. The biggest thing in MedTech is regulation, so we talk about how to get acceptance. We used to discuss it as if I knew, for example, those people who can do that measurement; those people are cheap; you could easily use them. Therefore, those things were hugely valuable because we were all building different products, not competing, and sometimes doing something together, especially the contacts.* (Ent-8)

A collaborative and open-minded approach is crucial for the success of an ecosystem. When the actors within the ecosystem are open to sharing information and working together, it creates a supportive and productive environment that benefits everyone. This type of ecosystem thinking emphasises the idea that the success of one member can lead to the success of the entire ecosystem. By prioritising collaboration and mutual support, the actors in the ecosystem can achieve more remarkable results and drive innovation in the health and wellness sector:

> *Do we have an open ecosystem, or should we work a walled garden from the garden perspective? I think history has proven that the walled garden strategy is not working. Because you will always be able to build complete solutions that satisfy the customers' needs, you need to partner up.* (Ent-1)

Having a shared cultural and social background can be beneficial for building trust and cooperation within an ecosystem. Members from the same region who share similar values can foster a sense of community and create a stronger bond. Theodoraki *et al.* (2022) argued that this can lead to more open and effective communication and a greater willingness to collaborate and share resources. Moreover, trust is a critical component of any flourishing ecosystem. Furthermore, Theodoraki *et al.* (2022) documented that when members trust each other and believe in the shared goals and values of the ecosystem, it can significantly enhance its overall effectiveness. A shared set of norms and values allows the members to work together towards a common goal and ensure the ecosystem's success:

> *I should have remembered the key teams and dimensions earlier. It would be best if you did not do anything harmful to another member of the ecosystem. That is the most important thing. So, you may think very differently, but you cannot say it in a way that could harm the ecosystem or the players.* (Ent-13)

In addition to shared cultural and social values (Theodoraki *et al.*, 2018), it is also essential for an ecosystem to have clear, formal rules and regulations in place to ensure its proper functioning. These rules and regulations help establish expectations and ensure all members follow the same guidelines:

> *We are responsible as a company as we have a contract. It is not the network that is an elution network where everybody comes and goes as they please. We have actual business contracts.* (Ent-12)

Companies need to follow ethical and responsible business practices. The failure and misuse of others may lead to decreased trust and confidence. As a result, companies that engage in unethical or irresponsible behaviour may face consequences such as being fired from the ecosystem:

> *The Oulu health ecosystem is a public body, so everything is not black and white. Of course, as long as you do your part in the ecosystem. You do not do anything wrong, so it is a kind of ecosystem that you are a part of. If you start behaving destructively toward another member, of course, you may throw it away.* (Ent-13)

4.1.3 Knowledge coordination. In an EE, the entrepreneurs share common knowledge about various things with the ecosystem members. This knowledge can create new opportunities, address challenges and develop solutions. Entrepreneurs may also use this knowledge to collaborate and create new products and services. In addition, they can use this knowledge to understand the needs of their customers better and develop better strategies to meet those needs. By sharing their knowledge, entrepreneurs can also help create a more robust and vibrant ecosystem:

> *I think we should not waste time and money, which is the biggest thing, so if you are developing something which you will find about two years later that the competition already has done much*

better, why spend time and money on that and focus really on the pain point what you might be able to solve. Still, the competitor is not able to solve it. So, we share resources or capabilities, researchers, and sometimes, in some exceptional cases, facilities. (Ent-22)

In ensuring the ecosystem's proper operation, specific individuals assume a pivotal role as orchestrators. Positioned centrally within the ecosystem, orchestrators actively facilitate the resources and knowledge sharing among its various actors. The effectiveness of the orchestrator's role depends on the resources at their disposal, determined by their strategic position within the network. One of the entrepreneurs explains their role in disseminating knowledge about specific business opportunities:

We are in a position here where we know ecosystem members, so based on the end customers' needs, we can, for example, select a particular company that would be an opportunity. Either we contact them ourselves and tell them that this company here is trying to build a project, or we let them contact them directly. (Ent-6)

By organising specific training programs related to technology, market and regulation, the ecosystem members know each other better and gain information about various aspects. Effective knowledge coordination can help improve the efficiency and effectiveness of transactions within the ecosystem and promote collaboration and knowledge sharing among ecosystem actors. It enables the resource constraints of the start-up to grow despite its small size and resources. A manager described the importance of these types of knowledge as follows:

The ecosystem is providing training for that, guideless, and how you can still be a small company and accomplish those targets and documentation, etc. (Ent-6)

4.2 Entrepreneurial transactive memory system structures

4.2.1 Differentiated knowledge. The types of companies within the health-care sector can be broadly categorised into business-to-business (B2B) and business-to-consumer (B2C). B2B companies sell their products and services to other businesses, such as hospitals, clinics and pharmaceutical companies. B2C companies sell directly to consumers through retail stores or online platforms. Each type of company requires a different business strategy and marketing approach. For example, B2B companies may focus on building solid relationships with their customers and providing technical expertise, while B2C companies may focus on consumer education and building brand awareness. Companies need to understand the differences between these business models and tailor their strategies accordingly. In addition, companies can benefit from the knowledge shared by ecosystem members. One of our interviews describes the importance as follows:

We are a B2C business, and most companies operating in the ecosystem are in the B2B business. We would benefit the ecosystem by sharing some best practices and learning in that area. (Ent-19)

4.2.2 Shared knowledge. Compliance with regulations is a critical factor in the commercial success of health and wellness companies. Companies that have already undergone the necessary certification procedures can provide valuable information and guidance to other ecosystem members who are obtaining certification. This information sharing can help streamline the certification process and ensure that new products and services are brought to market quickly and efficiently. In addition, having a network of companies in the health and wellness sector can help to keep everyone up to date on the latest regulations and standards, ensuring that the entire ecosystem is compliant and competitive:

Our relationship is cordial because almost all of us are. We have been going through the same phase, having the same challenges with product development, getting FDA approval, finding the customer, finding resources, finding financing, etc. (Ent-19)

Sharing information and knowledge among the members of an ecosystem is crucial to ensuring its success. Entrepreneurs can share information through mentorship programs, joint ventures and networking events. The more experienced actors can offer support and guidance to new members, while new members can bring fresh perspectives and innovative ideas. This exchange of information and knowledge helps to build a more robust, resilient ecosystem:

> *To some, it is support for those younger than us; we support them on whether we know what to do. In some, we have a relationship with big companies; we are learning how they are doing things, and we are trying to find places where we could work together.* (Ent-11)

4.2.3 Meta-knowledge. Meta-knowledge helps entrepreneurs make informed decisions about their ventures, such as which markets to enter, which products to develop and which strategies to pursue. This allows the companies to participate in ecosystem activities and learn from the experiences of others; they can avoid repeating the same mistakes. For example, one company expresses the importance of the health tech ecosystem as follows:

> *This kind of association can be helpful because they have their people on the ground. They should know the market; if they see it, they know the people who know it. So, it is to gather relevant business information to aid our decision-making.* (Ent-1)

The ecosystem organises events and seminars where people can regularly meet, establish trust and share common and cultural beliefs. This promotes the development of relationships, knowledge sharing and the exchange of ideas among entrepreneurs, resulting in a more interconnected and cohesive ecosystem. A coordinator of the ecosystem highlights the importance of ecosystem events as follows:

> *The ecosystem regularly organises events here and there and helps to meet people and organisations. They could say a few words about what is happening in Oulu and have a discussion mainly about the activities of companies.* (CE-2)

Apart from enhancing internal collaboration, the ecosystem enables companies to connect with potential business partners by allowing them to participate in international seminars and exhibitions. It provides them with opportunities to meet potential partners and build relationships. In addition, it helps to identify new markets and opportunities for collaborations as one interview quotes as follows:

> *Once a year, all our international partners come together to get to know each other, and then they can discuss and exchange that. Okay, what is it like to do business with severe products in Australia? What could we learn from you? So, we can also build new ecosystems or nodes in the ecosystem that the distributor in Australia is calling a guy in Chile who said that you had this in the last meeting. So, this kind of challenge in Chile was resolved the same way as in Australia; this is how we dealt with it, and they exchanged this information without our involvement.* (Ent-23)

4.3 The interplay between entrepreneurial ecosystem transactive memory system processes and structures

The processes and structure of TMS can significantly impact the success of an EE by facilitating the sharing and integration of knowledge, skills and resources among various actors, including entrepreneurs, investors, mentors and service providers (Yi *et al.*, 2021). The TMS processes, as previously discussed, involve encoding, storage and retrieval of information. Particularly, entrepreneurs need to be able to access and use the collective knowledge and expertise of other ecosystem members to improve their chances of success. On the contrary, a well-structured TMS allows not only (sharing) distribution but also knowledge and resource utilisation. In the EE context, TMS can help create a network of information exchange that promotes innovation and learning (Argote and Guo, 2016). The exchange and application of knowledge can lead to the development of innovative ideas,

products and services, ultimately contributing to the ecosystem's growth and sustainability (Theodoraki *et al.*, 2018). Thus, entrepreneurs must collaborate to create a well-functioning EE that facilitates not only knowledge creation and transfer but also its integration (application).

4.3.1 Transaction memory system processes and differentiated knowledge. The harmonious orchestration of TSM processes – knowledge specialisation, credibility and coordination – serves as a linchpin for cultivating differentiated knowledge in an ecosystem. When members of the EE delve deeply into their fields/domains, they develop significant expertise that gives rise to knowledge specialisation. Thus, knowledge specialisation implies how ecosystem actors – like entrepreneurs – acquire domain-specific knowledge and store it in their memory systems for later retrieval – either automatically or through laborious processing. This depth advances individual capacities and the ecosystem's overall collective knowledge base. Moreover, knowledge credibility serves as the cornerstone for efficient knowledge usage by illuminating the processes involved in the storage (retention) and retrieval of an individual's perceived dependability of knowledge. It thrives when actors express and apply their expertise to scenarios involving problem-solving and decision-making, improving the general standard of knowledge within the EE. Coordination of knowledge describes how ecosystem members work together to make it easier to retrieve (recall, recognise and relearn) distinct types of expertise, which helps create distinct knowledge beyond individual contributions. When entrepreneurs participate in TMS procedures, EE platforms become breeding grounds for distinctive, superior information. This knowledge, which is unique and valuable, turns into a powerful tool for getting an advantage in the fast-paced business world. Therefore, we suggest:

P1. Knowledge specialisation (1a), credibility (1b) and coordination (1c) are positively related to the development of differentiated knowledge within EEs.

4.3.2 Transaction memory system processes and shared knowledge. TMS processes have the potential to shape the shared knowledge within ecosystems. For instance, individuals possessing specialised knowledge become crucial architects of the shared knowledge repository within the EE. Their distinct perspectives and insights, encoded through information-encoding processes, inject diversity, elevating the collective knowledge within the ecosystem. Moreover, the presence of credible knowledge serves as a cornerstone in the development and acceptance of shared knowledge among actors. Consequently, the perceived trustworthiness and competence of credible individuals act as anchors, ensuring the assimilation and retrieval of their contributions into the shared knowledge base. Furthermore, knowledge coordination plays a pivotal role in fostering effective knowledge collaboration and integration within the shared repository. The coordinated efforts of individuals manifested through information retrieval processes allow for seamless communication and knowledge integration. This orchestrated synergy transforms the shared knowledge base into a dynamic and responsive reservoir capable of capturing the evolving knowledge within EE. We thus propose that:

P2. Knowledge specialisation (2a), credibility (2b) and coordination (2c) are positively related to the development of shared knowledge in an EE.

4.3.3 Transaction memory system processes and meta-knowledge. Entrepreneurs and other EE actors need to be aware of what others know, which information others require and how one's knowledge and skills can be appropriately exploited – "meta-knowledge." Individuals and organisations with meta-knowledge are better equipped to leverage their knowledge specialisation, credibility and coordination skills to adapt and thrive in uncertainty and change. Furthermore, as actors in the ecosystem develop their specialised knowledge, enhance their credibility and coordinate with others, they are likely to gain a deeper understanding of the interplay between different knowledge types and their innovation potential. This, in turn, can foster the emergence of new ideas and opportunities, ultimately leading to the growth and sustainability of the EE. Therefore, it can be argued that

TMS processes promote meta-knowledge in an EE, enhancing an individual's or organisation's ability to acquire, evaluate and apply new knowledge effectively. We thus suggest that:

P3. Knowledge specialisation (3a), credibility (3b) and coordination (3c) are positively related to the development of meta-knowledge in an EE.

Figure 3 provides the integrative model of the causal interactions between the EE transactive memory processes and structures.

5. Conclusion

This study explored how entrepreneurs and other EE actors organise and capitalise on the knowledge embedded within their ecosystems using the Finnish entrepreneurial health tech ecosystem. We found that transactive memory processes (knowledge specialisation, credibility and coordination) and structures (differentiated-, shared- and meta-knowledge) are crucial aspects of KM within EEs. Overall, the findings of this study have important implications for entrepreneurs, ecosystem actors and policymakers. Entrepreneurs can develop strategies to manage their knowledge resources better and foster innovation by understanding the interplay between TMS processes and structures. Ecosystem actors can also leverage these insights to design and implement effective support programs facilitating knowledge sharing and coordination within their respective ecosystems. In the rest of this section, we further elaborate on our contributions to literature and practice.

5.1 Theoretical implications

Our study has several significant theoretical implications. Prior studies on knowledge spillovers and firm agglomeration have demonstrated the importance of knowledge in shaping regional economies (e.g. Ghio *et al.*, 2015). These studies highlighted the importance of the availability of a stock of knowledge and channels through which knowledge is transferred to the growth and competitiveness of a region. However, this research has yet to be applied to EEs, where knowledge plays a critical role in supporting the growth and success of entrepreneurial ventures (Jones and Ratten, 2021; Roundy, 2020; Spigel and Harrison, 2018). To fill this gap, we explored KM within EEs through TMS lenses (Lazar *et al.*, 2022). Notably, we investigated how entrepreneurs integrate (garner and exploit) the knowledge available within their ecosystems. Our empirical findings identify TMS processes (knowledge specialisation, knowledge credibility and knowledge coordination) and structures (differentiated knowledge, shared knowledge and meta-knowledge) as essential components for effective knowledge integration within EEs. By understanding these processes and structures, researchers can develop more effective strategies for managing knowledge integration in EEs. Another theoretical implication of this research is the conceptual discussion on the interplay between TMS processes and structures. This finding suggests that effective KM in EEs requires a comprehensive approach to integrating TMS processes and structures.

Furthermore, this study has theoretical implications for the literature on TMS. It provides empirical evidence to support the conceptual framework of TMS and demonstrates its applicability in EEs. The study also expands the understanding of TMS processes and structures beyond traditional organisational contexts, highlighting their relevance in dynamic and uncertain environments. Moreover, this study has significant theoretical implications for KM, entrepreneurship and organisational behaviour. By providing insights into the role of TMS processes and structures in KM in EEs, the study contributes to developing more effective KM practices. The EE has been studied as a configuration of a network (Theodoraki *et al.*, 2018) or a system (Stam and Van de Ven, 2021) by highlighting the need to foster interactions between the elements to increase its success and sustainability. At the intersection of this approach, the TMS processes enable this goal and

provide an enriched understanding of the knowledge spillover within and between EEs (Qian, 2018; Roundy, 2020). While this study advances our understanding of knowledge spillover within the EE, future studies can enable the knowledge spillover between EEs (Fotopoulos, 2023).

5.2 Practical implications

Several policy and managerial implications can be drawn for entrepreneurs, practitioners and policymakers. First, EE actors must know that active participation and sharing of their relevant knowledge and practices can lead to a flourishing collective knowledge-sharing system. Creating dedicated networking platforms becomes crucial for facilitating collaborative learning and knowledge exchange among entrepreneurs. Practitioners need to offer ecosystem-level support, including resource allocation and mentorship programs and recognising the pivotal role of entrepreneurs. The study emphasises the value of nurturing a culture that promotes sharing knowledge and developing specialisation within EEs. Encouraging individuals to build expertise in specific areas and share that knowledge can enhance the ecosystem by incorporating a variety of skills and insights (Jones and Ratten, 2021). Policymakers and managers can promote credibility by creating mechanisms for verifying the accuracy and quality of information, such as peer review processes, expert panels and quality assurance procedures (Roundy, 2020). Furthermore, the study underscores the importance of developing comprehensive KM to enhance collaboration, structural diversity and overall efficiency within EEs. Thus, enabling the intricate mechanisms by which knowledge is disseminated, preserved and applied within the collective memory of an EE.

The study identifies differentiated-, shared- and meta-knowledge as critical TMS structures within EEs. Therefore, policymakers and managers should encourage diversity and specialisation within EEs. This can be achieved by supporting entrepreneurship in different sectors, industries and regions (Kansheba and Wald, 2021). Moreover, policymakers and managers can promote shared knowledge by creating mechanisms for knowledge exchange, such as online communities, mentorship programs and incubators. Furthermore, policymakers and managers should encourage the development of meta-knowledge by providing training and support for entrepreneurs on KM, promoting KM tools and techniques and encouraging reflection and evaluation of KM practices. Thus, a well-designed KM system can help to capture, store and disseminate entrepreneurial knowledge and experiences (Spigel and Harrison, 2018).

Overall, practitioners and policymakers need to pay attention to the dynamic nature of the ecosystem, which requires ongoing attention, investment and adaptation to changing needs and circumstances within it (Roundy *et al.*, 2018). Creating structure and formalisation of the knowledge transfer process in an EE enables proper KM. This can also result in a need for more clarity on how knowledge is created, shared and used in the ecosystem. Therefore, a healthy EE knowledge infrastructure allows entrepreneurs and other EE participants to overcome the challenges of accessing and using tacit knowledge (Roundy, 2020).

5.3 Limitations and future research directions

Because the data was collected through interviews with ecosystem actors in Finland, the findings may need to be more generalisable to other countries or regions. Conducting similar studies in different countries and comparing the results could help identify similarities and differences in ecosystem dynamics, enabling policies to support ecosystem development. In addition, this study uses cross-sectional data to study the role of KM in the ecosystem. However, given that the ecosystem is dynamic and evolves, so is its embedded knowledge. Therefore, a longitudinal study would allow for a better understanding of how

the ecosystem evolves and how factors such as knowledge impact the ecosystem at different development stages. Furthermore, the longitudinal study can reveal ecosystem changes, including changes in the types of knowledge created and shared and the impact of that knowledge on the ecosystem.

This research primarily centres around entrepreneurs as the key players in the health tech ecosystem. In health care, where data sensitivity is high, top management of companies assumes the primary role in decisions related to knowledge dissemination, coding and retrieval. Consequently, entrepreneurs emerge as the central actors. However, it is essential to recognise the importance of other actors with diverse knowledge types, such as universities, research centres, investors and local authorities. In future research, there is an opportunity to expand on this study by taking a more comprehensive ecosystem approach and conducting interviews with a diverse range of actors within the ecosystem.

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