Orchestrating Innovation Ecosystems: Dynamic Capabilities in the Medtech Industry

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ORCHESTRATING INNOVATION ECOSYSTEMS: DYNAMIC CAPABILITIES IN THE MEDTECH INDUSTRY

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ABSTRACT

Innovation ecosystems have been increasingly studied in the past few years. Previous research focused on the orchestration of innovation ecosystems and the diverse activities needed to maintain an ecosystem over time. However, few scholars studied the capabilities required to carry out orchestration activities. Drawing on the dynamic capabilities framework, we seek to understand how dynamic capabilities support orchestration activities in innovation ecosystems. Our single case study of an innovation ecosystem in the Medtech industry reveals that orchestration activities can be shared among several ecosystem actors and can be associated with sensing, seizing, and reconfiguring dynamic capabilities. By doing so, we contribute to the literature on innovation ecosystem orchestration. Our findings also point out the importance of historical and subjective time when studying dynamic phenomena. This complements recent research that views collective memory and history as valuable dynamic capabilities. We conclude by suggesting a rethinking of the dynamic capabilities framework to embrace the dynamic and heterogeneous nature of innovation ecosystems.

INTRODUCTION

Increased specialisation drives organizations to join ecosystems that combine the expertise of several organizations to create complex value propositions. The prevalence of ecosystems in for example semiconductors (Adner & Kapoor, 2010), power generation (Chen et al., 2019) or smart cities (Oomens & Sadowski, 2019) has found the attention of policymakers and scholars. Moore (1993) introduced the concept of ecosystems in the management literature. Since then, many scholars have explored the subject and identified several ecosystem types, such as business, innovation, knowledge and entrepreneurial ecosystems (Jacobides et al., 2018; Thomas & Autio, 2020).

This paper focuses on innovation ecosystems defined as "collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution" (Adner, 2006, p. 2). Studies revealed that innovation ecosystems share common characteristics with other ecosystem types but also present idiosyncrasies. Heterogeneous actors such as firms, universities, research laboratories, users, or institutions can all be part of an innovation ecosystem (Jacobides et al., 2018; Thomas & Autio, 2020) allowing for the consideration of both the user, production, and third-party sides (Autio & Thomas, 2014). These actors are dependent on each other's complementary products or services (Jacobides et al., 2018), implying a common purpose (Iansiti & Levien, 2004) and co-evolution of actors (Ritala & Almpanopoulou,

2017; Walrave et al., 2018). They both compete and collaborate (Leten et al., 2013; Moore, 1993; Shipilov & Gawer, 2020) to co-create a joint value proposition (Thomas & Autio, 2020). While business ecosystems emphasise value capture by a focal firm, innovation ecosystems focus on value creation by and for all ecosystem actors (Gomes et al., 2018). In the context of innovation ecosystems, co-creation aims at producing innovative products and services rather than a competitive value proposition or knowledge (Klimas & Czakon, 2021). Due to the dynamic nature of innovation (Mercan & Göktaş, 2011), such ecosystems are perceived as less static than other ecosystem types (Heaton et al., 2019; Valkokari et al., 2017).

The variety of ecosystem actors and their interdependencies call for alignment between actors for the value proposition to materialise (Adner, 2017; Lingens, Miehé, et al., 2021; Visscher et al., 2021). As ecosystems do not rely on formal contracts or hierarchical governance to coordinate actors (Autio, 2021; Bittencourt et al., 2020; Jacobides et al., 2018), orchestration coordinates activities in innovation ecosystems (Autio, 2021; Valkokari et al., 2017; Yaghmaie & Vanhaverbeke, 2019). Previous works build on insights from the innovation network literature and defined orchestration as "the set of deliberate, purposeful actions undertaken by a focal organization for initiating and managing innovation processes in order to exploit marketplace opportunities" (Verhoeven & Maritz, 2012, p. 5). Extant research explores the roles and characteristics of orchestrators (Bittencourt et al., 2020; Hurmelinna-Laukkanen & Nätti, 2018; Leten et al., 2013; Lingens, Böger, et al., 2021; Still et al., 2014; Yaghmaie & Vanhaverbeke, 2019) and their orchestration activities (Äyväri & Spilling, 2020; Hirvonen-Kantola et al., 2018; Lingens, Huber, et al., 2021; Pikkarainen et al., 2017; Still et al., 2014) along the ecosystem life cycle (Autio, 2021). However, there remains a lack of understanding of the capabilities required to carry out orchestration activities in innovation ecosystems.

To identify such capabilities, we build on the dynamic capabilities framework as developed by Teece et al. (1997). Originally presented at the firm level as the "ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516), dynamic capabilities have recently been studied in ecosystems. The framework has already been adopted by scholars to study ecosystem competition (Petit & Teece, 2020) and ecosystem growth and renewal (Heaton et al., 2019). Sunder & Ganesh (2021) recently drew on system thinking to present a dynamic capability ecosystem model. Feng et al. (2019) and Helfat & Raubitschek (2018) identified dynamic capabilities for ecosystem leaders. Finally, Chen et al. (2019) and Linde et al. (2021) considered how dynamic capabilities can help firms orchestrate their ecosystems.

The purpose of this paper is to study how dynamic capabilities support orchestration activities in innovation ecosystems. Especially, we aim to answer (1) how the dynamic capabilities framework enables a better understanding of ecosystem orchestration activities and (2) how the study of heterogeneous innovation ecosystems enriches the nascent literature on dynamic capabilities in ecosystems. To do so, we turn to a single case study of a nascent French ecosystem, named "Handicap Innovation Territoire" (HIT), in the disability sector. One actor, CoWork'HIT, particularly held our attention. CoWork'HIT is an innovation and expertise centre in the disability sector that helps organisations conduct their innovation projects from ideation to commercialisation. It also initiates innovation projects through research and development (R&D) activities and collaborations with ecosystem actors. Our analysis reveals several orchestration activities in the ecosystem that are distributed among ecosystem actors, as well as three associated dynamic capabilities.

This paper contributes to the recent literature on innovation ecosystem orchestration and dynamic capabilities in ecosystems. We extend research on ecosystem orchestration by providing empirical evidence of shared orchestration activities in an innovation ecosystem. We identify the dynamic capabilities associated with each orchestration activity, thus suggesting a distribution of dynamic capabilities among ecosystem actors. We also contribute to recent literature on dynamic capabilities (Coraiola et al., 2017) in which historical and subjective time are considered when studying dynamic phenomena. Our study of a heterogeneous innovation ecosystem with shared orchestration activities points out the importance of collective memory, time, and temporality. We illustrate historical time by presenting the common history and values shared by the ecosystem actors. Subjective time emphasises the idiosyncrasies and own goals of each ecosystem actor. This indicates tensions between the development of individual actors and of the ecosystem, which both need to be considered by orchestrators. Such findings highlight the need to consider the dynamic nature of innovation ecosystems when drawing on the dynamic capability framework to study ecosystem orchestration activities. This could lead to the development of a multi-level approach to dynamic capabilities in innovation ecosystems.

THEORETICAL BACKGROUND

Orchestrating ecosystems

Adner defined ecosystems as "the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize" (2017, p. 40). By alignment structure, he referred to the mutual agreement of actors on ecosystem incentives, purpose and activities flow and configuration. The alignment and common understanding among ecosystem actors were suggested as essential elements for ecosystem success (Adner, 2017; Petit & Teece, 2020; Walrave et al., 2018).

One way to achieve such alignment between heterogeneous actors and successfully generate a joint value proposition is through orchestration (Autio, 2021). In the context of innovation ecosystems, scholars have drawn on the innovation network literature (Hirvikoski & Saastamoinen, 2020; Linde et al., 2021) and defined orchestration as "the set of deliberate, purposeful actions undertaken by a focal organization for initiating and managing innovation processes in order to exploit marketplace opportunities" (Verhoeven & Maritz, 2012, p. 5). This definition reflects the traditional view that ecosystems are coordinated by a single actor such as a focal firm (Adner, 2017; Dattée et al., 2018), keystone (Iansiti & Levien, 2004), platform leader (Cusumano & Gawer, 2002) or modular architect (Jacobides et al., 2018). Previous research depicted *the* orchestrator as the unique actor responsible for different orchestration activities (Bittencourt et al., 2020; Heaton et al., 2019). Such activities may include setting up the foundation of the ecosystem architecture (Autio, 2021), configuring and maintaining ecosystems relationships and partnerships (Äyväri & Spilling, 2020; Dedehayir et al., 2018; Linde et al., 2021), managing knowledge (Äyväri & Spilling, 2020; Bittencourt et al., 2020; Gomes et al., 2020), encouraging ecosystem participation (Autio, 2021; Poblete et al., 2022; Walrave et al., 2018), or ensuring value co-creation and capture (Äyväri & Spilling, 2020; Linde et al., 2021; Ritala et al., 2013).

A more recent view argued that multiple actors can carry out such activities in an innovation ecosystem (Pushpananthan & Elmquist, 2022; Valkokari et al., 2017; Visscher et al., 2021). For example, Lingens, Huber & Gassmann (2021) showed that an orchestrator lacking production-related knowledge will have to delegate some tasks to another actor, resulting in an ecosystem with double orchestrators. On the other hand, multiple orchestrators will have to take over orchestration activities when an

orchestrator lacks consumption-related knowledge. Our current understanding of shared orchestration in innovation ecosystems remains limited and scholars have encouraged more research about orchestration activities and orchestrators (Gomes et al., 2020; Heaton et al., 2019; Hirvonen-Kantola et al., 2018; Poblete et al., 2022). In this paper, we elaborate knowledge on ecosystem orchestration by exploring the capabilities associated with orchestration activities in a heterogeneous innovation ecosystem in the medical technology industry.

Dynamic capabilities in ecosystems

To conduct our research, we draw on the dynamic capabilities framework (Teece et al., 1997). Stemming from the resource-based view, dynamic capabilities offered a new way to understand how firms could achieve competitive advantage in rapid-changing environments (Teece et al., 1997). Subsequent research demonstrated the relevance of the framework in less dynamic environments, where effective dynamic capabilities mostly rely on existing knowledge (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2009; Peteraf et al., 2013). Dynamic capabilities are distinct from operational capabilities, which refer to ordinary capabilities needed for firms to make a living (Sunder & Ganesh, 2021). They cannot be acquired, and are rather built over time (Heaton et al., 2019; Teece et al., 1997) through the co-evolution of experience accumulation, knowledge articulation and knowledge codification (Zollo & Winter, 2002). Considering the unique learning mechanisms and histories of firms from which dynamic capabilities emerge (Eisenhardt & Martin, 2000; Zollo & Winter, 2002), various processes and practices may be considered dynamic capabilities. Teece (2007) described three types of dynamic capabilities, namely the capabilities to sense opportunities and threats, to seize such opportunities, and to reconfigure the assets of a firm to maintain competitiveness.

A nascent body of research has considered dynamic capabilities in the context of ecosystems (Heaton et al., 2019; Helfat & Raubitschek, 2018; Linde et al., 2021; Petit & Teece, 2020). For example, Feng et al. (2019) identified dynamic capabilities to facilitate resource renewal along the ecosystem lifecycle. Scholars also turned towards the dynamic capabilities framework to better understand ecosystem orchestration. Helfat & Raubitschek (2018) and Chen et al. (2019) demonstrated the importance of dynamic capabilities, such as environmental scanning, innovation, value integration and collaborative arrangement, for platform leaders and hub firms to orchestrate their ecosystems. Similar findings suggested that strong dynamic capabilities are required to effectively orchestrate ecosystems (Linde et al., 2021; Petit & Teece, 2020). This paper goes beyond such work by considering the dynamic capabilities approach to explore the capabilities associated with ecosystem orchestration activities whether by one or several actors in the context of innovation ecosystems.

METHOD

Our research is based on a single case study (Yin, 2018) of the HIT innovation ecosystem in the disability sector located in the Bretagne region in France, and one of its central actors, CoWork'HIT.

Setting

Fours actors, namely a rehabilitation centre, a regional technological innovation centre, and the territorial organisation for Lorient agglomeration (later called agglomeration), supported by the regional authority, initiated the HIT project in 2017 to answer a national call for projects named "Territoires d'Innovation". This latter was

managed by a public bank on behalf of the French state as part of the third phase of the Investment for the Future program (PIA 3) and aimed at identifying and supporting innovations carried out by French territories. In the case of HIT, the agglomeration was appointed as representative of the project. For three years, the founding organisations built the HIT project, which eventually became one of the prize-winners of the national call for projects. In 2019, the HIT project was officially launched, covering more than sixty operations over eight years. At the time of our research, the HIT project gathered about a hundred partners, of which 37 were financially involved. In total, the project benefited from several grants that amount to €14 million, including €6,6 million from the French state and €1,4 million from the regional authority.

To further structure and develop the ecosystem, the founding organisations brainstormed and decided to create a new firm, CoWork'HIT, referring to the idea of co-working to produce disability-related innovations. CoWork'HIT was launched in June 2021 to support actors, whether or not from the innovation ecosystem, in developing their innovations from ideation to commercialisation. CoWork'HIT was established as a cooperative company of collective interests and was expected to endure beyond the 8-year period of the HIT project to maintain the innovation ecosystem over time. The collective status of CoWork'HIT implies four representative bodies, namely the founders, financers, users, and experts or employees, which gathered once a year for a general assembly and every three months for a strategic committee. One employee from the rehabilitation centre transferred to CoWork'HIT as technical director. Another employee from the regional technological innovation centre was hired as director of CoWork'HIT. CoWork'HIT intended to hire two peer helpers, two engineers, and three business developers. This research context allowed us to explore orchestration activities by CoWork'HIT in the nascent HIT innovation ecosystem.

Data collection

Our research is based on primary and secondary sources collected over six months. Data on past events was also collected retrospectively, allowing us to cover a broader period. The collected data aimed at understanding the history and development of the HIT innovation ecosystem as well as identifying the associated orchestration activities.

In total, 17 semi-structured interviews were conducted online, in French, with CoWork'HIT and diverse ecosystem actors. We began with three interviews with the directors of CoWork'HIT, which provided us with basic information on the firm and the HIT project. Following our discussion, CoWork'HIT advised us on potential interviewees within the innovation ecosystem, which we contacted by email. 14 additional interviews were carried out with universities, associations, companies, non-profit health insurance, and territorial institutions, producing rich and triangulated narratives (see Table 1). An interview guide served as a basis for each interview. Complementary questions were asked when judged relevant and additional questions were added to check facts and reduce bias. Interviews lasted between 40 and 80 minutes and were recorded with permission from the interviewees. All were transcribed and combined, resulting in 182 single-spaced pages of transcripts. One researcher also attended the online inauguration of CoWork'HIT broadcast on YouTube. This event confirmed information gathered during the interviews and offered new insights from other ecosystem actors.

Secondary sources were collected to better understand the research context and support evidence from the primary sources. The regional authority and CoWork'HIT provided us with strategy documentation related to the HIT project. CoWork'HIT also shared a PowerPoint document used to present the firm and the HIT project to internal

or external actors. Finally, public documentation such as press coverage and a news bulletin was downloaded from the HIT website. Data sources are presented in Table 2.

Table 1

Overview of ecosystem actors

Organisations	Interviewees
CoWork'HIT - Innovation and expertise centre in the disability sector	▪ Technical director (and Engineer at the rehabilitation centre) ▪ Director
Rehabilitation centre	▪ Former engineer ▪ Director (and Deputy general manager at the non-profit health insurance and President of CoWork'HIT)
Regional authority	▪ Head of "Innovation and economic strategies" ▪ Innovation manager ▪ Project director "Training, research and innovation"
Regional technological innovation centre	▪ Project manager "Medical technologies e-health"
Territorial organisation for Lorient agglomeration	▪ Project manager "Handicap Innovation Territoire"
Non-profit health insurance	▪ General manager ▪ President
University "Bretagne"	▪ Vice-president for innovation
Public bank	▪ VC Investment Officer
University "Engineering"	▪ Researcher
Local agency for urban planning, economic development, and technology	▪ Director "Companies and innovation support"
Firm specialising in digitalised healthcare services	▪ Managing director and co-founder
Start-up specializing in access to digital interfaces for people with disabilities	▪ Co-founder and head of "Handicap & Inclusion"

Data analysis

The data analysis enabled us to reconstruct the development of the HIT innovation ecosystem and to uncover the orchestrations activities and associated capabilities within it. We began the first step of the analysis after the first interviews were carried out. Following a thematic analysis (Miles & Huberman, 1994), we coded the collected data in NVivo to bring out the most relevant elements. As more interviews were conducted, themes were refined and adjusted. The coding process was done separately by two of the researchers who later compared their work. The emerging codes formed the basis for a timeline and narrative (Langley, 1999), checked by the interviewees, on the birth and development of the HIT innovation ecosystem. The quotes presented in this paper have been translated from French to English after analysis. The second step consisted in identifying the orchestration activities taking place in the innovation ecosystem. Going back and forth between our data and the ecosystem orchestration literature, we were able to characterise orchestration activities which appeared to be distributed among ecosystem actors. Finally, based on the dynamic capabilities literature, we

associated each orchestration activity with one of the three dynamic capabilities categories, namely *sensing*, *seizing* and *reconfiguring* capabilities (Teece, 2007).

Table 2
Summary of data sources

Data sources	Primary sources	Secondary sources
Type of data	**Semi-structured interviews** 17 interviews 182 pages Between 40 and 80 minutes Online interviews **Minutes** CoWork'HIT inauguration 2h30 live on YouTube	**Internal documentation** 2 mind maps on strategy documentation regional authority Minutes taken by CoWork'HIT 3 strategic committee 29 pages 1 PowerPoint Presentation of HIT and Cowork'HIT **Public documentation** News bulletin "Handicap & Innovation" 5 articles from the HIT website

FINDINGS

Our thematic analysis revealed that the HIT innovation ecosystem benefited from existing relationships between actors, shared values and collective memory. The ensuing dynamic faced a change that required new solutions to keep financing innovation. Following a national call for projects, actors began to collaborate and co-constructed the HIT project which was eventually awarded. Furthermore, the analysis revealed that CoWork'HIT helped develop and sustain the innovation ecosystem. Figure 1 illustrates the HIT innovation ecosystem development.

A fertile ground for an innovation ecosystem

Our data suggested that a dynamic toward an innovation ecosystem was already taking place in the region of Lorient before the HIT project. Particularly, we identified three elements supporting this dynamic, namely the influence of a renowned actor, existing relationships between actors, and shared values.

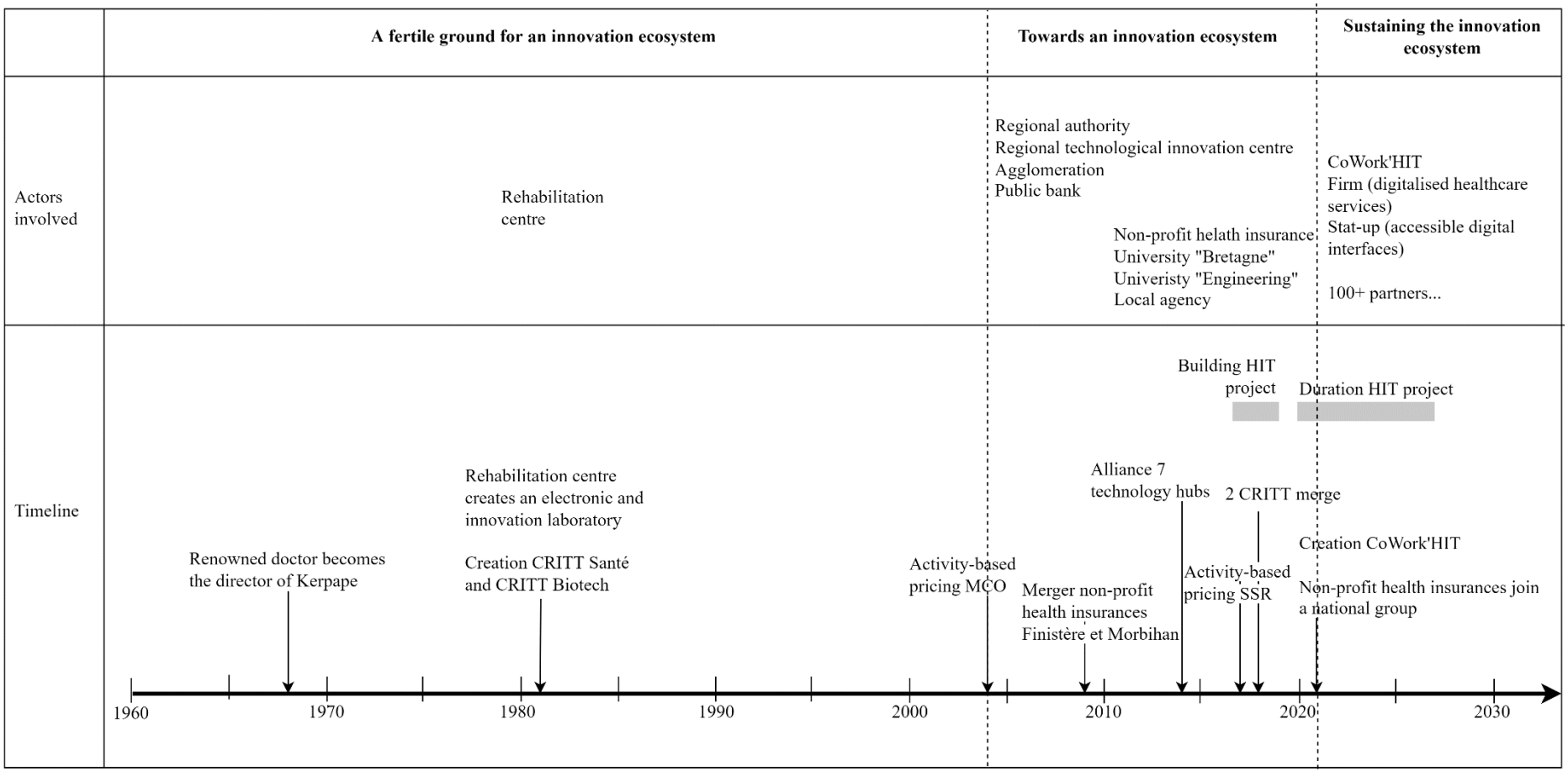
The influence of a renowned actor

Created in the 1920s as a sanatorium to cure patients with tuberculosis in Ploemeur near Lorient (Bretagne, France), the establishment became a rehabilitation centre in 1959. In 1968, one doctor took on the director function and developed the innovation status of the rehabilitation centre. One interviewee described him as an influential figure who raised awareness for disabled persons' difficulties in accessing everyday life services and places such as sports, driving schools and cinemas. He also involved local politicians in improving disabled access standards on the territory of Lorient.

In 1981, the rehabilitation centre opened an electronic laboratory and hired two engineers to innovate and co-create solutions with and for the patients. The centre gradually became known for its innovations and built new partnerships, as a former engineer explained:

> "Let's say that some relationships were created with many external partners and these relationships remained. And so, the image of [the rehabilitation centre] was

Figure 1
Timeline of the HIT innovation ecosystem development



already turned towards innovation, was known for its innovation and so, we never had issues with finding partners."

Two interviewees from the rehabilitation centre mentioned collaborations with the regional technological innovation centre and the agglomeration. The HIT project and CoWork'HIT may not have been possible without the rehabilitation centre, as indicated during the online inauguration of CoWork'HIT, and by the general manager of the non-profit health insurance:

"We understand that CoWork'HIT was not created from scratch. It's true that [the rehabilitation centre] still has […] a reputation precisely in innovations for rehabilitation. So, we started with this great heritage, this great transmission."

"There would not be [the rehabilitation centre] in Lorient, there would be no CoWork'HIT on the territory of Lorient. That's it."

Existing relationships and collective memory

The relationships existing before the HIT project were mostly centred around the rehabilitation centre, making it a cornerstone in linking local actors. On top of the previously mentioned collaborations, the interviews revealed collaborations between the university "Bretagne" and the rehabilitation centre, the regional technological innovation centre and the firm specialising in digitalised healthcare services. While these collaborations were bilateral and not structured, they were described as a success factor for the HIT project

Trust between actors enabled these relationships to develop and facilitate collaborations. The president of the non-profit health insurance said he fully supported the HIT project because he trusted the rehabilitation centre and its top management.

Shared values and collective memory

Common values and interests also participated in forming a good environment for the innovation ecosystem. The values carried by non-profit health insurances, such as universality, accessibility or fairness, favoured collaboration and innovation.

Actors on the territory had interests in innovation. Innovation was part of the culture of the non-profit health insurance and the rehabilitation centre. The regional technological innovation centre stems from the merger of two Regional Centres for Innovation and Technology Transfer (CRITT) created in 1981. Since then, the organisation has guided firms in their R&D activities and innovation projects. Innovation was also important to the two universities. The interviewee from the university "Engineering" explained that innovation was key to the education of future engineers. The interviewee from the university "Bretagne" claimed that innovation was a necessity and a department was dedicated to innovation activities. Finally, the regional authority had an innovation department to support the innovation projects of the territory. When it comes to the disabled subject, the agglomeration needed to have an accessibility committee, but its committee was very active and accomplished more than required by the law:

"There was an intercommunal accessibility committee that was very active at [the agglomeration], and that went much further those regulatory measures on providing an overview of what is, what the minimum requirements are."

One interviewee from the public bank said the organisation had encountered and supported different projects in the disability industry. In the end, the disability subject became a means to gather everyone:

"Everyone is perfectly comfortable with the subject, take it on with a perfect continuity"

"There was already, let's say, a tendency and a voluntaristic policy before the HIT project that were the fertile ground to go further."

All the interviewees tended to believe that, above all individual interests and values, the regional culture of Bretagne facilitated collaborations between actors, regardless of their discords or diverging opinions:

"In Bretagne, I think there's a real historical tradition. We can put aside discords aside, between a metropolis and a region, between an urban area and another urban area, between an organisation and another organisation, from the moment it's for the interest of Bretagne."

Evolving towards an innovation ecosystem

The territorial dynamic described above was later challenged by a change in the environment. The activity-based pricing ("T2A" in French), first introduced in 2004 for medical, surgical, and obstetrical (MCO in French) units, was extended to follow-up care and rehabilitation (SSR in French) in 2017. This impacted the financing plan of care centres, such as the rehabilitation centre, which saw its innovation activities and electronic laboratory threatened because the new pricing system did not view them as productive activities. This change, along with other needs, led to the construction of the HIT project, which received support from local politicians and actors.

Triggers for an innovation ecosystem

We found that the need for financial resources impelled the rehabilitation centre to look for alternatives to finance and sustain the innovation activities of its laboratory.

The rehabilitation centre built on its previous relationships to raise awareness among politicians and to solicit actors such as the regional authority:

"It's the innovation department of [the rehabilitation centre] that came to see the region and said that they were going to fail if we didn't find a solution to help them."

Next to the need for funds, the rehabilitation centre and the health industry faced other needs in the environment. First, the rehabilitation centre received an increasing number of requests for R&D activities but struggled to answer them. The director of the rehabilitation centre explained:

"[The rehabilitation centre has] a clinical activity but also a very important research and development activity. We have ever more companies coming to us and asking for advice, but it's all done without an economic model, with no specific ambition."

Second, the disability industry was fragmented, and organisations needed a structure to develop their economic activities, as identified by the HIT project founders:

"We sensed before […] the need of firms in the disability industry that was not much structured. After all, a fragmented industry with a lack of ready-to-use support. There was this need which had been expressed several times."

Collaborations between actors

The regional authority identified the call for projects and started collaborating with the rehabilitation centre, the regional technological innovation centre, and the agglomeration to co-construct the HIT project. The first phase between 2017 and 2019 consisted of crafting the project. During the construction, the reputation of the founders and the network of two engineers at the rehabilitation centre and one consultancy firm helped attract new actors into the nascent innovation ecosystem. In the end, about a hundred partners contributed to the HIT project either by investing money in the project or the capital of CoWork'HIT or by bringing their expertise and knowledge. The

diversity of actors was necessary to gather various skills and competencies that could complement each other, which required expanding partnerships outside of the territory of Lorient. One interviewee explained:

> "On innovation development, [the agglomeration] could not say "Yes we have 30 very specialised firms in the disability industry on the urban area of Lorient" […] So the idea was to integrate partner territories where there were different actors that were Brest and Rennes, with a partnership with Quebec."

Ultimately, territories, universities, organisations, and users worked together to define the 61 operations within the HIT project, thus establishing common goals and values.

Alongside the co-construction of the HIT project, several mergers and alliances took place on the territory. Local non-profit health insurances first merged at the regional level and later joined a national group. The two regional centres (CRITT) also merged to integrate health and biotech into one regional technological innovation centre. Finally, the seven technology hubs present in Bretagne allied in 2014 to gather their resources and better support the development of innovation in the region.

Support from local politician figures and actors

The co-construction of the HIT project was possible thanks to the support of diverse actors who trusted the founders and believed in the success of the project. The non-profit health insurance and the regional authority fully supported the rehabilitation centre when answering the call for projects.

The elected representatives in the agglomeration of Lorient also backed up the HIT project and approved the status of the agglomeration as representative of the project. The interviewees mentioned the importance of the support of local politicians:

> "I say thank you, thank you to all the elected politicians on the Lorient territory that have really, everyone joined this, deputy and mayor, everyone was supportive and very honestly, so that was easier with that."
>
> "There were the elected representatives and the political will that positioned itself. It's not because you have a very dynamic actor that the territory chooses to go strongly in that direction."

Sustaining the innovation ecosystem

As the innovation ecosystem formed and grew, actors expressed a need for structure to sustain the innovation ecosystem beyond the HIT project time frame. Ecosystem actors thus decided to create CoWork'HIT to create value beyond the HIT operations and ensure new innovation projects. We also found that other actors helped CoWork'HIT and participated in maintaining the innovation ecosystem.

CoWork'HIT as a structuring entity

The innovation ecosystem formed around the HIT project and operations. However, the founders wanted to establish a structuring entity to ensure the survival of the ecosystem beyond the HIT project time frame. CoWork'HIT aimed at coordinating the ecosystem actors, establishing a viable economic model in the disability sector, and sustaining the innovation ecosystem over time. Two interviewees explained:

> "Quickly came the idea to have an innovation centre, lasting beyond the project and being the supportive, accelerating, training structure for tomorrow's innovations."

The differentiation of CoWork'HIT, compared to existing innovation centres on the territory lied in its ability to guide actors throughout the whole innovation process, from ideation to commercialisation.

> "The strength of CoWork'HIT, it's from idea to market. And in other organisations

that you may have seen such as Living Labs or others, market access tends to be forgotten."

Moreover, CoWork'HIT valued users and patient integration. The technical director described how users were integrated into a project with the French rowing federation:

"So, there were technical specifications. Our choice was in a co-design logic with the users, this is one of our main principles."

CoWork'HIT hoped to become the expert in disability innovation on the territory but also at the national and international levels. The challenge to secure CoWork'HIT place as the structuring entity of the innovation ecosystem was the need for legitimisation, as the director of CoWork'HIT mentioned:

"We hope to convince people that we can bring things for employment too. Obviously, we're small, that's an ambition, we must first show what we can do. It's by showing what we can do to partners that we will convince others more easily."

Complementarities between Cowork'HIT and other ecosystem actors

When identifying the activities of CoWork'HIT, we noticed that five other ecosystem actors were involved in maintaining the HIT innovation ecosystem. The interviews revealed that CoWork'HIT relied on ecosystem actors' knowledge and skills to carry out its R&D activities and to properly guide its customers through their innovation process. CoWork'HIT had to identify these skills and knowledge and make sense of it to be able to redirect its customer to the right ecosystem actor:

"If it's a rather simple project, we'll do it ourselves. But if it's a complex project, we'll rely on [the regional technological innovation centre]. If it needs 6 months to mature because it's very multidimensional and visions are required, we do not have the resources that can spend such a long time without seeing the return on investment […] However, if it's just a more operational project where we say "there's a good idea but we need a material competence, we need a robotic competence, and the competencies of other actors, bringing it to the market", we will quickly gather them. In this case, CoWork'HIT can do it."

We also observed that ecosystem actors created connections with each other, thus stimulating knowledge exchange and collaborations. The collective status of CoWork'HIT implied that several ecosystem actors were part of its governance and attended strategic committees and general assemblies. Moreover, ecosystem actors organised events and invited each other, or simply participated in similar events. CoWork'HIT solicited several ecosystem actors to participate in its online inauguration. The rehabilitation centre, a start-up specializing in access to digital interfaces for people with disabilities and Cowork'HIT all attended the Autonomic exhibition in Paris in 2021. The start-up was invited to participate in both events.

Actors such as the regional technological innovation centre and the rehabilitation centre brought customers to CoWork'HIT, thus ensuring value creation over time:

"The first services and the first very big things, whether services from HIT or [the rehabilitation centre], and most of the expertise, for now, come from [the rehabilitation centre]. It won't last, however that is still, that's logic."

Their reputation in the territory helped to attract new actors in the ecosystem, particularly at the beginning:

"What was good for us was that at a certain point, every time we went to see an actor with which we had worked with [...] we managed to convince them, and they accepted to join the project."

The local agency for urban planning, economic development, and technology (later called local agency), the agglomeration,and a researcher at the university "Engineering"

also participated in making sure value is created over time by assessing the outcomes of HIT operations and their impact on the territory. One interviewee from the local agency explained:

> "The idea is to carry out this study with indicators that were defined as reference indicators. And so, to carry out this study at regular intervals […] I believe it's every 2 years. What is done is quite complicated. And so, a study was done to mark t0 and the idea is that the following studies will look at whether the HIT project has an impact on the territory, based on the indicators."

Finally, one of the orchestration activities identify was the alignment of ecosystem actors. The agglomeration and the regional authority supported CoWork'HIT by coordinating partners and communicating a vision centred on the disability subject:

> "As a project manager of this Handicap Innovation Territoire project, among my mission, the first one is to coordinate the partner consortium, so ensure the follow-up of all the actions, facilitate the global partnership dynamic."
>
> "We will speak about disability as a positive value […] we chose to say that we could build positive values, and even economic values even though there was a long way to go […] And we all say that we present something for which we wouldn't make money, but we will build an economic model such that we will be able to balance the budget of [the rehabilitation centre]."

In total, we identified 13 activities aimed at sustaining the ecosystem over time, i.e., 13 orchestration activities. A summary can be found in Table 3.

Shared orchestration activities and dynamic capabilities

Our study suggests that orchestration activities can be distributed among the HIT innovation ecosystem actors. We observed that CoWork'HIT remains central in orchestrating the ecosystem and is responsible for most of the orchestration activities. To further understand orchestration activities and in line with previous research (Heaton et al., 2019; Linde et al., 2021), we associated each orchestration activity with a dynamic capability. The dynamic capabilities framework enabled us to identify the capabilities required to orchestrate. *Expanding interactions with external actors, Identifying where to find the appropriate skills and knowledge,* and *Scanning the environment in search of solutions* were related to sensing capabilities. Teece (2007) related sensing capabilities to the individual ability to learn and to sense opportunities. Looking for solutions when facing changes in the environment is essential to be able to identify emerging trends and opportunities (Teece, 2007). Identifying knowledge and skills across the ecosystem involves an ability to map the scattered skills and knowledge of diverse ecosystem actors. This refers to the orchestration of dispersed knowledge in ecosystems as studied by Gomes et al. (2020). Finally, to expand interactions outside of the ecosystem, actors need to be able to sense future opportunities and identify the appropriate partners. This could be done by connecting and looking for complementarities with other ecosystems.

Co-creating with the users and other actors, Putting ecosystem actors in contact with each other, Making sense of actors' dispersed knowledge and skills, Creating value for the ecosystem, and *Tap ecosystem actors' knowledge and skills to create value* are all activities that lead to seizing the opportunities identified in the first place. Co-creating and relying on other actors' skills can be seen as means to seize opportunities and create innovations. By connecting actors with each other, orchestrators can promote knowledge flow (Gomes et al., 2020) and favour future collaborations. The creation of

Table 3

Distribution of orchestration activities among ecosystem actors and the corresponding capabilities

		Local agency	Regional technological innovation centre	CoWork'HIT	Rehabilitation centre	Agglomeration	Regional authority
Sensing capabilities	Expanding interactions with external actors			✓			✓
	Identifying where to find the appropriate skills and knowledge			✓			✓
	Scanning the environment in search of solutions		✓				✓
Seizing capabilities	Co-creating with the users and other actors			✓			✓
	Putting ecosystem actors in contact with each other	✓		✓	✓	✓	✓
	Making sense of actors' dispersed knowledge and skills			✓			
	Creating value for the ecosystem	✓		✓			
	Tap ecosystem actors' knowledge and skills to create value			✓			
Reconfiguring capabilities	Ensuring value creation over time	✓	✓	✓		✓	✓
	Exchanging competencies between ecosystem actors	✓		✓	✓	✓	
	Learning new skills and activities			✓			✓
	Making sure actors are aligned			✓		✓	✓
	Attracting new actors in the ecosystem		✓	✓	✓	✓	✓

value for the ecosystem refers to the ability to seize and realise the value proposition around which the ecosystem is organised (Linde et al., 2021).

Finally, reconfiguring capability refers to the continuous alignment and realignment of assets (Teece, 2007). *Ensuring value creation over time, Exchanging competencies between ecosystem actors, Learning new skills and activities, Making sure actors are aligned,* and *Attracting new actors in the ecosystem* all enable the ecosystem to renew over time. Ensuring value creation involves an ability to adapt the value proposition to changing conditions in the innovation ecosystem (Linde et al., 2021). Exchanging competencies and learning new skills are part of knowledge management and transfer activities (Teece, 2007). Making sure actors are aligned refers to the core of ecosystems which Adner (2017) defines as an alignment structure of multiple interacting partners. It enables orchestrators to align incentives and minimise agency issues (Teece, 2007). Lastly, attracting actors in the ecosystem implies an ability to reorganise the ecosystem as these new actors are integrated (Linde et al., 2021).

DISCUSSION

In this paper, we presented the development of a heterogeneous innovation ecosystem and suggested that orchestration activities can be shared among several ecosystem actors. We then relied on the dynamic capabilities framework (Teece et al., 1997) to associate each orchestration activity with sensing, seizing, or reconfiguring capabilities.

Our findings can help actors willing to take on the role of orchestrators by presenting some of the capabilities required to organise and sustain their ecosystems over time. Our insights also inform orchestrators of the tensions that can arise in their innovation ecosystem and of the possibility to adapt their activities as the innovation ecosystem evolve. Finally, this research can help policymakers to better understand orchestrating activities and improve the coordination and performance of innovation ecosystems. In the context of the MedTech industry, this could encourage and guide the development of technologies that are relevant and of high social value for the users.

Below, we discuss the contributions of our research to both the innovation ecosystems orchestration and dynamic capabilities literature.

Implications for the innovation ecosystem literature

Our research enables a better understanding of orchestration activities in innovation ecosystems. First, early research on innovation ecosystems stated that a single actor was responsible for orchestrating and sustaining an ecosystem over time (Bittencourt et al., 2020; Heaton et al., 2019). Recently, scholars indicated that orchestration activities can be shared among multiple ecosystem actors (Pushpananthan & Elmquist, 2022; Valkokari et al., 2017; Visscher et al., 2021). Our study supports this claim and provides empirical evidence of an innovation ecosystem with shared orchestration activities.

Second, we extend research on innovation ecosystem orchestration by drawing on the dynamic capabilities framework. Shared orchestration activities can be related to a dynamic capability, thus suggesting distributed dynamic capabilities across the innovation ecosystem. More particularly, orchestration activities and dynamic capabilities seem to be shared in space, i.e., among several ecosystem actors, and in time, i.e., as actors get in charge of different or new activities throughout the ecosystem lifecycle (Hurmelinna-Laukkanen & Nätti, 2018). This implies that ecosystem actors may be able to engage in sensing, seizing, or reconfiguring at various times, based on their role, along the ecosystem lifecycle. Similarly, Heaton et al. (2019) proposed that sensing, seizing, and reconfiguring capabilities are particularly needed during the initial, development and renewal stages, respectively.

Enriching the dynamic capabilities literature

Our study of a heterogeneous innovation ecosystem in which orchestration activities are shared contributes to a recent dynamic capabilities literature. First, the distribution of dynamic capabilities within an innovation ecosystem, as suggested in our research, points to the existence of dynamic capabilities at the ecosystem level. This proposition draws on the work of Teece (2007) who argued that successful firms should rely on sensing, seizing, and reconfiguring capabilities simultaneously. However, as these dynamic capabilities require different mindsets and "are unlikely to be found in individual managers, they must be somewhere represented in top management, and the principal executive officer must succeed in getting top management to operate as a team" (Teece, 2007, p. 1347). Building on such insights, we offer that this is also true of dynamic capabilities in innovation ecosystems. In other words, for an innovation ecosystem to be successful, the three categories of dynamic capabilities should be present simultaneously. As they involve different mindsets and orchestration activities, they are unlikely to be found in a single orchestrator. Instead, several actors share various orchestration activities and thus, represent dynamic capabilities at the ecosystem level. This claim resonates with Giudici et al. (2018) who argued that dynamic capabilities can be co-created for orchestration to have an impact on the network members' sensing capabilities.

Second, our paper points out the importance of collective memory, history, and temporality in heterogeneous innovation ecosystems. This refers to recent research that emphasises the importance of historical and subjective time when studying dynamic phenomena (Coraiola et al., 2017). Coraiola et al. (2017) claimed that collective memory and history, i.e., historical time, could be viewed as organisational dynamic capabilities. Historical time can be expressed through a common history and shared values among ecosystem actors. Subjective time also needs to be considered and represents the idiosyncrasies of each ecosystem actor, their path-dependency and own future development. The evolution of individual actors versus the evolution of the ecosystem as a whole creates tensions (Ritala & Almpanopoulou, 2017) that have implications for orchestration. This implies multiple temporalities that orchestrators will have to manage (Poblete et al., 2022). They have to align several different ecosystem actors which pursue their own goals while maintaining the collective memory and shared values of the ecosystem as new actors are integrated. Added to this is the own individual development of each orchestrator.

CONCLUSION

Our paper presents a single case study of an innovation ecosystem in which orchestration activities appear to be shared between one central actor and other ecosystem actors. We also suggest a distribution of dynamic capabilities among actors, thus indicating a development of dynamic capabilities at the ecosystem level.

The consideration of historical and subjective time when studying orchestration in the context of innovation ecosystems and the resulting tensions highlights the specificities of dynamic capabilities in innovation ecosystems. This suggests the need to rethink dynamic capabilities at the ecosystem level. Traditional approaches (Teece et al., 1997) study dynamic capabilities at the organisational level, thus acknowledging the temporality of a single firm. Recent research identified various dynamic capabilities at the ecosystem level but do not put forward this notion of temporality (Coraiola et al., 2017). In line with Salvato & Rerup (2011) who offered a multi-level perspective on dynamic capabilities, we advance the need to better consider the dynamic and heterogeneous nature of innovation ecosystems when drawing on the dynamic

capability framework to study ecosystem orchestration activities. In light of ecosystems, we need to rethink the dynamic capabilities framework through a multi-level perspective to take into account the notions of time and multiple temporalities and to address the tensions that can arise as innovation ecosystems evolve. Such suggestions are aligned with the work of Schilke et al. who argued that "studying the evolution of dynamic capabilities and the role of time is highly consistent with the focus of dynamic capabilities on strategic change" (2018, p. 407).

Finally, we advise further research to confirm or refute these findings. We relied on a single case study to illustrate a yet understudied phenomenon in which orchestration activities are distributed across an ecosystem. Longitudinal studies within an innovation ecosystem or multiple case studies in different innovation ecosystems could refine our findings. Research in other ecosystems such as business, knowledge or entrepreneurial ecosystems could reveal whether such findings can be confirmed in other contexts

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