Characterising The Structure and Dynamics of Ecosystem Orchestration: A Literature Review

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Abstract :

In the past years, the ecosystem concept has gained importance in the strategy and management fields. Originated by Moore in 1993, ecosystems have since then been analysed and critically reviewed by many scholars. The biological metaphor used to describe the variety of actors suggests that artificial ecosystems emerge by themselves, a point for which it has been criticised. Past research showed that ecosystems need to be orchestrated to develop and renew over time. Although research on ecosystems flourished, our understanding of ecosystem orchestration remains limited. Reviewing the literature on ecosystem orchestration, this paper summarises the current research on the structure and dynamics of orchestration. In particular, the article reviews a recent research stream that addresses dynamic capabilities in ecosystems, thus laying the ground for further research.

Keywords: Orchestration, Ecosystems, Dynamic capabilities, Narrative literature review

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Résumé :

Au cours des dernières années, le concept d'écosystème a gagné en importance dans les domaines de la stratégie et de la gestion. Introduits par Moore en 1993, les écosystèmes ont depuis été analysés et examinés de manière critique par de nombreux chercheurs. La métaphore biologique utilisée pour décrire la variété des acteurs suggère que les écosystèmes artificiels émergent d'eux-mêmes, ce qui lui a été reproché. Des recherches antérieures ont montré que les écosystèmes doivent être orchestrés pour se développer et se renouveler au fil du temps. Bien que la recherche sur les écosystèmes ait prospéré, notre compréhension de l'orchestration des écosystèmes reste limitée. Passant en revue la littérature sur l'orchestration des écosystèmes, cet article résume les recherches actuelles sur la structure et la dynamique de l'orchestration. En particulier, l'article présente un courant de recherche récent qui porte sur les capacités dynamiques des écosystèmes, formant ainsi les bases pour de futures recherches.

Mots-clés : Orchestration, Écosystèmes, Capacités dynamiques, Revue de littérature narrative

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INTRODUCTION

Inspired by biology, the concept of ecosystem was introduced by Moore (1993) to suggest that companies may not belong to one industry but rather to an ecosystem spanning a wide range of industries. The concept aimed at describing a new type of competitive environment in which actors collaborate while competing with each other to both create a joint value proposition (Adner, 2017; Moore, 1993; Thomas & Autio, 2020) and fulfil their own interests (Leten et al., 2013). The interdependency and common faith of a heterogeneous set of actors are typical of ecosystems (Adner & Kapoor, 2010; Iansiti & Levien, 2004). These actors generally organise around a focal firm or innovation (Autio & Thomas, 2014) without the need for hierarchical governance mechanisms (Jacobides et al., 2018) or formal contracts (Autio, 2021; Bittencourt et al., 2020; Jacobides et al., 2018). Many industries organise around ecosystems (Adner, 2006; Ritala et al., 2013) and examples can be found in the Medtech industry (Klein, 2015), the semiconductor industry (Adner & Kapoor, 2010; Leten et al., 2013) or the electricity power industry (Chen et al., 2019). Over the past few years, research on ecosystems has proliferated (Autio & Thomas, 2014), resulting in different ecosystem types. Innovation ecosystems, entrepreneurial ecosystems, knowledge ecosystems, business ecosystems, and platform ecosystems, among others, were identified and distinguished depending on their purpose, scope, and type of actors (Jacobides et al., 2018; Thomas & Autio, 2020). Focusing on business ecosystems, Koening (2012) reviewed the work of Moore and identified four kinds of ecosystems based on the type of interdependencies and control over resources. Similarly, Jacobides et al. (2018) identified three ecosystem streams, namely business, platform and innovation ecosystems.

Although the growing interest was beneficial to the ecosystem literature, few scholars claimed it led to incoherent and confusing theoretical insights (Adner, 2017; Autio, 2021). They questioned the relevance of the ecosystem metaphor (Fréry et al., 2012; Granstrand & Holgersson, 2020; Koenig, 2012; Oh et al., 2016) and pointed out the difficulty of empirically measuring ecosystem performance since the goals of individual actors and the goals of

ecosystems may conflict (Ritala & Almpanopoulou, 2017). Moreover, unlike natural ecosystems, artificial ecosystems are designed entities and do not develop solely on their own (Adner & Kapoor, 2010; Oh et al., 2016). Orchestration was identified as a crucial means to manage the development of ecosystems over time and coordinate interdependencies and interactions between ecosystem actors (Autio, 2021; Chen et al., 2019; Gomes et al., 2020; Valkokari et al., 2017; Yaghmaie & Vanhaverbeke, 2019). Extant research explored 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 provided insights on their activities (Bittencourt et al., 2020; Heaton et al., 2019; Leten et al., 2013; Valkokari et al., 2017) along the ecosystem life cycle (Autio, 2021). However, most scholars have drawn on definitions of innovation networks to explore the concept of orchestration and there exists no clear definition in the context of ecosystems. Ecosystems are a particular type of networks in which actors are heterogeneous, interdependent and evolve in a dynamic context (Heaton et al., 2019; Thomas & Autio, 2020; Valkokari et al., 2017), thus requiring a specific definition of orchestration in the context of ecosystems.

To address this issue, this paper presents the structure and dynamics of ecosystem orchestration as depicted in recent research work. By structure, I refer to orchestration activities and the actors conducting such activities, namely the orchestrators. By dynamics, I point out the evolving and path-dependency nature of ecosystems and introduce a new perspective involving the dynamic capabilities framework. This narrative literature review contributes to the ecosystem orchestration literature by clarifying the concept and suggesting a new area of research on dynamic capabilities in ecosystems.

The remainder of this paper is structured as follows. First, orchestration definitions, orchestration activities and orchestrator types identified in past research are presented. Then, the dynamics of ecosystem orchestration are described based on the dynamic capabilities perspective and the path-dependent nature of ecosystems. The fourth section concludes with a definition of ecosystem orchestration and recommendations for future research.

1. CHARACTERISING THE STRUCTURE OF ECOSYSTEM ORCHESTRATION

1.1. FROM NETWORK TO ECOSYSTEM ORCHESTRATION

Before its application to ecosystems, the concept of orchestration has been studied in innovation networks. Dhanaraj & Parkhe (2006) defined innovation network orchestration as

"the set of deliberate, purposeful actions undertaken by the hub firm as it seeks to create value (expand the pie) and extract value (gain a larger slice of the pie) from the network" (p. 659). Later, Verhoeven & Maritz (2012) refined this definition and viewed innovation network 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" (p. 5). Many scholars drew on such definitions when studying ecosystem orchestration. Out of the 27 reviewed articles on orchestration (see Table 1), 12 rely on insights from the innovation network literature to define orchestration. Table 1 indicates which articles rely on such literature and which ones do not provide an explicit definition.

In ecosystems, orchestration is viewed as a purposeful action that is required to manage knowledge and the interactions between multiple actors (Autio, 2021; Bittencourt et al., 2020). Focusing on facilitating orchestration activities, Äyväri & Spilling (2020) considered orchestration as "the participatory and supportive management practices in innovation ecosystems to enable multi-stakeholder co-creation, maximize learning of all actors involved and finally to achieve the shared vision of the ecosystem" (p. 77). The authors argued that orchestration is about managing *with* other ecosystem actors rather than merely managing them. Bittencourt et al. (2020) provided a similar view by assimilating orchestration to enabling leadership as opposed to strict management. Orchestration can also be realised through rules or values, otherwise called tight or loose orchestration (Davidson et al., 2015). The former is formal and implies that actors in charge of orchestrating the ecosystem can influence other actors through policies and explicit rules. The latter is informal and suggests that actors can rely on cultural norms to exert only a limited influence across the ecosystem (Davidson et al., 2015).

1.2. ORCHESTRATING ACTIVITIES

Based on past research, orchestration activities can be divided into five categories, namely (1) attracting and retaining actors, (2) coordinating and connecting actors, (3) aligning actors, (4) capturing and distributing value, (5) ensuring the self-renewal of the ecosystem through value creation.

Table 1. Overview of the reviewed articles on orchestration

REFERENCE	SOURCE	DEFINITION OF ORCHESTRATION
Autio (2021)	Innovation: Organization and Management	Dhanaraj & Parkhe (2006)
Ayväri & Spilling (2020)	Co-Creating and Orchestrating Multistakeholder Innovation	Dhanaraj & Parkhe (2006) Verhoeven & Maritz (2012)
Bittencourt et al. (2020)	Revue Internationale d'Intelligence Economique	Dhanaraj & Parkhe (2006)
Chen et al. (2019)	International Conference on Strategic Management (ICSM 2019)	Dhanaraj & Parkhe (2006)
Dattée et al. (2018)	Academy of Management Journal	No explicit definition
Davidson et al. (2015)	Strategy & Leadership	No explicit definition
Dedehayir et al. (2018)	Technological Forecasting & Social Change	No explicit definition
Dhanaraj & Parkhe (2016)	The Academy of Management Review	Dhanaraj & Parkhe (2006)
Heaton et al. (2019)	Industrial and Corporate Change	No explicit definition
Helfat & Raubitschek (2018)	Research Policy	No explicit definition
Hirvikoski & Saastamoinen (2020)	Co-Creating and Orchestrating Multistakeholder Innovation	Verhoeven & Maritz (2012)
Hirvonen-Kantola et al. (2018)	The ISPIM Conference	Dhanaraj & Parkhe (2006)
Hurmelinna-Laukkanen & Nätti (2018)	Industrial Marketing Management	Verhoeven & Maritz (2012)
Jacobides et al. (2018)	Strategic Management Journal	No explicit definition
Leten et al. (2013)	California Management Review	No explicit definition

Table 1. Continued

REFERENCE	SOURCE	DEFINITION OF ORCHESTRATION
Linde et al. (2021)	Technological Forecasting & Social Change	Verhoeven & Maritz (2012)
Lingens, Miehé & Gassmann (2021)	Long Range Planning	No explicit definition
Pikkarainen et al. (2017)	Technology Innovation Management Review	Nambisan & Sawhney (2011)
Reypens et al. (2020)	Organization Studies	Dhanaraj & Parkhe (2006)
Roijakkers et al. (2013)	35th DRUID Celebration Conference	No explicit definition
Shipilov & Gawer (2020)	Academy of Management Annals	No explicit definition
Still et al. (2014)	International Journal of Technology Management	Dhanaraj & Parkhe (2006)
Valkokari et al. (2017)	Technology Innovation Management Review	No explicit definition
Visscher et al. (2021)	Creativity and Innovation Management	No explicit definition
Yaghmaie & Vanhaverbeke (2019)	EuroMed Journal of Business	No explicit definition

The first category involves activities to persuade actors to join the ecosystem (Lingens, Böger & Gassmann, 2021; Pikkarainen et al., 2017). There should be sufficient and relevant incentives to stimulate participation (Autio, 2021) and encourage actors to stay in the ecosystem (Yaghmaie & Vanhaverbeke, 2019). Orchestration activities also involve shaping the ecosystem (Leten et al., 2013), limiting actor turnover (Hirvikoski et al., 2020) and ensuring stability (Pikkarainen et al., 2017).

The second type of activity promotes knowledge mobility, which refers to how easily knowledge is shared, acquired, and spread by the actors (Dhanaraj & Parkhe, 2006). Orchestration activities can enhance such mobility by coordinating and connecting ecosystem actors. Coordinating the different actors and ensuring partnership creation are salient activities to promote interactions and foster information exchange (Hirvonen-Kantola et al., 2018; Linde et al., 2021; Lingens, Böger & Gassmann, 2021). Other activities to connect actors are facilitating activities (Reypens et al., 2021; Still et al., 2014) and supportive practices for co-creation (Äyväri & Spilling, 2020).

The third type of activity relates to the alignment of ecosystem actors. Adner (2017) referred to alignment in ecosystems as *"the extent to which there is mutual agreement among the members regarding [their] positions and flows"* (p. 42). In terms of orchestration activities, ecosystem alignment implies defining the roles of actors, managing potential conflict, ensuring actors are keen to work for common value creation (Autio, 2021; Linde et al., 2021), and setting a common agenda (Hirvonen-Kantola et al., 2018; Leten et al., 2013).

Only when actors interact and agree on a common direction can value be created (Dhanaraj & Parkhe, 2006) and subsequently captured, which constitutes the fourth orchestration activities type. The literature refers to value capture as appropriability, that is, the ability to capture profits generated by an innovation (Dhanaraj & Parkhe, 2006). Orchestration activities are associated with appropriability (Chen et al., 2019) and should guarantee a fair distribution of value among actors (Yaghmaie & Vanhaverbeke, 2019) to prevent imitation and opportunistic behaviours (Chen et al., 2019; Yaghmaie & Vanhaverbeke, 2019).

The final type of orchestration activity ensures ecosystem renewal over time. Defining and creating a joint value proposition is the first step towards a sustainable ecosystem because it motivates actors to stay and capture the value created (Hirvikoski & Saastamoinen, 2020; Linde et al., 2021; Lingens, Huber & Gassmann, 2021). However, as ecosystems are not static (Lingens, Böger & Gassmann, 2021), a second step is needed to continuously maximise value

creation and foster ecosystem growth. Orchestration activities should also involve the exploration of new ideas (Lingens, Böger & Gassmann, 2021). Actors can expand their interactions with actors outside of the ecosystem such that innovative inputs drive future development and goals (Lingens, Huber & Gassmann, 2021). Table 2 summarises the set of activities across the five categories.

Table 2. Five categories of orchestration activities

CATEGORY	ACTIVITIES
Attracting and retaining actors	Persuade actors to join
	Provide sufficient incentives for participation
	Limit actor turnover
	Ensure stability
Coordinating and connecting actors	Promote knowledge mobility
	Coordinate and connect ecosystem actors
	Ensure partnership creation
	Foster information exchange and interactions
	Adopt facilitating and supportive practices for co-creation
Aligning actors	Define the roles of ecosystem actors
	Manage conflict
	Ensure ecosystem actors are willing to co-create
	Set a common agenda
Capturing and distributing value	Appropriate the value generated
	Ensure a fair distribution of value among ecosystem actors
	Prevent opportunistic behaviours
Ensuring the self-renewal of the ecosystem through value creation	Define a joint value proposition
	Explore new ideas
	Expand interactions with external actors

1.3. ORCHESTRATORS: PLAYERS, FACILITATORS, SPONSORS

Many scholars studied a specific type of actors in ecosystems, namely the orchestrators whose activities differentiate them from more traditional concepts such as "hub firm" (Autio &

Thomas, 2014; Chen et al., 2019), "modular architect" (Jacobides et al., 2018), "platform leader" (Cusumano & Gawer, 2002), "ecosystem leader" (Moore, 1996), "keystones" (Iansiti & Levien, 2004), or "focal firm" (Adner, 2017; Dattée et al., 2018). Different ecosystem actors can take on an orchestrating position. First, actors who possess knowledge can become orchestrators (Lingens, Miehé & Gassmann, 2021), and more particularly, knowledge of both production and consumption (Jacobides et al., 2018). Second, some scholars attributed the position of orchestrators to large and established actors who often have a central position in their ecosystem and many resources that enable them to exert authority on others (Chen et al., 2019; Dhanaraj & Parkhe, 2006). Other scholars argued that it is not the size of the actor that grants it an orchestrating position, but rather its ability to apply smart power, which refers to the use of informal authority in order to stimulate and shape the ecosystem (Lingens, Miehé & Gassmann, 2021). Finally, actors that can easily learn, adapt, and share knowledge, such as start-ups, have also been identified as possible ecosystem orchestrators (Lingens, Böger & Gassmann, 2021)

Past research described two types of ecosystem orchestrators, namely player and non-player orchestrators (Leten et al., 2013) (see Table 3). Hurmelinna-Laukkanen & Nätti (2018) further divided the latter into facilitator and sponsor orchestrators and associated each of the three types with different activities and capabilities. Other authors showed that the orchestrator type influences the role and activities performed by this orchestrator (Bittencourt et al., 2020; Hirvonen-Kantola et al., 2018; Hurmelinna-Laukkanen & Nätti, 2018). Player orchestrators focus on achieving their goals and improving their competitive advantage (Äyväri & Spilling, 2020; Hurmelinna-Laukkanen & Nätti, 2018). They tend to have a controlling approach and can enact the role of the architect, judge, gatekeeper, or conductor (Pikkarainen et al., 2017). Such orchestrators, unlike facilitator and sponsor orchestrators, usually compete in the market against other ecosystem actors (Leten et al., 2013). Facilitator orchestrators focus on the common interest and well-being of the ecosystem without striving for financial gain (Äyväri & Spilling, 2020). They have an enabling role and exert discrete influence over the ecosystem by connecting actors with relevant resources (Hurmelinna-Laukkanen & Nätti, 2018; Pikkarainen et al., 2017). Finally, sponsor orchestrators may receive financial gain but remain concerned with the collective goals of the ecosystem. Depending on their role, they focus on sharing knowledge, coordinating interactions, developing assets or promoting a joint vision (Hurmelinna-Laukkanen & Nätti, 2018; Pikkarainen et al., 2017).

Table 3. Who are ecosystem orchestrators?

TYPES OF ORCHESTRATORS	ACTIVITIES
Players	Achieve their own goals
	Improve their own competitive advantage
	Architecture role
	Controlling approach
	Compete on the market against ecosystem actors
	Architect, judge, gatekeeper, conductor
Facilitators	Focus on the common interest and well-being of the ecosystem
	Connect actors with relevant resources
	Enabling role
	Less controlled approach through discrete influence
	Do not strive for financial gain
	Leader, promoter
Sponsors	Concerned about ecosystem collective goals
	Focus on sharing knowledge
	Liaison role
	Relaxed approach
	Receive financial gain
	Representative, liaison, coordinator, auctioneer, developer

1.4. SINGLE VERSUS MULTIPLE ORCHESTRATOR(S)

Traditionally, the literature depicted the orchestrator as a unique actor that performs different orchestration activities (Bittencourt et al., 2020; Dhanaraj & Parkhe, 2006; Heaton et al., 2019; Leten et al., 2013; Verhoeven & Maritz, 2012). Other approaches acknowledged the possibility of having a single orchestrator in an ecosystem. Autio (2021) refers to top-down orchestration to describe how one actor takes charge of the ecosystem architecture by purposefully designing and implementing activities. Similarly, Dedehayir et al. (2018) and Reypens et al. (2021) identified a "dominating" approach to orchestration. They suggested that a single actor controls the ecosystem and is responsible for various activities related to value creation and capture, and to the management of the ecosystem.

A more recent view argued that multiple orchestrators can be found in one ecosystem (Adner, 2017; Äyväri & Spilling, 2020; Pikkarainen et al., 2017; Visscher et al., 2021). Autio (2021) argued that ecosystem value can be co-discovered by several ecosystem actors. This bottom-up approach to orchestration suggests that an orchestrator needs to collaborate and negotiate with multiple actors in order to define ecosystem rules and expected behaviours. The presence of multiple orchestrators was empirically demonstrated. Based on multiple case studies, 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, when an orchestrator lacks consumption-related knowledge, multiple orchestrators will have to take over orchestration activities. The empirical research of Reypens et al. (2021) led to similar findings. The authors found that consensus-based orchestration, in which orchestrators share control over ecosystem goals and vision, is needed to manage the numerous actors and build a flexible ecosystem. The presence of multiple orchestrators is likely to result in higher innovative value, but also makes coordination more challenging (Lingens, Huber & Gassmann, 2021). A trade-off between innovation and coordination or a hybrid approach with both dominating and consensus-based activities can help orchestrators handle the multiplicity and heterogeneity of ecosystem actors (Lingens, Huber & Gassmann, 2021; Reypens et al., 2021).

2. CONSIDERING THE DYNAMICS OF ECOSYSTEM ORCHESTRATION

According to past research, ecosystems have a dynamic nature and evolve in space and time (Bittencourt et al., 2021; Oh et al., 2016; Thomas & Autio, 2020; Valkokari et al., 2017). As they go through periods of growth, decline and eventually renewal (Heaton et al., 2019), ecosystems can expand (Visscher et al., 2021) from local to regional or global levels (Pilinkienė & Mačiulis, 2014; Ritala & Almpanopoulou, 2017). Furthermore, actors may enter or exit ecosystems, take on new tasks, combine existing ones, and take on new roles (Iansiti & Levien, 2004; Williamson & De Meyer, 2012). Mercan & Göktaş (2011) also argued that ecosystems evolve as market conditions change. The ability of ecosystems to remain adaptive and flexible (Linde et al., 2021) is crucial to their success over time (Heaton et al., 2019). To approach this ability to continuously adapt, an emerging stream of research has resorted to the dynamic capability framework.

2.1. A DYNAMIC CAPABILITIES PERSPECTIVE ON ECOSYSTEMS

Dynamic capabilities refer to "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (Teece et al., 1997, p. 516). Dynamic capabilities cannot be acquired, but are rather built over time (Heaton et al., 2019; Teece et al., 1997). They are distinct from operational capabilities, which refer to ordinary capabilities needed for firms to make a living (Sunder & Ganesh, 2021). Firms evolving in fast-paced environments are advised to use or develop dynamic capabilities(Helfat & Peteraf, 2009) to be more resilient and adaptable when facing changes (Helfat & Peteraf, 2009), and to improve their innovative ability (Teece, 2007). Ultimately, dynamic capabilities can help firms to sustain a competitive advantage (Teece et al., 1997). Considering the unique learning mechanisms and histories of firms from which dynamic capabilities emerge (Eisenhardt & Martin, 2000; Zollo & Winter, 2002), different processes and practices may be considered as 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.

In the context of ecosystems, dynamic capabilities are central (Petit & Teece, 2020). Helfat & Raubitschek (2018) suggested that platform leaders need three dynamic capabilities, namely innovation capabilities, environmental scanning and sensing capabilities, and integrative capabilities. Likewise, Walrave et al. (2018) argued that focal firms need dynamic capabilities to maintain a viable value proposition, and Feng et al. (2019) showed the importance of dynamic capabilities to become an ecosystem leader. When it comes to ecosystem orchestration, sensing capabilities enable the identification of opportunities and partners, seizing capabilities stimulate the development of an attractive value proposition by exploiting opportunities, and reconfiguring capabilities ensure ecosystem competitiveness and growth over time (Linde et al., 2021). Other authors have identified dynamic capabilities for orchestrators (Heaton et al., 2019), such as environment scanning, collaborative arrangement, and value integration (Chen et al., 2019) or role-switching and role-augmenting capabilities (Hurmelinna-Laukkanen & Nätti, 2018). According to Petit & Teece (2020), the success of an ecosystem depends on the dynamic capabilities of the orchestrator. Moreover, orchestration in ecosystems is a dynamic activity in itself (Hurmelinna-Laukkanen & Nätti, 2018). It depends on the formality of interactions, the degree of enforceability in the ecosystem, and the degree of influence actors have on each other (Davidson et al., 2015). Orchestration activities may also change alongside the life cycle of ecosystems. Autio (2021) offered a four-layer

framework with tangible actions to orchestrate ecosystems throughout the initiation, momentum, and control stages of ecosystems.

2.2. THE PATH-DEPENDENT NATURE OF ECOSYSTEMS

Next to their dynamic nature, ecosystems are path-dependent (Autio & Thomas, 2014). The activities performed and insights brought by actors during the creation of ecosystems affect the development of a future value proposition (Lingens, Huber & Gassmann, 2021). In the same way, the knowledge acquired in the past by diverse actors influences the future knowledge base of the whole ecosystem (Reischauer et al., 2021). Knowledge tends to be more easily shared and deployed when there exists a common identity among actors (Äyväri & Spilling, 2020). This collective identity builds over time as actors interact and develop historical and socially constructed practices and values (Thomas & Autio, 2020).

Studying the role of time and history in a firm's competitive advantage, Coraiola et al. (2017) argued that collective memory and the capacity to manage the past can be seen as dynamic capabilities, which are path-dependent by nature (Eisenhardt & Martin, 2000; Sunder M & Ganesh, 2021). First, memory is what enables actors to retain information and reproduce past routines. Second, an organisation's history is generally constructed by adapting past knowledge and practices to the needs of the new environment. Finally, organisational memory can be used for imagining the future based on the resources and symbols generated by the current organisational routines and practices (Coraiola et al., 2017). Managing knowledge sharing and developing a collective identity and vision are activities performed by orchestrators and contribute to the ecosystem's performance (Äyväri & Spilling, 2020; Bittencourt et al., 2021).

CONCLUSION AND AGENDA FOR FUTURE RESEARCH

By addressing the current ecosystem orchestration literature through the dynamic capability framework, I propose to characterise ecosystem orchestration as follows: orchestrating an ecosystem involves multiple activities to attract, connect, align, and retain actors**,** to capture and share value among the ecosystem, and to sustain value co-creation for ecosystem renewal. For an ecosystem to thrive over time, such activities require one or multiple orchestrators to develop or maintain dynamic capabilities and to capitalise on the (potential) collective memory of the ecosystem. Such a characterisation complements the existing valuable insights on orchestration activities and orchestrators in ecosystems by integrating the dynamic and

path-dependent nature of ecosystems. However, there remains a lack of conceptualisation of ecosystem orchestration, which offers several research opportunities.

The first research area is to study orchestration together with the variety of ecosystem types. Business, innovation, knowledge, entrepreneurial, or platform ecosystems share some characteristics but also display idiosyncrasies. All ecosystems strive for co-creation relationships but these can aim at creating knowledge, innovations, or competitive value (Klimas & Czakon, 2021). Furthermore, each ecosystem type has a different goal, which can be about enhancing entrepreneurship, competitiveness, or innovation capabilities (Pilinkienė & Mačiulis, 2014). These unique characteristics hint at various orchestration activities. Thus, there is an opportunity to identify whether orchestration activities differ and whether a single orchestrator or multiple ones are preferred depending on the types of ecosystem. Future empirical research may compare orchestration activities in different ecosystem types to further characterise these types and enrich the literature on ecosystems. In addition, questions on whether these activities are mutually exclusive and how they evolve over the life cycle of the ecosystem (e.g. Autio, 2021) should be considered.

A second research opportunity is to clarify what is being orchestrated. Most research on ecosystem orchestration does not clearly state what is being orchestrated within an ecosystem (Autio, 2021; Linde et al., 2021). Few scholars have focused on specific orchestration such as resources or knowledge orchestration. For instance, Gomes et al. (2020) proposed a framework for orchestrating dispersed knowledge in ecosystems, and Bittencourt et al. (2021) studied how resources are orchestrated in innovation ecosystems. Clarifying what is subject to orchestration, i.e., actors, knowledge, and resources, is important to further conceptualise ecosystem orchestration.

Finally, a third opportunity for research is to consider the history of ecosystems when studying orchestration. Reinecke et al. (2020) argued that history and time have become important in the study of organisations. Similarly, Coraiola et al. (2017) demonstrated that the ability to manage memory, time, and history in organisations is critical for success. Although the salience of history in organisations has been proved, it is a missing element in the study of ecosystems. The history, memory and collective identity of ecosystems could prove of interest to understanding the emergence of ecosystems and the distribution of orchestration activities among the actors. Future research may study whether collaboration between actors before the creation of an ecosystem influences the number of orchestrators and types of orchestration activities.

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