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Innovation ecosystem strategies of industrial firms: A multilayered approach to alignment and strategic positioning

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There is a growing interest in innovation ecosystems. Embedding innovation processes in ecosystems comes with several opportunities and managerial challenges. This paper's aim is to increase our understanding of the strategies that industrial firm managers use to deal with innovation ecosystems. How do they align partners and activities while securing and developing their role in the ecosystem? Drawing on 98 interviews with CEOs, CTOs and innovation managers in Germany and the Netherlands, we identify two layers in innovation ecosystems: an explorative layer, which is open and aimed at identifying opportunities for innovation, and an exploitative layer, which is semi-closed and aimed at enacting these opportunities to create new value propositions for customers. We analyse how companies act upon these two layers productively, particularly in relation to alignment and strategic positioning; how they create synergies between the different layers; and how they cope with the existing tensions. Furthermore, we discuss differences in strategic choices regarding ecosystem strategies, and propose a maturity model for the development of innovation ecosystem strategies.

KEYWORDS

exploration and exploitation, industrial firms, innovation ecosystem strategies, innovation ecosystems, multilayered systems

1 | INTRODUCTION

Innovations are typically not stand-alone novelties created by single companies, but new combinations of existing and novel components, products and services, produced by multiple organizations (Iansiti & Levien, 2004). Innovations are created interactively and as part of a wider system, bringing together the contributions of different parties to create value for customers. As a consequence, companies can only partly influence their innovations' chances of success by means of internal management practices; to a large extent, they depend on others' efforts and the dynamics in the broader external network of partners (Van de Ven et al., 1999). These networks do not only comprise supply chains and innovation alliances of focal firms, but also

producers of complementary innovations, user communities, research institutes, governmental agencies, standard-setting bodies, financiers and other actors (Coombs & Georgiou, 2002). To capture these complex interrelations, the interdependencies and competition among actors and the non-linear dynamics of innovation processes, the analogy of ecosystems has been introduced (Moore, 1993), which has gained popularity in practice-oriented and academic management discourse (e.g. Adner & Kapoor, 2010; Gawer & Cusumano, 2014; Hooge & le Du, 2016; Ormala et al., 2014).

Operating in innovation ecosystems comes with challenges. These relate to strategic decisions such as with whom to cooperate and with whom to compete (Van de Ven et al., 1999); how much to invest in the ecosystem as a whole, versus investing in one's own

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position within it (Autio & Thomas, 2014); and how to align internal innovation activities with technological progress in the ecosystem (Adner & Kapoor, 2010). To deal with these questions, firms may develop more or less deliberate ecosystem strategies, which are approaches for aligning partners and innovation activities, and for securing and advancing the role of the firm within the ecosystem (Adner, 2017). Current literature pays some attention to ecosystem strategies (e.g. Holström Olsson & Bosch, 2017; Valkokari et al., 2017), but this attention is fragmented and mostly based on a limited number of case studies or examples. Besides, most innovation ecosystem strategy literature focuses on hub firms, orchestrators or platform providers (e.g. Dhanaraj & Parkhe, 2006; Gawer & Cusumano, 2014), often large multinational companies, whereas the majority of firms involved in ecosystems are, almost by definition, not in such a position. Studies including perspectives on the strategies of SMEs or peripheral companies are still rare (Radziwon & Bogers, 2019). What lacks is a comprehensive overview of how firms of different sizes and ecosystem positions act strategically upon innovation ecosystems.

The purpose of this paper is to deepen the understanding of innovation ecosystem strategies implemented by industrial firms. In particular, we aim to identify the ways in which different firms build and maintain their position in innovation ecosystems, how they deal with the need for alignment in these webs of interdependencies and to what extent they do this as part of a deliberate ecosystem strategy. To answer these questions, we will first develop a structural perspective on innovation ecosystems (Adner, 2017) and define the concept of innovation ecosystem strategy in relation to this. Empirically, we rely on a data set of almost one hundred interviews with innovation managers of companies of different sizes and industries. To analyse our data, we will use a multilayered framework, distinguishing between an explorative and an exploitative layer of the ecosystem (cf. March, 1991). We will present the ways in which these managers position their companies and align efforts in relation to the two layers of the ecosystem. Tensions and synergies among these activities will also be articulated. Furthermore, we will discuss to what extent these activities together constitute a deliberate innovation ecosystem strategy and will present a tentative maturity model. To conclude, we will discuss our findings in the light of existent literature, specify our contributions to theory development and practice and discuss limitations and roads for further research.

2 | ECOSYSTEMS AND ECOSYSTEM STRATEGIES

There is a variety of innovation system and ecosystem concepts, with different foci and boundaries (Clarysse et al., 2014; De Vasconcelos Gomes et al., 2018). To clarify the conceptual basis of our study, we will develop a conceptual perspective on innovation ecosystems, position it in literature and discuss our assumptions regarding its boundaries, structures and complexity (Phillips & Ritala, 2019). After that, we will elaborate upon the concept of innovation ecosystem strategies.

2.1 | Innovation ecosystems: Boundaries and structures

In the literature on innovation ecosystems, a distinction has been made between two general perspectives: ecosystems-as-affiliation and ecosystems-as-structure (Adner, 2017). The first one sees ecosystems as communities of companies and other actors that are associated by membership of certain geographical or industry networks (Scaringella & Radziwon, 2018; Valkokari, 2015) around anchor tenants (Agrawal & Cockburn, 2003) or industry platforms (Gawer & Cusumano, 2014). The ecosystems-as-structure perspective, on the other hand, sees ecosystems as process configurations with a common purpose (Adner, 2017). Companies and other actors are part of such an ecosystem because their innovation processes are directly or indirectly coupled to processes of other actors, together resulting in innovations. This structural perspective aligns with the technological innovation system perspective (Carlsson & Stankiewicz, 1991; Hekkert et al., 2007; Musiolik et al., 2012), which draws its system boundaries in terms of actors and interactions that are relevant for the successful generation and implementation of new technologies, rather than in terms of geography, industry or membership of a network. However, where the technological innovation system literature remains at a more generic level, addressing policymakers and actors at a macro level (Hekkert et al., 2007), the innovation ecosystem literature approaches technological innovation at a micro or meso level, addressing corporate actors and focusing on the creation of novel value propositions in specific innovative products and services (Adner & Kapoor, 2010). In our study, we take the ecosystems-as-structure perspective as a starting point.

In an ecosystems-as-structure perspective, an ecosystem has open and dynamic boundaries. Innovations often have a fuzzy front end and develop in a non-linear manner (Van de Ven et al., 1999), so ecosystem boundaries are often not clear-cut and may change over time, with certain peripheral actors neither clearly in nor out. From a firm perspective, an ecosystem includes the heterogeneous set of actors that contributes directly or indirectly to new value creation processes in which the firm is involved. This includes not only customers and suppliers of the focal firm but also complementors, regulating bodies, financial institutions, universities and others (Bowonder & Miyake, 2000; Coombs & Georgiou, 2002). As the 'ecosystem' concept emphasizes a shift of attention from the included institutions and actors to the flows among them and their co-evolution over time (Ritala & Almpantopoulou, 2017), it is the intensity of these flows and interdependencies that indicates what can be considered core, peripheral or external to an innovation ecosystem.

In an ecosystem, the innovation processes of heterogeneous actors towards new value creation require alignment, that is, agreement about purposes, knowledge flows, rules of engagement and complementary contributions of the different actors (Adner, 2017; Jacobides et al., 2018; Walrave et al., 2018). This may be coordinated by a single actor in the role of system orchestrator (Gawer & Cusumano, 2014), hub firm (Faccin et al., 2020) or keystone (Iansiti & Levien, 2004), but this is not a necessity (Aarikka-Stenroos &

Ritala, 2017). Ferdinand and Meyer (2017) argue that innovation ecosystems can also be held together by a community of different organizations. They see innovation ecosystems as 'all relevant actors, their activities, and relations, which together coordinate actions and the flow of information resources and which reciprocally constitute the collective endeavour of distributed innovation' (Ferdinand & Meyer, 2017: p. 4). Alignment (or misalignment) inside the ecosystem is then the outcome of various decision-making processes and coordination activities of multiple actors. In our study, we remain open to different alignment structures. We do not assume the presence, or absence, of a centrally orchestrating actor in specific ecosystems.

2.2 | A multilayered perspective to capture ecosystem complexity

Interactions within innovation ecosystems can be highly complex because of the many actors and flows involved, the various stages in innovation process and the uncertainties regarding technologies, customer needs, regulation, etc. Conceptually, there are different ways to do justice to the complexity of innovation ecosystems. Phillips and Ritala (2019) plead for including multiple perspectives in the conceptualization and empirical study of ecosystems. Meynhardt et al. (2016), for instance, discuss ecosystems at a macro level and micro level, whereas Walrave et al. (2018) build on a multilevel perspective to study niche-level and regime-level alignment (Geels, 2002; Kemp et al., 2001). Other authors take multiple perspectives into account by distinguishing between business, knowledge and innovation ecosystems and thematizing their interrelations (Clarysse et al., 2014). The approach of Valkokari (2015) is interesting; they locate innovation ecosystems at the intersection of knowledge and business ecosystems, bringing together the exploration of new knowledge with the exploitation for collective value creation. Including an exploration and an exploitation perspective (March, 1991) on ecosystems is an important addition, in particular because these are core elements of a company's innovation strategy (Wilden et al., 2018). According to March (1991), a company, or any system, needs to engage in both exploration and exploitation in order to prosper. Exploration and exploitation have different purposes and require different modes of steering and aligning, but their interaction is required to impact the system positively (Gilsing & Nooteboom, 2006; Gupta et al., 2006). In order to capture the strategically relevant complexity of innovation ecosystems, we therefore distinguish between an explorative and an exploitative layer, each with a different purpose and mode of alignment, yet reciprocally related. The explorative layer captures the flows among heterogeneous actors that relate to variation, experimentation and discovery of new innovation opportunities to arise, whereas the exploitative layer comprises the selection, implementation and materialization of these opportunities in innovations that add value. In line with this view, we define innovation ecosystems as multilayered structures aligning the multilateral interactions of a heterogeneous set of actors aiming for novel value propositions to arise (exploration) and materialize (exploitation).

2.3 | Innovation ecosystem strategies

A point of criticism on the ecosystem concept is that some authors see it as a self-reproducing, gradually evolving system, to which individual companies can only adapt (Oh et al., 2016; Papaioannou et al., 2009). In our study, we assume that ecosystems are dynamic and that 'agency' plays a crucial role. Innovation ecosystems are constantly transforming structures, loosening and tightening, expanding and contracting and merging and splitting. These dynamics are not governed by an internal system logic, but are the result of the strategic actions of many visible hands (Rip & Groen, 2001) of scientists, policymakers, managers and others, within and between the different layers of the system. This implies that managers do not only adapt to innovation ecosystems but also have opportunities to shape them. They cope with dependencies from the past and the present (Garud & Karnoe, 2001), anticipate actions of other actors and engage in reflective actions of shaping and adapting the ecosystem and the relations within it. This constitutes the playing field in which innovation ecosystem strategies develop.

In the literature on innovation ecosystem strategies, two complementary perspectives can be discerned. Some authors focus on the roles or positions that firms adopt vis-à-vis other firms and actors in the ecosystem. Iansiti and Levien (2004), for instance, differentiate between keystones, physical dominators and niche players, whereas Valkokari et al. (2017) distinguish between hub firms and spokes on a local and global scale. Different positions offer different opportunities to access resources and to appropriate value from an innovation ecosystem (Jacobides et al., 2018). Others focus more on the collaborative processes within ecosystems and consider strategies as different ways of aligning actors and their offerings (Autio & Thomas, 2014; Walrave et al., 2018). Holström Olsson and Bosch (2017), for example, identify 12 innovation ecosystem strategies, encompassing different kinds of collaboration with different kinds of external parties. In our study, we build on Adner (2017), who combines these two perspectives. He states that alignment is at the heart of an ecosystem strategy and that firms should be clear about whether they want to take the responsibility to shape the alignment in the ecosystem or follow the lead of others. He defines innovation ecosystem strategies as 'the way in which a focal firm approaches the alignment of partners and secures its role in a competitive ecosystem' (Adner, 2017: p. 47). The competitiveness in this definition does not only refer to the games for remunerative positions within an ecosystem but also to the positioning of the ecosystem as a whole, compared with competing ecosystems. Strategic positioning thus plays at two different levels (Adner, 2017).

As most authors on ecosystem strategies appear to assume a centralized ecosystem structure (Adner, 2017; Gawer & Cusumano, 2014; Iansiti & Levien, 2004; Valkokari et al., 2017), the securing of a role often boils down to creating and defending a profitable hub position or finding a complementary position in relation to this hub firm. However, ecosystems may also be multipolar or decentralized (Aarikka-Stenroos & Ritala, 2017; Brusoni & Prencipe, 2013; Ferdinand & Meyer, 2017), which makes the possible

strategic positions more varied and the positioning processes more dynamic. These more complex processes may include activities that enable access to value appropriation (Nambisan & Sawhney, 2011) or control over valuable sources of innovation or knowledge flows (Pol & Visscher, 2010).

In our multilayered perspective on ecosystems, securing a role may involve strategic positioning in both the explorative and exploitative layers and alignment processes in each of them. Explorative alignment can comprise collaborative activities, such as setting joint standards or setting up strategic collaborations with scientific institutes (Holström Olsson & Bosch, 2017). Orchestrating the coherence and leverage of innovation processes (Nambisan & Sawhney, 2011), joint experimentation with value propositions (Walrave et al., 2018) and setting up a platform that aligns innovation activities (Gawer & Cusumano, 2014) are aimed more at the exploitative layer. When regarded separately, these positioning and alignment activities do not automatically constitute an innovation ecosystem strategy. To some extent, they should form a coherent pattern and be pursued deliberately to contribute to the innovativeness and long-term competitiveness of the firm. Following these considerations, we see innovation ecosystem strategies as deliberate and coherent ways in which firms approach the alignment of their innovation activities within the different layers of an ecosystem and the ways in which they secure their position in relation to other actors and to the ecosystem as a whole.

3 | RESEARCH DESIGN

The purpose of this study is to provide a comprehensive overview of innovation ecosystem strategies of established industrial firms of different sizes, in different sectors and ecosystems and in different positions of centrality. We are especially interested in strategies that work and contribute to the innovativeness and competitive position of companies. To reach this variety, we carried out an interview study with senior managers of almost one hundred reputable innovative firms. In the sections below, we will provide transparency about the data collection and analysis of this interview study. Following the guidelines by Aguinis and Solarino (2019), we will describe and justify the research setting, the sampling procedure, the interviewees and their importance, the documentation of the interviews, data disclosure, first-order codes, higher order codes and saturation in the analysis.

3.1 | Data collection

In this paper, we use the empirical work done within the Horizon 2020 project, 'Industrial Innovation in Transition' (IIT).¹ In 2015 and 2016, a group of five research teams conducted almost 700 semi-structured interviews with CEOs, CTOs and innovation managers of established innovative firms in 11 European countries, in five industrial sectors (manufacturing, information and communications technology [ICT], agro-food, biopharmaceutical, clean technology).

The authors of this paper were responsible for data collection in the Netherlands and Germany, consisting of interviews with managers of 98 industrial firms. Within each company, the manager who was responsible for innovation strategy was interviewed. An interview took about 1.5 h and followed an interview guideline that focused on different aspects of innovation practices. Innovation ecosystems was one of the themes, but questions were also asked about the corporate strategy, internal innovation management practices, foresight activities and the relation with public policy. For this article, only the part on ecosystems is used. Regarding this topic, interviewees were first asked whether they were familiar with the concept of innovation ecosystems. After that, the concept was described in very general terms, as the interdependencies firms have, related to their innovation processes with collaborators, suppliers, customers, complementors, public research bodies, other infrastructure, finance and regulators. This created a common ground for the interview and delineated the scope of interactions in which we were interested, but prevented a bias towards certain actors, networks, strategies or theoretical perspectives. We did not define or choose a clearly demarcated innovation ecosystem to discuss, which would contrast with our dynamic ecosystem-as-structure perspective, but followed the interviewees in their view of relevant actors (such as suppliers, customers, public research bodies and regulators) and flows (such as money, employees and knowledge) for innovation and their scope of the ecosystem. In doing so, we defined their innovation ecosystem together with them. Subsequently, the interviewees were asked explorative questions about (1) the relevance of ecosystems for their innovation processes; (2) the (alignment of) interactions with, and importance of, different actors for their innovation processes; (3) their own position in the ecosystem; and (4) their strategies to influence the ecosystem and their position in it. To be able to triangulate part of the findings from the interviews, additional data were collected in the form of company documents, annual reports and quantitative data from company databases. This also provided information about the position of a company in the value chain, size, market position, activities and corporate strategy.

The objective of our empirical study was to identify a variety of ecosystem strategies in innovative companies. A purposive sampling strategy was used to select a heterogeneous sample of companies with explicit innovation experience and success. To identify appropriate companies, we used different strategies in parallel. We asked innovation experts with wide industry networks, and representatives of industry associations, for suggestions of innovative firms and scanned the national and regional press, social media, Internet sources and lists with innovation award winners for suitable candidates. We also used a snowball method, asking interviewees for recommendations. In doing so, we were able to select companies that were externally recognized as technology and innovation leaders in their field. The purpose was not to select a sample that would be representative of a sector or a country, but to select a variety of reputable innovative companies—of different sizes, industries and positions in the value chain—with established and successful innovation practices. Our assumption was that within these companies one is more likely to find

effective innovation ecosystem strategies. But also companies that are innovative frontrunners with less elaborate ecosystem strategies provide relevant insights to our question. Phrased differently, the purpose of our sampling strategy was to exclude mediocre or non-innovative companies, as this would compromise the lessons one can learn from their ecosystem strategies. Start-ups and very small companies with less than 10 employees were also excluded, because we assumed that more elaborate and mature strategies and practices could be found in established companies. We did not select based on membership of a certain ecosystem, which would not fit with the ecosystem-as-structure perspective, nor on the role a company claimed to have in an ecosystem. Instead of categorizing the companies in advance, we explored their ecosystem relations, positions and strategies during the interviews. Although some of the studied firms had business relationships with one another, or collaborated on innovation, these relationships were not discussed explicitly, due to reasons of confidentiality.

In the Netherlands and Germany, 494 companies were contacted, of which 98 representatives agreed to an interview. In total, we conducted 48 interviews in the Netherlands and 50 in Germany, with a team of 11 interviewers (both senior staff and master-level student assistants). The interviewees were all responsible for (a large part of) the innovation activities and strategy in their company: 33 interviewees were CEOs or managing directors, 53 were CTOs or innovation managers, and 12 interviewees had another managerial function. Table 1 gives an overview of the number of companies, per sector and size category, at which representatives were interviewed.

3.2 | Data analysis

Interviews were carried out in the native language of the interviewee. Almost all interviews were done face-to-face and on-site. Verbatim transcripts were made. In the analysis of the interview transcripts, we focused on the sections regarding ecosystems and ecosystem strategies. We developed a coding scheme focusing on our unit of analysis: innovation ecosystem strategies. Our definition of ecosystem strategies as 'deliberate and coherent ways in which firms approach the *alignment* of their innovation activities within the *different layers* of an ecosystem, and the ways in which they secure their *position* in relation

to other actors and the ecosystem as a whole,' formed the basis for this scheme. Innovation ecosystem strategies were usually not articulated as such by managers, nor were they described explicitly in company documents. Therefore, we went back and forth between, on the one hand, what managers said their company did to align innovation processes and position themselves in relation to the ecosystem and, on the other hand, a conceptual framework classifying the elements of an ecosystem strategy. We did this in three iterations. We started with the analysis of 11 interviews, selecting managers who had articulated elaborate ecosystem strategies, in order to develop a first version of the coding scheme. This analysis was done jointly by two of the authors. We expanded this to 27 interviews in order to fine-tune the scheme and conduct a first analysis. All interviews coded by one author were checked by another author, and differences in classification were discussed to reach consensus. After that, we selected interviews with managers of companies of different sizes, from different industries and countries, and with less elaborate ecosystem strategies in order to cover the full variety of our sample. One of the authors analysed the Dutch interviews, whereas another author analysed the interviews with German companies. There were no indications of notable differences in ecosystem strategies between the Dutch and German companies in our sample, so we did not distinguish between the two countries in our analysis. After in-depth analysis of 60 interviews, saturation was reached. At this stage, we were able to identify stable patterns. A quick scan of the remaining 38 interviews did not provide new insights.

Following Gioia et al. (2013), we created a coding framework in which the first-order concepts were formed by the concrete activities that managers told their companies carried out to deal with innovation ecosystems. We made an inventory of these activities and classified them with second-order themes, 'aligning' and 'strategic positioning' (the two core elements of an ecosystem strategy), and identified patterns in the ways in which companies dealt with these. On the basis of our theoretical framework, we added an aggregate dimension, distinguishing between strategies acting upon the explorative layer of the innovation ecosystem and strategies acting upon the exploitative layer. We analysed whether companies focused on one of these layers or on both, whether they enacted synergies or experienced tensions between the layers. Table 2 gives an overview of the coding scheme, with exemplary quotes (translated from Dutch or German) from the interviews.

TABLE 1 Overview per sector of companies of different sizes at which managers were interviewed

	10–49 employees	50–249 employees	250–2999 employees	3000– employees	Total
Manufacturing	6	12	14	15	47
ICT	2	6	1	5	14
Agro-food	-	2	6	3	11
Biopharma	1	4	2	3	10
Clean tech	7	3	2	4	16
Total	17	26	25	30	98

TABLE 2 Coding scheme

Aggregate dimensions	Second-order themes	First-order concepts	Exemplary quotes
Explorative layer strategies	Aligning	<ul style="list-style-type: none"> • exchanging knowledge within networks and associations • conducting pre-competitive (European) research projects • sponsoring PhD research and professorships • contributing to industry roadmaps and foresight activities • establishing or joining research and innovation campuses 	<i>Opening it [i.e. a technology campus] and attracting partners will maintain critical mass</i>
	Strategic positioning	<ul style="list-style-type: none"> • publicly demonstrating innovative capabilities • taking initiative in setting up consortia and network activities, organizing conferences and establishing campuses 	<i>Without innovation you will be dumped in an ecosystem. If you are highly innovative and have high speed, then you have the luxurious position of being able to decide what to share and what not to share</i>
Exploitative layer strategies	Aligning	<ul style="list-style-type: none"> • bringing complementary firms together in projects • creating platforms, living labs and dedicated innovation campuses • including customers and suppliers 	<i>We're turning to publish our API so that other companies can make complementary products and that forms an ecosystem</i>
	Strategic positioning	<ul style="list-style-type: none"> • showing that they are a competent and reliable innovation partner • acquiring or building alliances with pivotal ecosystem partners and start-ups • engaging in multiple, expanding networks • technology brokering 	<i>We [strengthen our position in the ecosystem] by coming up with new innovations. [...] if you enter the market first [with a new therapy] and get for that area 10 years market exclusivity, then you also get a status that you influence the ecosystem</i>

4 | RESULTS

Almost all interviewed managers acknowledged that their innovation processes were not confined to their company itself, but that a wider group of actors played a role and needed to be aligned. About two out of three considered these external parties as highly important for their innovation processes. This does not mean that all companies deliberately acted upon an innovation ecosystem. Some confined themselves to bilateral collaborations within the supply chain. A medium-sized, high-tech manufacturing firm, for instance, mainly relied on its own innovation capacity and only collaborated with customers and a few selected partners. The CEO considered research institutes, suppliers and other companies to be of limited relevance for innovation and feared that they would 'run' with their IP, so he chose not to collaborate with them. However, most companies had a broader view of relevant actors beyond the supply chain and also engaged in multilateral collaborations. Universities and other public research bodies were mentioned most often as part of the companies' ecosystems, but also regulatory bodies, financiers and others were sometimes recognized as relevant. For most companies, the actual and potential knowledge flows that were considered relevant for innovation opportunities to arise and materialize determined the scope of their innovation ecosystems. Other flows, of people, services and finances also occurred in innovation ecosystems, but these were considered less prominent and defining.

4.1 | Multilayered innovation ecosystems

As argued in the theoretical section, we see innovation ecosystems as multilayered structures aligning the multilateral interactions of a heterogeneous set of actors aiming for innovations to arise and materialize. When interviewing managers, we noticed that they talked about innovation ecosystems at two different levels. Some emphasized open interactions that aim at exploring future options. The manager of a multinational manufacturing firm, for instance, said, 'Innovation ecosystems are more about living in the right world, where ideas can grow and develop, without having to have a specific purpose'. Others foregrounded more dedicated multilateral collaborations, working on concrete innovations. These differences were captured by the explorative and exploitative layers in our conceptual framework. The explorative layer covers the structures in the ecosystem that focus on the flow of knowledge among actors aiming at the identification and elaboration of (future) opportunities for innovation. It has the characteristics of an open system, facilitating multiple loose relations and pre-competitive collaborations among actors. The exploitative layer refers to semi-closed and competitive structures in the ecosystem, involving collaborations of actors developing, selling and embedding innovations that add value to customers. In principle, these two layers can be complementary when the exploitative layer draws on the search and experimentation processes, as well as the network relations in the explorative layer, whereas the explorative layer gains legitimacy and continuity through the implementation processes and concrete

innovations. Figure 1 visualizes this layered conceptualization of innovation ecosystems.

4.2 | Aligning and strategic positioning in the explorative layer

Alignment activities in the explorative layer were related to creating and sustaining networks that were aimed at innovation and that had certain flows of knowledge, people and financial resources in common. More than half of the interviewed managers stated that their companies were active in building or strengthening platforms, associations or regional networks that were used for exploring new technologies and identifying business opportunities. Some companies played an active role in orchestrating and propagating these networks, thus positioning themselves in a pivotal role. For instance, a medium-sized ICT company was active in setting up a centre of excellence in its technological field, shaping it as a cooperative with public and private parties and organizing informal ‘barbecue and beer’ gatherings to facilitate exchanges. Others took the initiative—often with governmental support—to set up a campus, an association or a network where heterogeneous sets of companies, research institutes and others could meet to share and develop ideas. These networks were mostly open and aimed to create critical mass and foster the emergence of new combinations. The CTO of a multinational manufacturing firm that was developing an innovation campus on its premises, said, ‘The innovative power that this gives you, [...] bringing together two people with knowledge who, without each other, would not have been able to find the solution, that is, for me, the power of an ecosystem’.

Alignment activities were also related to specific knowledge flows in the explorative layer of the ecosystem. Most of the interviewees told that their company maintained bilateral or multilateral relationships with universities and research institutes, regarding the front end of their innovation processes. For example, the R&D manager of a large agro-food company stated, ‘I think that university cooperation is very important for us. That means we look at it in a really basic way.

That's not innovation, that's the preliminary stage, that's actually the idea generation’. Some companies aligned knowledge flows with universities by funding professorships and PhD research, when possible at different universities, and sometimes made their equipment available to students. This kind of sponsoring gave them the opportunity to learn about new technologies and methods and steer knowledge development. Companies also collaborated with academics in multilateral research projects that were publicly financed. National and European funding schemes were mentioned several times as vehicles for pre-competitive international research and as potential hotbeds for new ecosystems. Several large companies took the lead in creating a consortium and attracting others, whereas some smaller companies mentioned they were being asked to join these consortia.

In order to ‘attract others’ or to ‘be asked to join’, and thus secure a position in the ecosystem, it was considered important to have an innovative reputation. Several companies actively worked on their innovative standing, for instance, by giving presentations at meetings and conferences and sharing some of their innovative ideas with others. The CTO of a large biopharma company stated, ‘I think we attract a lot of partners because we are the frontrunners. At least they want to talk to us. They also want us to participate in conferences and congresses to give lectures, to hear what we are doing. That is what comes with status of being the first’. About one in five of the interviewed managers said that they actively sought publicity for their innovations in order to strengthen their reputation in the ecosystem.

4.3 | Aligning and strategic positioning in the exploitative layer

Alignment activities in the exploitative layer were related to the creation and maintenance of consortia, multilateral partnerships, strategic alliances, joint development programmes, etc., aiming to bring about new products and services. Partners, such as suppliers, complementors, knowledge institutes and start-ups, came from the associations and networks in the explorative layer, though not exclusively.

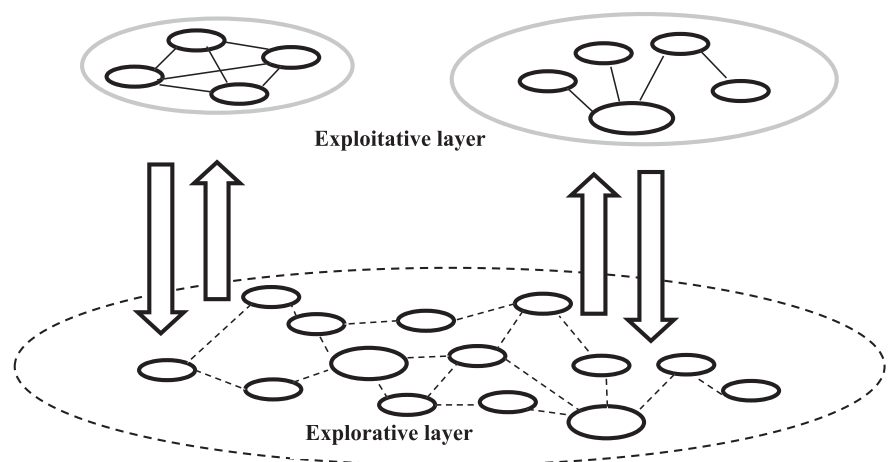


FIGURE 1 Multilayered innovation ecosystem model

Especially customers, who rarely played a significant role in the explorative layer, were often included in the exploitative layer. The R&D manager of a large agro-food company, stated: 'We no longer work on innovation in which no customer is involved. Of course we do all sorts of things in that exploration phase. But by the time we start to make it serious, a customer has to be involved'. On the other hand, certain actors from the explorative layer, such as competitors, government agencies and universities, were predominantly not included in exploitative layer collaborations and interactions. Concrete opportunities to create value for customers were driving the formation of partnerships in this layer of the ecosystem.

A few companies enabled the alignment of multilateral innovation efforts of complementary firms by setting up dedicated platforms or innovation labs. These had similarities to the platforms and campuses described in the explorative layer, but they were more closed and focused, comprising a set of partners that were committed to bringing identified opportunities to the market. An innovation manager of a large manufacturer headed such a lab: 'We have a room for brainstorming, halls where people can tinker, build the first demonstrator [...] and then companies have to embrace it and make euros out of it themselves, but we organize the infrastructure [...]. It is not for free. If you offer things for free, then there is no commitment'. Leading a successful innovation lab or platform gave such a firm a central position in the exploitative layer of its ecosystem.

Alignment activities were also related to specific knowledge flows in the exploitative layer of the ecosystem. Some companies stimulated desirable R&D projects with suppliers and producers of complementary products, or organized workshops with potential customers, to get their input and commitment. Some also financed, assisted or acquired start-ups to bring the contributions of these into the network. These bilateral collaborations required mutual commitment. The R&D manager of a medium-sized biopharma firm emphasized: 'As far as I'm concerned, that also means exchanging hardcore knowledge. And also hardcore help each other to drive innovation forward'. Companies with a central position in this layer of the ecosystem could be very directive in asking for commitment from other actors. The CTO of a large biopharma company stated that their partners in joint innovation activities 'need to do what we want. In our partnerships basically it is so that we have a clear vision what we want to get out and they either comply or not. If they comply we work with them if they don't we do not'. In this way, innovation efforts within the ecosystem were aligned.

In the exploitative layer, innovation opportunities were being enacted, and new value was being created. To get a role in this layer of the innovation ecosystems, companies worked on building a position that made them interesting to collaborate with. Size mattered. Several interviewees stated that because of their size and market position, they were interesting partners, as they could bring an innovation to the market and reach many customers. The CEO of a large agro-food company, for instance, explained that 'because we are the largest biotech company in [...], we are the Cinderella of biotechnology. [...] that is why people often want us to join'. Managers of larger companies were aware that the profits of the innovations should be

shared fairly among the partners in the ecosystem to keep this layer functioning well. Smaller companies worked on their innovative reputations to secure a role in this layer. Being known as a technological frontrunner, being capable of contributing pivotal technologies and being considered reliable and trustworthy all played an important role.

4.4 | Innovation ecosystem strategies

The alignment and positioning activities described above do not yet make an innovation ecosystem strategy. A strategy entails a more or less coherent and deliberate approach of these activities. And although almost nine out of 10 of the interviewed managers stated that they aimed to develop the ecosystem as part of their firm's strategy, we observed quite a variety in the maturity of ecosystem strategies. Several companies were only just becoming aware of the relevance of ecosystem alignment and positioning activities. They mostly focused on exploitative layers and were only starting to open up for the explorative layer and to approach their ecosystem activities more strategically. The R&D manager of a large agro-food company, for instance, said that they did not have an institutionalized approach for identifying complementary small companies with whom to collaborate—'we now come across these kinds of companies on the basis of a kind of coincidence'—and that they should work on their reputation and visibility to attract these companies for collaboration in the exploitative layer.

Other companies already had a more coherent and deliberate approach. They were well aware of their position in the explorative and exploitative layer of relevant ecosystems, purposefully participated in alignment activities and linked these activities to each other and to the company strategy. The innovation manager of a medium-sized biopharma firm, for example, illustrated how his approach had matured: 'Five, ten years ago, well, then we'd go to those business congresses... One person went there and took a look, almost without obligation. Now there really is a plan: "with whom are we going to talk, why, relationship maintenance". [...] Yes, that is very active now'. The most mature ecosystem strategies were systemic, in the sense that the alignment and positioning activities were also seen in the light of the functioning of the ecosystem as a whole. Only a few companies had such a systemic vision. The CEO of a medium-sized manufacturing company can serve as an example. His company played an orchestrating role, bringing together partners in both layers of the ecosystem and facilitating the transition from exploration to exploitation. Although he could not profit directly from all collaborations made possible through these orchestration activities, he acknowledged that, in the end, a well-functioning ecosystem was also important for his company: 'You can see that players also find new business opportunities among themselves, in which we are not directly involved, but that does make the network more interesting for them, so to speak. And in the end we benefit from that too'.

Mature innovation ecosystem strategies mostly took into account both layers. The layers were complementary, and well-orchestrated strategic activities could create a 'flying wheel' of

aligned opportunity recognition and value creation. A managerial challenge was to link the activities of the two layers. Some interviewees, such as the R&D manager of a multinational manufacturing firm, mentioned that they enacted synergies between the layers by specifically choosing partners for exploration that could also be involved in a later stage for more focused innovation processes. Others, like the CEO of a medium-sized ICT firm, explained that they used their central position in the explorative layer of the ecosystem to become a broker for collaborations in the exploitative layer: 'We discuss with all these ecosystem partners, each week, with lists, action lists, what will you do, what will I do, what are market opportunities. And if company A sees something that is good for company B, we mention that to company B, so company B gets more chances, more sales chances'.

Other interviewees put emphasis on the tensions between the layers. Some argued that the explorations in the ecosystem led to too many ideas to follow up or too few ideas with real potential to add value to their customers. Others complained that explorative ecosystem interactions were too slow, uncommitted, long term oriented and full of politics and ritual dances. They experienced barriers when they wanted to proceed from recognizing an opportunity to actually doing something with it. The R&D manager of a large manufacturing firm spoke of a recent experience: 'Last week I was in such a meeting again, and they were all there, [the industry associations], the university, and in the end I asked, what are we going to do? Then the answer of the new chairman was: we will form a working group, do you want to be part of it? I said "No", ha! That is really a waste of my time. [...] forming a damned working group. I thought we would do something together'. Moreover, partners in the explorative layer were not always considered suitable for the exploitative layer. This was for competitive reasons; with a few exceptions, companies were willing to interact with competitors in the explorative layer, but not in the exploitative layer—this also had to do with differences in practices and outlooks. In particular, universities and government agencies were mentioned as partners with whom interaction could be difficult in the exploitative layer. The CEO of a medium-sized ICT firm, for instance, confided: 'As entrepreneur I can't get a grip on the government. They are good people, but really too slow; they have good ideas, but they really don't get it. That is a difficult, difficult, very difficult battle'.

As a result of the frustrations caused by these tensions, a few companies withdrew from the explorative layer of the innovation ecosystem and put more emphasis on the exploitative layer. To compensate for the loss of exploratory options, they put more effort into establishing dedicated ecosystem relationships, such as exclusive bilateral exchanges with research groups, start-ups and complementary firms. The innovation manager of a large ICT company, for instance, argued that they followed an integration strategy, trying to internalize essential roles in their innovation ecosystem through acquisitions, or internal development, in order to become less dependent on external actors such as universities and suppliers. 'We are our own ecosystem', he stated. They created a platform to enable structured exchanges with complementors in the explorative layer.

5 | DISCUSSION

Our study corroborates that innovation ecosystems, as structures aligning the multilateral interactions of a heterogeneous set of actors aiming for novel value creation, are relevant for innovative industrial firms (Adner & Kapoor, 2010; Ormala et al., 2014). The introduction of multiple layers, for exploration and exploitation (March, 1991), has broadened and nuanced Adner's (2017) conception of innovation ecosystems. From an empirical perspective, this broadening covers the variety of meanings the term 'innovation ecosystem' has for managers. From a conceptual perspective, the nuancing better grasps the complexity of ecosystems (Phillips & Ritala, 2019) and brings different conceptions of ecosystems together into one model (cf. Clarysse et al., 2014; Valkokari, 2015). Moreover, this conceptualization makes a more sophisticated notion of innovation ecosystem strategies possible, with alignment and positioning activities (Adner, 2017) in the exploitative layer being more directly focused on realization of innovations with a more closed and dedicated set of actors than in the explorative layer. This notion of ecosystem strategy also includes ways to create coherence and synergies or deal with tensions between the layers.

In line with the existent literature on ecosystem strategies, we recognized that certain companies aimed at becoming keystones (Iansiti & Levien, 2004) or hub firms (Valkokari et al., 2017) by engaging in orchestration activities (Dhanaraj & Parkhe, 2006) such as creating platforms (Gawer & Cusumano, 2014), setting up technology campuses, attracting new members (Faccin et al., 2020), building consortia and facilitating regional networks. We also found companies with more adaptive strategies, a category that received less attention in the literature so far (Radziwon & Bogers, 2019). These participated in, and aligned with, the 'orchestras' in order to strengthen their relationships with hub companies and prosperous networks (Nambisan & Baron, 2013), to tap into various knowledge sources or to monitor innovative moves of competitors. Participating in ecosystems with dominant central players could open up opportunities for direct and indirect network effects (Jacobides et al., 2018; Parker & Van Alstyne, 2005) but might also create resource dependencies that limit the freedom to explore alternative pathways for innovation (Christensen & Bower, 1996; Pol & Visscher, 2010). However, not all ecosystems had a centralized structure with leader/follower dynamics. Especially the explorative layer was often loosely coupled (Bosoni & Prencipe, 2013) or multipolar (Aarikka-Stenroos & Ritala, 2017), with several actors taking a proactive role, jointly or at different moments. In those cases, alignment can be seen as mutual adjustment (Thompson, 1967).

A common element in ecosystem strategies was the building of a position in which a company would be involved, adjusted to, or followed by others. Ecosystems typically have an open and dynamic nature, and most firms have no guaranteed access to insightful explorations or remunerative collaborations in the explorative and exploitative layers. One frequently adopted strategy was to make use of the firm's innovative capabilities (Teece, 2007) or complementary assets (Tripsas, 1997) to build a position. Large firms could bring in their

influence in the industry, and their strong market position, to attract others, as long as they showed willingness to share the benefits of new products and services with smaller partners. The focus of smaller firms was on building a visible innovative reputation—being a frontrunner in technologies and a capable innovator—to become an attractive partner for knowledge institutes, government agencies and larger companies. A third strategy, used by firms of various sizes, focused less on internal resources and more on interfirm relations and network positions. This strategy was used to build a reputation as a broker (Hargadon & Sutton, 1997) in the ecosystem and become an ‘obligatory passage point’ (Callon, 1986) for knowledge flows.

Our study has shown a variety of innovation ecosystem strategies. Companies can focus on either one or on both layers. From the perspective of an individual firm, an argument can be made in favour of including both layers. Activities in the explorative layer result in coordinated experimentation and search processes and in opportunities for innovation and business development. But, as Autio and Thomas (2014) argue, being embedded in such a system does not necessarily lead to value creation, only to opportunities to do so. The real value is added and captured in the exploitative layer (cf. Clarysse et al., 2014), and one can argue that companies should be active in this layer as well. A successful innovation ecosystem strategy enacts a virtuous cycle in which opportunities for innovation arise in the explorative layer that are materialized in the exploitative layer, which in turn strengthens the innovative reputation of the firm and makes the explorative layer more attractive for other actors to participate.

However, our study has made clear that in practice, it may be challenging to make this virtuous cycle work. Although most companies were active in both layers, many were struggling to enact synergies, and some even made a retracting movement. The exchange processes in the explorative layer can be slow, uncommitted and politicized, and some companies consider the transaction costs too high (Jacobides et al., 2018; Williamson, 1985). It may be more efficient and effective to identify opportunities for innovation through internal research, acquisitions or exclusive knowledge exchange and outsourcing relations. In a few cases, we found indications that smaller companies may have reservations about the exploitative layer, especially when large, dominant firms are present. They fear they will lose too much independence and are afraid that the large firm will require the whole ecosystem to fully commit to them, causing a lock-in for others (cf. Von Raesfeld & Roos, 2008). We do not have data to indicate whether, or under which circumstances, an ecosystem strategy focusing on one layer is less or more effective than a strategy covering both layers. From a system's perspective, an exchange between the explorative and exploitative layer is crucial for its functioning (March, 1991), either by firms being active in both layers or by a division of labour between actors focusing on one or the other (Gupta et al., 2006). In either case, it requires a flow of knowledge and other resources, not only within a layer but also from one layer to another.

In addition to the variety described above, our study revealed differences in the stage of development of innovation ecosystem strategies. The most elaborate strategies could be found within medium-sized or larger firms that had worked for several years on building and

boosting the explorative layer of an ecosystem; had acquired a brokering or hub position; and were active in stimulating the emergence of partnerships with complementary actors for value creation in the exploitative layer. Other companies were just starting to look beyond their value chain for dependencies and opportunities for collaboration. Based on our results presented in the previous section, we can tentatively propose a maturity model of innovation ecosystem strategies. Table 3 gives a description of the distinguished levels.

When following the steps of this maturity model from Level 0 to Level 3, one sees a growing awareness of the relevance of ecosystems for innovation, an increasing number and heterogeneity of relevant actors and an increasing elaborateness and proactiveness in alignment and positioning activities. Whether companies with higher maturity levels exceed companies with lower levels, in innovativeness or effectiveness, in general or in specific situations, cannot be concluded from our data. However, if the management of a company considers its ecosystem important for its innovation processes and aims to deal with it strategically, then the two highest levels appear more suitable. The main difference between Levels 2 and 3 lies in the systemic perspective. A Level 2 strategy regards an ecosystem from the focal company's perspective and assesses its opportunities and threats from this point of view. A Level 3 strategy regards the functioning of the ecosystem holistically and looks at what the focal company, and others, can contribute, lose and gain. In that sense, a Level 3 strategy is truly systemic.

TABLE 3 Maturity levels of innovation ecosystem strategies

Level	Description
0	The company is not aware of the potential relevance of ecosystems for its innovation processes. It hardly collaborates, or only on the initiative of others, and with a limited number of known partners from the value chain. No effort is put into building an innovative reputation or a deliberate innovation ecosystem strategy.
1	The company is aware of the relevance of ecosystems for its innovation processes. It collaborates with others, but mostly within the value chain, and occasionally puts effort into building its reputation as an innovative company. There is no coherent and overarching innovation ecosystem strategy.
2	The company has a coherent innovation ecosystem strategy. It deliberately aligns its innovation with a variety of other companies, knowledge institutes, etc. It is aware of its position in the ecosystem and deliberately aims to strengthen this position. The strategy covers both layers, or, when the company chooses to focus on only one layer, it ensures that it receives sufficient input from the other layer.
3	The company has a coherent and encompassing innovation ecosystem strategy, covering both layers. It proactively aligns innovation efforts and knowledge flows, anticipates future requirements regarding technologies and partners and aims for a central or indispensable position in the ecosystem. It has a systemic view of innovation processes, fostering the functioning of the ecosystem as a whole and allowing value capturing for all involved actors.

6 | CONCLUSIONS

The purpose of this paper was to deepen our understanding of how industrial firms build and maintain a position in innovation ecosystems and how they deal with the need for alignment in these webs of interdependencies. We conceptually constructed and empirically substantiated a multilayered innovation ecosystem model and identified strategies that companies employ for acting upon the different layers of the ecosystem. We developed insights into the variety of these strategies and identified difficulties that companies encounter when trying to develop an effective ecosystem strategy that covers both layers. What this study adds to existent literature on innovation ecosystems is a more complex, nuanced and varied notion of ecosystem strategies. The ecosystem strategies that have received most attention in literature, such as keystone, hub or orchestrator strategies, are in fact special cases, next to which ecosystem strategies exist with different foci, starting positions or levels of maturity. The multilayered model, with strategies focusing on the explorative layer, exploitative layer or both, and the maturity model presented in this paper offer a broad and argued range of possible strategies, with their advantages and potential drawbacks.

In a broader sense, our study also contributes to the understanding of the added value of the innovation ecosystem strategy concept. When considered separately, many of the identified alignment and positioning activities have already received ample attention in literature, for example, on open innovation, innovation networks, knowledge management or industry-academia interaction. The added value lies in adding the systemic perspective, in which a larger and more heterogeneous set of actors, and the knowledge flows among them, are being considered as relevant for innovation. In an ecosystem, the flows and actors are understood in relation to each other and to the functioning of the system as a whole. This becomes particularly visible in the ecosystem strategy of the highest maturity.

Moreover, it can be acknowledged that ecosystem activities, especially in the explorative layer, affect the technological innovation system. Implementing strategies can strengthen the overall institutional system through knowledge transfer and exchange. Although the innovation system approach has been criticized as being static (Hekkert et al., 2007), we indicate in which way institutions such as industry associations and research funding schemes are being integrated into companies' innovation strategies, which are being influenced by them at the same time.

The outcomes of this study help innovation managers reflect on their ways of dealing with ecosystems. It provides not only concrete examples of alignment and positioning activities but also offers a reference for critically assessing the coherence of these activities and for making strategic choices on how to deal with innovation ecosystems and the dependencies they imply. Especially when companies are opening up their innovation processes beyond their value chain, this study contains relevant insights. The companies on which our study is built were recognized as innovators in their branch and are potentially ahead of others in developing ways to deal with ecosystems productively.

Companies that are still at the lowest levels can be advised to consider putting effort into developing their innovation ecosystem strategy. Companies with Level 0 strategies lack awareness, or see little relevance in ecosystems, and may miss out on innovation opportunities. Firms with Level 1 strategies recognize the relevance of ecosystems but have a limited scope and are not yet acting upon them strategically. Whether reaching the most mature and systemic level is possible or suitable for a specific company depends on the corporate strategy, available resources, the structure and functioning of the relevant ecosystems, the network position and the positions that have already been taken by other companies.

This study has several limitations. It is based on an analysis of interviews with representatives of established industrial firms. A study of strategies of other kinds of firms—in particular start-ups or service firms—may identify additional alignment and positioning activities and different ways in which companies manage the tensions and synergies between the different layers. Furthermore, on the basis of our data, we cannot draw robust conclusions about the frequency of occurrence or the effectiveness of different innovation ecosystem strategies or different maturity levels. This would require data collection with a more representative sample and additional data about innovation performance, market shares, business models and industry characteristics. This could be done in a large-scale quantitative study, but a comparative case study of companies with different ecosystem strategies or maturity levels and similar business models would also lead to additional insights into the success of the identified strategies.

A further limitation of our study is that we focused on ecosystem strategies of companies, not on broader ecosystems. In-depth single case studies of specific ecosystems, including the perspectives not only of different managers but also of other members of the focal organization and representatives of related private and public organizations in different layers, can provide a more fine-grained insight into the interactions, interdependencies and strategies among different actors in innovation ecosystems. It could also highlight the differences in what various actors consider to be a relevant ecosystem and shed light on the relation between ecosystem strategies and the overall structure of an ecosystem.

Finally, more in-depth studies at the firm level will add depth to the understanding of innovation ecosystem strategies. It can be expected that especially the larger companies are active in more than one innovation ecosystem. How they balance their involvement in the different layers of multiple ecosystems, and how they differentiate and create synergies among them, will be an interesting route for further research.

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ENDNOTE

¹ The IIT project team consisted of five partners: the University of Aalto (Finland, coordinator Erkki Ormala), Joanneum Research (Austria), the University of Manchester (UK), the University of Twente (the Netherlands) and Zabala Innovation Consulting (Spain). See <https://www.iit-project.eu/>.

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