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Connection successfully established: How complementors use connectivity technologies to join existing ecosystems – Four archetype strategies from the mobility sector

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ABSTRACT

Supporting fast and extensive data transfer, connectivity technologies entail opportunities for stronger inter-firm collaboration and new value propositions, resulting in business model innovation. Whereas prior research has mainly focused on connectivity-induced changes in the business models of ecosystem orchestrators, we turn our attention to (prospective) ecosystem complementors. We examine how digital service providers can configure business model mechanisms to enter an ecosystem and connect themselves to its value proposition. Based on an explorative qualitative study of four cases in mobility, we develop four archetypical connection strategies for complementors. We observe that the four archetypes differ in their implications for the ecosystem value proposition, for the role of other actors in the ecosystem, and the triple-bottom-line performance of the ecosystem. Connectivity technologies can combine economic, environmental, and social benefits.

1. Introduction

Wireless communication networks enable firms to quickly transfer large volumes of data (Parida et al., 2019b); they facilitate inter-firm collaboration and a shift towards a service orientation (Jovanovic et al., 2021; Sjödin et al., 2020a; Visnjic et al., 2018). Digitalization allows firms to act on these opportunities and offers new possibilities for value creation, delivery, and capture, which are the constituting mechanisms of a business model (Foss and Saebi, 2017; Teece, 2010). Connectivity is key to digitally enabled business models (Jovanovic et al., 2021). Connectivity can be understood as the connection between individual digital artifacts regarding accessibility, interoperability, pervasiveness, speed, synchronization, portability, and omnipresence (Lanzolla et al., 2021). Advancements in connectivity technologies have fostered business-to-business (B2B) collaborations in the form of ecosystems, in which firms co-create a joint value proposition (Kohtamäki et al., 2019; Huikkola et al., 2021; Sjödin et al., 2020b). Ecosystems often generate enormous amounts of value as they cross industry boundaries and yield complex and highly customer-centric solutions

(Adner, 2017; Aarikka-Stenroos and Ritala, 2017; Jacobides et al., 2018; Kamalaldin et al., 2021).

For an ecosystem to be successful, the involved firms' business models must be aligned (Casadesus-Masanell and Ricart, 2010; Leminen et al., 2017; Thompson et al., 2018). The literature on the digitalization of business models has grown tremendously over the last few years (cf. Caputo et al., 2021; Foss and Saebi, 2017), especially for B2B firms (e.g., Leminen et al., 2018, 2020; Paiola et al., 2022; Westerlund et al., 2017). Nevertheless, our knowledge about the alignment of digitally enabled business models in ecosystems has remained limited and requires further research (as pointed out by Kohtamäki et al., 2019; Pagani and Pardo, 2017; Paiola and Gebauer, 2020; Ritter and Pedersen, 2020; and many others).

In many ecosystems, the so-called orchestrator recruits and coordinates other ecosystem participants – the 'complementors' – to create the ecosystem value proposition (Autio, 2021). Although the orchestrator is a central and dominant firm in an ecosystem, the ecosystem's success typically depends as much on the complementors as it depends on the orchestrator (Panico and Cennamo, 2022). However, existing

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ecosystem research has mainly focused on the orchestrators (e.g., Iansiti and Levien, 2004; Li, 2009; Williamson and de Meyer, 2012).

Complementors are particularly relevant in the context of digitalization, as they facilitate the expansion of an ecosystem's aims and scope (Tavalaei and Cennamo, 2021). Thomas et al. (2022) demonstrate that the value proposition of an ecosystem is rarely permanently fixed when the ecosystem is established, but is commonly revised when the ecosystem is mature. This revision is often driven by new complementors that utilize advancements in connectivity and digital technologies to enable new business models (Kohtamäki et al., 2020). These observations lead to our research question: "How can new complementors use connectivity technologies to align themselves with the value proposition of an existing ecosystem?" Building on rich data on four cases in the mobility sector, consisting of 36 interviews and substantial amounts of archival data, our study identifies four archetypical strategies that firms apply towards this end. The four archetypes represent combinations of two binary dimensions. The first dimension addresses the contribution of the new complementor to the ecosystem value proposition, either *broadening* or *deepening* it. The second dimension concerns the newcomer's approach towards the stakeholders of the ecosystem – we find that the new complementor can either *replace* existing stakeholders of the ecosystem or *attract* new ones to the ecosystem. The combination of these two dimensions leads to the four archetypes: 'Cannibalization' (deepening/replace), 'Exploitation with Orchestrator' (deepening/attract), 'Exploration with Orchestrator' (broadening/replace), and 'Dual Expansion' (broadening/attract). We highlight how complementors can design the individual business model mechanisms for all archetypes to join the ecosystem successfully.

Our study makes four critical contributions to the digitalization literature and the ecosystem literature: First, we show that many firms can benefit from developments in digital technologies without having to make major changes to their business model. Rather, they can utilize collaborators to this end. Relatedly, we show how advancements in connectivity affect inter-firm relationships. Second, we respond to calls to study the implications of digitalization for sustainability (Dodgson, 2021; George et al., 2021; Parida et al., 2019b). We illustrate that digitalization can simultaneously strengthen multiple pillars of the 'triple-bottom-line.' Third, we contribute to the emerging stream of research on complementors in ecosystems by identifying four archetypical strategies for configuring business model mechanisms that allow complementors to contribute to the value proposition of an existing ecosystem. Fourth, we contribute to the literature on ecosystem evolution by providing evidence that (a) ecosystems converge into so-called 'meta-ecosystems' (Palmié et al., 2022) and that (b) an incoming complementor could become the orchestrator of an existing ecosystem.

2. Theoretical background

2.1. Connectivity and business models

Connectivity technologies – wireless communication networks such as Wi-Fi, 5G, and Bluetooth – enable firms to profit from the advances of digitalization, such as the efficient storing, sharing, and processing of data (Parida et al., 2019b). With the benefits of digitalization, firms can collaborate to innovate, as new business opportunities are enabled (Gebauer et al., 2020; Rad et al., 2022). To profit from these new opportunities, firms must adapt their business models (Isabelle et al., 2020; Kohtamäki et al., 2019; Westerlund et al., 2014, 2017). In broad terms, a business model describes the division of labor (task division and task allocation) and integration of effort (reward distribution and information flow) of a firm (Puranam et al., 2014). While there are a variety of business model concepts (see Gassmann et al., 2016 for an overview), they tend to converge in the exact core mechanisms that allow firms to make a profit: value creation (establishing the value proposition), value delivery (providing the value proposition to the customer) and value capture (generating revenue for the firm) (Foss and Saebi, 2017, 2018;

Saebi et al., 2017; Teece, 2010; Zott and Amit, 2010).

When an organization redesigns or reconfigures one or more of these three mechanisms, business model innovation occurs (Foss and Saebi, 2017; Massa and Tucci, 2013; Ritter and Lettl, 2018). Novel technologies triggering digital transformation are the main reason for business model innovation. The complexity of digital transformation affects multiple components of a firm and its business model (Hess et al., 2016; Ritter and Pedersen, 2020). Firms must face the challenges of digitalization and adapt their business model accordingly to remain competitive (Gassmann et al., 2020; Paiola and Gebauer, 2020; Wirtz et al., 2010). At the same time, firms must be aware of the new opportunities and business models enabled by novel technologies (Massa et al., 2016; Zott and Amit, 2010). According to previous research, modifying their business model to leverage novel technologies often poses a greater challenge to firms than developing the technological knowledge and competencies required to understand and handle these novel technologies (Chesbrough and Rosenbloom, 2002; Teece, 2010).

Digitalization allows firms to engage in business model innovation that extends beyond their industry (Leminen et al., 2020; Parida et al., 2019a; Sjödin et al., 2020a). External partners from other industries support firms in the value creation process by expanding existing value propositions or improving the provision of existing value propositions to customers. Business model innovation through co-development partnerships fosters the emergence of novel ecosystems in which the rules of and roles in value creation, value delivery, and value capture are defined anew (Priem et al., 2018). In turn, the ecosystem and its rules and roles have a lasting impact on the business models of all firms involved (Jacobides et al., 2018).

2.2. Connectivity and ecosystem alignment

Scholars have consistently linked the management of digital transformation and business model innovation to an ecosystem perspective (e.g., Kohtamäki et al., 2019; Paiola and Gebauer, 2020; Sjödin et al., 2020b; Teece, 2018). Ecosystems are a growing field in the strategy and innovation literature (Jacobides et al., 2018; Kapoor, 2018). While ecosystem terminology was initially used inconsistently (Jacobides et al., 2020), subsequent efforts have sharpened the concept by examining the constituent components of an ecosystem (such as actors, activities, links, artifacts, relations, and positions; Adner, 2017; Granstrand and Holgersson, 2020) and by distinguishing ecosystems from other forms of value co-creation (e.g., platforms, alliances, and supply chains; for a comprehensive overview, see Adner [2017] and Scaringella and Radziwon [2018]).¹ In ecosystems, firms cooperate to materialize value for a targeted customer. The value creation of a given firm relies on upstream components and downstream complements that other firms provide but contribute to the given firm's value proposition (Adner and Kapoor, 2010). This concept demands that the firms interact multilaterally with independent yet interdependent firms that contribute non-generic complements (Adner, 2017; Jacobides et al., 2018). Accordingly, some firms take on the role of "ecosystem orchestrators" by setting up alignment structures for their ecosystems (Adner, 2017; Lingens et al., 2021; Williamson and de Meyer, 2012). As orchestrators do not fully control their complementors hierarchically (Jacobides et al., 2018), the orchestrators must ensure that participating in their ecosystems is advantageous for the complementors and hence must balance their own value capture with that of their complementors (Chesbrough et al., 2018). Although firms in an ecosystem are

¹ Scholars have categorized ecosystem research into multiple sub-streams to clarify the concept (Hou and Shi, 2021; Jacobides et al., 2018; Thomas and Autio, 2020). Strictly speaking, our study deals with "innovation ecosystems" in the terminology suggested by Thomas and Autio (2020), whereas other forms of ecosystems (e.g., "entrepreneurial ecosystems" or "knowledge ecosystems") are beyond our scope. We use the shorter term "ecosystems" for readability only.

hierarchically independent, they tend to identify with the ecosystem and share mutual understandings and goals (Thomas and Ritala, 2022). Ultimately, the ecosystem actors enter a symbiotic relationship for value creation (Moore, 1993). They commonly originate in different industries (Aarikka-Stenroos and Ritala, 2017; Moore, 1993, 1996), which can stimulate innovation (Adner and Kapoor, 2010, 2016; Salerno et al., 2015).

While one or a small number of firms may assume the role of ecosystem orchestrator, many other firms in the ecosystem pursue more complementor-oriented strategies (Kamalaldin et al., 2021). Although ecosystem complementors outnumber orchestrators by far, complementor strategies have hitherto received much less attention in the literature than orchestrator strategies (see Tavalaei and Cennamo, 2021). Our study examines complementor strategies to help close this research gap.

3. Methods

3.1. Research design

To answer the question of how a firm can use connectivity technologies to become a complementor in an existing ecosystem, we apply an explorative case study. Case study research is most suitable to answering 'how' and 'why' questions (Yin, 2018). To study strategies of different firms, we use the multiple case study approach to build theory inductively (Eisenhardt and Graebner, 2007) by comparing similarities and differences among cases. Our study comprises four cases in the field of mobility. All four cases materialize their value proposition by employing an ecosystem. The mobility ecosystem is currently facing a major transformation due to digitalization, which ultimately affects the business models of actors within this ecosystem (Boston Consulting Group, 2018; Deloitte, 2017; McKinsey, 2017). Therefore, mobility represents a fruitful domain to study our research question.

3.2. Sampling strategy and case selection

The four cases used in this study are part of a broader project that collected ecosystem cases. To ensure comparability among our cases, we followed a theoretical sampling approach to diminish alternative justifications and to increase the generalizability of our findings (Eisenhardt, 1989, 2021). We used three criteria for case selection. First, all of our cases are based on new services created or enabled by a new complementor. Second, the value proposition was enabled by new technology and network solutions (e.g., 3G, 4G, 5G, IoT, or improved Wi-Fi) that accelerated connectivity among partners. Third, all our cases stem from the mobility field. As ecosystems are cross-industry collaborations (Aarikka-Stenroos and Ritala, 2017; Moore, 1993, 1996), we based this criterion on the content of the value proposition and not on specific industry affiliations such as 'automotive' or 'logistics.' We also paid attention to variation across cases (cf. Eisenhardt and Bingham, 2017),

for example in terms of company size or the relation of the value proposition to mobility (whether the service is a mobility service itself or a complementary service in the field of mobility).

All our cases are situated in the same Central European country, confining them to one geographical region with similar conditions regarding telecommunications infrastructure, legal requirements, and cultural background. In all cases, at least the basic functionalities of the ecosystem value proposition existed before the new complementor joined (in case DELTA, they existed in different, hitherto unlinked ecosystems). By involving the complementor and connectivity technologies, the ecosystem value proposition is either enriched by additional functionalities or can be executed more efficiently or effectively. The four cases comprise two cases in the realm of autonomous transportation and two cases in the realm of digital mobility platforms. By request of our informants, we use pseudonyms for all four firms. Table 1 provides an overview of our four cases.

3.3. Data collection

Our study is based on multiple sources of evidence (Yin, 2018). First, we relied on semi-structured interviews with informants, which were conducted between July 2017 and May 2020. As stated in section 3.2, the cases used for this study are part of a larger project. The research group handling the project agreed to share data among its members. Thus, some interviews were conducted by other researchers. One of the co-authors of the article at hand conducted at least two interviews in each of the four cases included herein. Taken together, the four cases comprise 36 interviews from 22 different subjects. We had transcripts for 34 of the interviews. The remaining two interviews were conducted by one of the present authors, who took detailed notes during the interviews. For each case, we had interviews from at least two different informants from two or more different firms in the respective ecosystem. In case ALPHA, we conducted interviews with the new complementor, the orchestrator of the ecosystem, and officials of the country's civil aviation authority. In case BRAVO, we interviewed representatives of the new complementor, the orchestrator, and current complementors. In case CHARLIE, we interviewed informants of the new complementor and the orchestrator, the latter being the sole actor that needed to align with the new complementor. In case DELTA, we interviewed subjects from the new complementor and other complementors since the ecosystem was not led by an orchestrator. Some informants did not work in the focal ecosystems anymore, allowing them to describe their respective ecosystem without any ongoing obligation towards the involved firms. Moreover, in case CHARLIE, some respondents filled the same position at different points in time: some individuals we interviewed at the beginning of this study changed jobs or left the company, and we interviewed their successors in later stages of the study as well. In the same case, we also interviewed an informant who left the company before we began collecting data. This allowed us to get a nuanced picture of the case.

Table 1

Case descriptions.

	ALPHA	BRAVO	CHARLIE	DELTA
Realm of value proposition	Logistics and transportation	Local public transportation	Public transportation	Car services
Former mode of execution by orchestrator	Transportation of laboratory samples by taxicab	Operation of buses by human drivers outside pedestrian zones	Provision of information on platform only	Separate services within automotive and ICT network ecosystems
Novelty due to new complementor bringing in connectivity technologies	Autonomous transportation of laboratory samples by drone	Self-driving shuttles in pedestrian zones	Increased functionality and user convenience of platform	Automated services and transaction via platform

In addition to the interviews, we collected documents as a secondary source of information. We gathered publicly available data for all cases. This data included documents created by the participating firms themselves, such as annual reports, flyers, media releases, and website content. Some firms also provided us with internal documents such as internal reports (ALPHA), contracts among ecosystem participants (BRAVO), or presentations (CHARLIE). Further, we also collected external documents, mostly media coverage in newspapers, magazines, and online news, to include the perspective of actors (i.e., media) outside the ecosystems. We also found TV and radio news reports for cases ALPHA, BRAVO, and CHARLIE. This secondary data offered us additional evidence, allowing us to extend and triangulate our data basis (see the section on data analysis for more details). Table 2 gives a summary of our data.

3.4. Data analysis

We conducted a thematically oriented analysis to identify patterns

Table 2
Overview of data sources.

Case	Informants	Informant Positions	Interviews	Sources
ALPHA	7	C-Level (orchestrator)	2	10 Semi-structured interviews & follow-ups External and internal documentation
		C-Level (new complementor)	1	
		Director (new complementor)	3	
		Director (new complementor)	1	
		Director (new complementor)	1	
		Manager (new complementor)	1	
		Manager (authority)	1	
BRAVO	7	Director (new complementor)	1	12 Semi-structured interviews & follow-ups External and internal documentation
		Director (current complementor)	2	
		Manager (new complementor)	2	
		Manager (new complementor)	2	
		Manager (new complementor)	2	
		Manager (orchestrator)	2	
		Manager (orchestrator)	1	
CHARLIE	2	C-Level (new complementor)	3	6 Semi-structured interviews & follow-ups External and internal documentation Direct observation/digital artifact
		Director (orchestrator)	3	
DELTA	6	Member of the Board of Directors (new complementor)	2	8 Semi-structured interviews External documentation
		C-Level (existing complementor)	1	
		C-Level (new complementor)	1	
		C-Level (new complementor)	1	
		Director (existing complementor)	2	
		Manager (new complementor)	1	
Total	22		36	

related to our research question (Braun and Clarke, 2006). We started with a separate within-case data analysis of each case (Eisenhardt, 1989; Miles and Huberman, 1994). In the beginning, we actively read the interview transcripts and produced case write-ups in which we sketched the ecosystem, the roles of the different actors, and their interaction (Eisenhardt, 1989; Yin, 2018). Subsequently, we compared the write-ups with internal and external documents, complemented them, and resolved ambiguities. These steps allowed us to counter potential retrospective recall bias, as our interviews were conducted while or after the new digital services were created (cf. Ozcan and Eisenhardt, 2009). Drawing on our rich database, we identified patterns and mechanisms within each case of how the complementor linked itself to the ecosystem value proposition. After conducting this within-case analysis for each case, we started comparing the patterns among the cases. Following Eisenhardt (1989), we searched for cross-case patterns by comparing similarities and differences among the cases. While re-iterating this process, we also referred to the literature, which supported us in defining dimensions and categories across our cases. Exemplary proof quotes of our patterns are provided in Table 3 in the appendix.

While analyzing the processes within the ecosystems, we cycled between our data and existing literature (cf. Eisenhardt and Graebner, 2007). As we observed that some new entrants ‘attack’ existing participants of an ecosystem, an author with a military background explained that there are different principles for attacking and defending in combat (Armed Forces Staff, 2019; Infantry Training Unit, 2015). Translating these principles into management thinking, it is possible to distinguish two dimensions with two traits each. New complementors can deepen or broaden the ecosystem value proposition along the first dimension. Deepening the value proposition means enriching it without changing its basic nature. Broadening the value proposition means diversifying (enlarging) it, satisfying needs it did not cover before. Along the second dimension, new complementors can replace or attract ecosystem stakeholders. When replacing existing stakeholders of an ecosystem, the new complementor contributes to the ecosystem by eliminating stakeholders (typically, current complementors or competitors). When attracting stakeholders to the ecosystem, the new complementors contribute to the ecosystem by increasing its value in the eyes of these stakeholders (typically, its end customers). The combination of the two dimensions of our framework yields four archetypal strategies.

Throughout the analysis, we paid great attention to triangulation by focusing on three different aspects of triangulation (Jick, 1979; Patton, 2015). First, concerning data triangulation, we used different data sources (primary data from different informants; secondary data created by different actors). Second, we used investigator triangulation, as two researchers analyzed the data independently and discussed the emergent findings with a third researcher. Both aspects have been shown to help ensure construct validity (Gibbert et al., 2008). Third, we used theory triangulation as we initially sought to study our phenomenon from a bottleneck angle before we decided to approach it from a digitalization and connectivity perspective.

Our analysis was guided by Gibbert et al.’s (2008) framework for establishing the methodological rigor of case studies. We thus tested our research’s internal, construct, and external validity and reliability (cf. also Cook and Campbell, 1979). We ensured its internal validity by grounding our research question and the proposed relationships in the existing literature, taking patterns from previous research into account (e.g., Adner, 2017; Kohtamäki et al., 2019; Markovic et al., 2020; Parida et al., 2019a). We ensured theory triangulation by approaching our phenomenon from different perspectives, which further strengthened the internal validity. Construct validity was achieved by extensive data triangulation, as described in the data collection section and the

paragraph above. We carefully selected suitable cases to ensure external validity and conducted cross-case analysis. To ensure reliability, we used the protocols of the cases themselves, but also built a database for internal coordination that enabled us to track data acquisition. Deviating from Gibbert et al.'s (2008) framework but in line with recommendations of other scholars (e.g., Gioia et al., 2013), we chose not to reveal the actual names of the firms we analyzed since we agreed on confidentiality and anonymity with our informants. Anonymity and confidentiality prevent informants from painting too optimistic a picture of their company and case.

4. Findings

We present the findings of our analysis in four parts. First, we describe how new complementors can transform the ecosystem's value proposition by deepening or broadening it (Section 4.1). Second, we describe how the new complementors can target ecosystem stakeholders by either replacing existing stakeholders (be it current complementors or competitors) or by attracting stakeholders to the ecosystem (be it customers or additional complementors).² (Section 4.2). Third, we describe the four strategies that the new complementors use to enter an existing ecosystem and connect themselves to the existing ecosystem value proposition. These strategies result from combining the previous two dimensions (Section 4.3). Fourth, we describe how connectivity technologies provide economic and non-economic benefits to ecosystem participants and customers (Section 4.4).

4.1. Deepening vs. Broadening: How connectivity technologies can advance the ecosystem value proposition

A critical part of our findings is how new complementors transform the ecosystem value proposition by applying digital technologies that enable higher connectivity. The new complementor either strengthens (deepening) the ecosystem value proposition or diversifies (broadening) it. We subsequently describe both approaches.

In cases ALPHA and CHARLIE, orchestrators coordinate the ecosystem value proposition for the final customer. In case ALPHA, the orchestrator is a hospital, and the new complementors are a drone manufacturer and a logistics company that teamed up to manage the transport of blood samples between the hospital and its laboratory. Drone-based transport is more efficient than traditional means of transport (the hospital always called cabs to transport the blood samples). The new complementors thus improved (deepened) the ecosystem value proposition, the healing of patients. Case CHARLIE refers to the app of a national transportation provider. The app was released in 2016. Soon after its launch, the orchestrator decided to open the app to third parties, enabling them to offer their services on its underlying platform. The new complementor improved the user interface by adding swipe options to choose a starting point and destination for the journey. Later, the new complementor reprogrammed the entire front-end of the app, adding additional options and configurations. Since customer friendliness is a key driver of value for an app, cooperating with digital service providers enhanced (deepened) the ecosystem value proposition. As an orchestrator's informant pointed out:

Our value proposition is the value proposition for the end customer. We want to be the personal digital travel companion for public transportation passengers in [Central European Country]. The value proposition was actually relatively clear from the very beginning. – Director (orchestrator), CHARLIE

² 'Attracting stakeholders' can be about new stakeholders as well as existing stakeholders. In the latter case, new complementors increase the ecosystem's appeal (perceived value) to current stakeholders, thereby tying them more closely to the ecosystem.

Cases BRAVO and DELTA pursue a different approach. In these cases, the new complementors diversify (broaden) the ecosystem value proposition. In case BRAVO, the new complementor is an operator of autonomous shuttles which extend the ecosystem value proposition by enabling new services (e.g., public transportation in pedestrian zones; on-demand routes). This extension of the ecosystem value proposition leads to a diversification of the ecosystem as more opportunities are offered to the final customer. Ultimately, the ecosystem becomes less dependent on a specific service the more services are offered.³

In case DELTA, the new complementor—a mobility equipment provider—enables further complementors, such as ICT providers and car dealers, to combine their offerings for an interconnected car. Different services can be offered conveniently to the final customer, merging different value propositions within one ecosystem and ultimately enabling novel business opportunities. In addition to cashless payment at fuel stations, measurement of the car's ecological footprint and calculation of its value, the new complementor provides Wi-Fi in the car and thus extends the business model of the ICT provider by opening new fields for application:

Together with [the ICT provider] we offer people an update with which they can create a Wi-Fi network inside their car. They have [a product of the new complementor] with Wi-Fi capability. They could go on vacation and give their kids the ability to surf on the go, watch or download movies, etc. That's definitely appreciated. – Director (current complementor), DELTA

While studying the transformation of the ecosystem value proposition, we made another interesting observation. We found that orchestrators have to implement relatively incremental changes when their value proposition is deepened. In case CHARLIE, the orchestrator simply needed to admit the new complementor onto the existing platform. In the case of ALPHA, the orchestrator simply reassigned the transport of blood samples to a different business partner. The primary innovation occurred on the part of the hospitals' business partners that used connectivity-enabled technologies to provide their services to the orchestrator:

That is, the [B2B partner] passes the order on to [other B2B partners] to transport that [blood sample]. My advantage with [the new B2B partners] also is: if they can fly with the drone, they transport that [blood] by drone. If the drone cannot fly, they transport the blood samples in a different way and sort of how we did it before: with a cab. – C-Level (orchestrator), ALPHA

In cases BRAVO and DELTA, the new complementors triggered more radical changes on the part of the existing ecosystem as the connectivity technologies enabled the extension of the existing ecosystem value propositions. These extensions allowed the orchestrator and current complementors to serve previously unaddressed customer needs:

You have to create added value for the city. Not necessarily just technically, but of course also be able to say: Okay, well, for the elderly population, people with walkers and who have corresponding disabilities, are walking impaired and so on, how can we transport them better from A to B? These are now the big questions that are coming up. – Manager (orchestrator), BRAVO

³ This distinction between the 'deepening' and 'broadening' cases is akin to the distinction between "architectural innovations" and "generational innovations" in the product innovation literature (Henderson and Clark, 1990). In this literature, "architectural innovation involves changes in linking mechanisms between [...] subsystems, while generational innovation involves changes in subsystems" (Gatignon et al., 2002: p. 1106). Whereas generational innovations and 'deepening' cases are more self-contained, architectural innovations and 'broadening' cases have more systemic character.

4.2. Replacing vs. Attracting: How complementors can approach ecosystem stakeholders

The second critical part of our findings concerns the stance the new complementors adopt towards ecosystem stakeholders. The new complementors can either seek to replace existing stakeholders or attract new or current stakeholders to the ecosystem.

In cases ALPHA and BRAVO, the new complementors sought to eliminate rivals when injecting themselves into the existing ecosystem. In case BRAVO, the new complementor competed with other service providers offering mobility in pedestrian zones (e.g., bicycles or [electric] kick bikes), which could also have partnered with the orchestrator. In case ALPHA, the new complementor directly sought to cannibalize the prior complementor of the orchestrator:

We can replace a transport event that would traditionally have been done by road with one that is done by air. – Director (new complementor), ALPHA

In cases CHARLIE and DELTA, by contrast, the new complementors sought to address the customers of the existing ecosystem. The new complementors either contribute additional services or improve the app, helping the orchestrator to offer many mobility services through a single source more conveniently to its customers:

The data of the vehicle has always been in the foreground. The “loyalization” of the customer [has been in the foreground] as well, especially with the additional services in the group interaction to switch on. – Director (current complementor), DELTA

We observed that the value capture processes of the new complementors are affected by the stakeholders they are targeting. When the new complementor is trying to beat and replace other service providers, its value capture mechanism relies on a B2B model involving the orchestrator, as the new complementor does not interact directly with the end customers. In case BRAVO, the new complementor provided the orchestrator self-driving shuttles at a reduced price, as both would engage in the subsequent development of the bus:

That’s also one reason why [the new complementor] gave us the vehicle at a super price: because we developed it further with them. – Manager (orchestrator), BRAVO

In contrast, the new complementors in cases CHARLIE and DELTA engage in multilateral relationships. They also interact with the orchestrator or existing complementors of the respective ecosystems and directly with the end customers. The value capture processes took different forms. In case CHARLIE, the new complementor improves the functionality and service offering by programming the customer interface of the app. The new complementor has to pay a listing fee to the orchestrator, turning its value capture into a B2B2C approach:

We were a normal supplier to our end customers. More and more, we now want to say, “We’re going to stay that, but we’re going to open up our sales channels, our touchpoints to those partners. And they’ll come in.” So I would just say it’s not revenue sharing that’s changed, it’s first realizing that we can open up our channels as a platform in the first place. We’re constantly working on that, so, for example, we’ve now made this pricing model. – Director (orchestrator), CHARLIE

The situation is different in case DELTA, where the new complementor established a new platform for the end customers. The new complementor unites complementors of multiple other ecosystems on the platform. Accordingly, the value capture mechanism of the new complementor becomes a B2B2C model, as the new complementor takes a fee from the other complementors offering their services on the new platform:

Our business model is certainly that first of all the final customer pays [as he buys our product]; respectively, that is financed through the partner

fee. You know, in the ecosystem, we earn something on every transaction.
– Member of the Board of Directors (new complementor), DELTA

4.3. Combining the two dimensions: How complementors can connect themselves to existing ecosystems

The two dimensions generate four archetypes, ‘Cannibalization’ (deepening/replacing), ‘Exploitation with Orchestrator’ (deepening/attracting), ‘Exploration with Orchestrator’ (broadening/replacing), and ‘Dual Expansion’ (broadening/attracting). These four archetypes represent different strategies of how complementors can connect themselves with existing ecosystems and contribute to the ecosystem value proposition. These four strategies also imply different meta-organizational designs, as displayed in Fig. 1. We will discuss the unique characteristics of each archetype separately in the following sections. Each section delineates how the new complementor needs to set up its business model to successfully connect with the existing ecosystem.

4.3.1. Cannibalization

Cannibalization, exemplified by case ALPHA, leaves the ecosystem value proposition of the orchestrator towards the final customers unchanged. The customer (in case ALPHA, the patient in the hospital) is served in the same way as before. However, the new complementor provides the building blocks for the orchestrator more efficiently than the prior complementor it replaced:

We subsequently decided [...] that we would price it exactly the same as today’s transports are priced. In other words, if a courier transport costs [amount of money], then the drone also costs [amount of money] per flight. – Director (new complementor), ALPHA

The new complementor may bring along other new complementors that are necessary to implement the new value creation mechanism (e.g., a manufacturer of drones and a drone operator). The new complementor may not only seek to take the place of an existing partner in the ecosystem itself, but may also not shy away from replacing any new complementor it has brought along with a competitor if such substitution serves its purposes. Concretely, the new complementor (a logistics company providing transportation as a service) had a dispute with the drone operator, causing the logistics firm to search for another drone operator to partner with:

That’s when we looked for another partner. – Director (new complementor), ALPHA

Ultimately, because no other actor could provide a better service than the first drone operator, the logistics company and the drone operator rejoined forces and provided the transportation solution to the hospital.

4.3.2. Exploration with orchestrator

Case BRAVO, representing a joint exploration of novel business opportunities with the orchestrator, extends the ecosystem value proposition. The new complementor in case BRAVO, an operation provider of smart shuttle buses, provides the connectivity technologies (shuttles and IT infrastructure) that allow the orchestrator (in case BRAVO, a public transportation provider) to diversify its offerings. The new complementor and the orchestrator also collaborate with further partners (e.g., research institutions, authorities) to develop the new complementor’s invention further, commercialize it, and materialize the expansion of the ecosystem value proposition (value delivery):

I really wanted this ecosystem to be perceived as an ecosystem. That it is recognized for the quality of the research and the projects. – Manager (new complementor), BRAVO

An orchestrator usually only agrees to an extension of the ecosystem

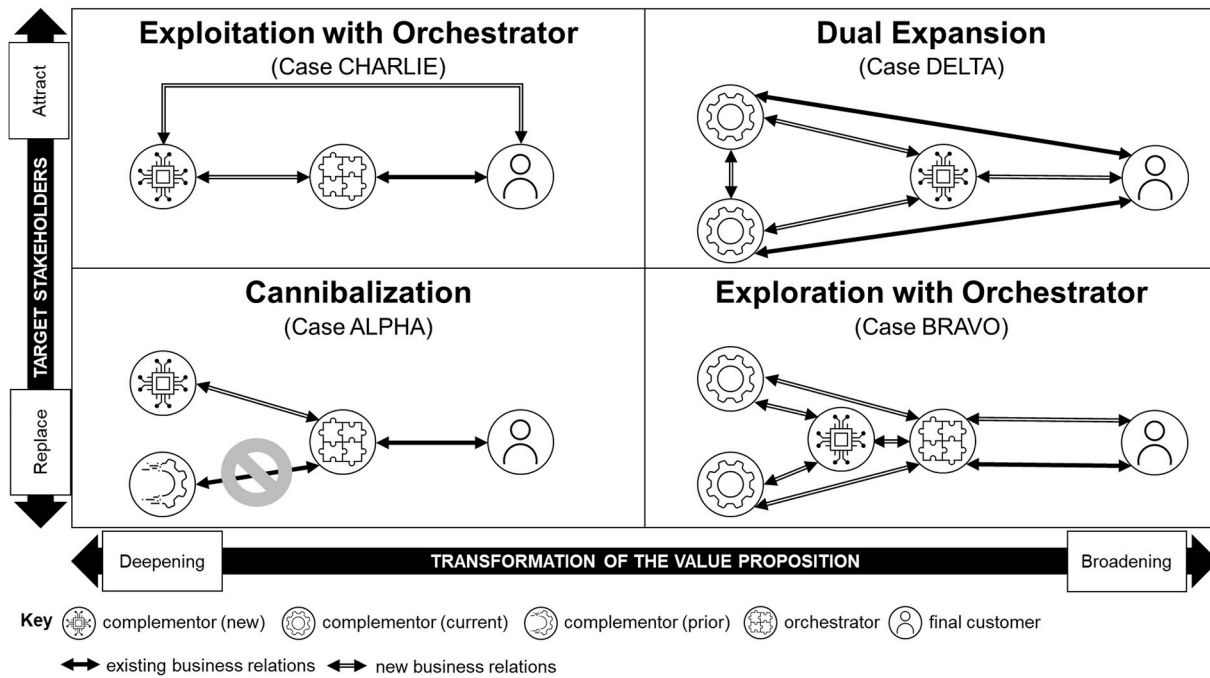


Fig. 1. Organizational design of ecosystems.

value proposition if the extension adds value to the orchestrator’s value creation. The new complementor, in contrast, may not seek a rewarding business case, but a fruitful opportunity to learn:

It would be wrong to say that we’re only interested in the mobility of persons. That is, [we’re also interested in] the mobility of services, goods, and so on. Of course, this is something that is not unique to [Public Transportation Provider]. – Manager (new complementor), BRAVO

4.3.3. Exploitation with orchestrator

Case CHARLIE, which represents the third archetype, represents exploitation with the orchestrator. The orchestrator already has a digital platform, and the new complementor enhances the services of the platform (value delivery). The new complementor connects itself with the ecosystem’s existing value proposition by participating on the platform. The new complementor creates additional value by improving the user interface and service offering:

The [new complementor] sort of took open data and made a timetable and said, “It can be done better.” And that’s how they got on our radar. [...] they subsequently became our technology provider. – Director (orchestrator), CHARLIE

While the contributions of the new complementor deepen the existing ecosystem value proposition, they do not trigger changes to the existing ecosystem participants (e.g., the orchestrator still offers the same digital travel app); they solely make the journey for the customer more convenient.

4.3.4. Dual expansion

Case DELTA represents the last archetypal strategy that we derived. In this archetype, the new complementor brings in the connectivity technology to integrate and digitalize the existing services of the diverse complementors of different ecosystems (automotive, ICT). The new complementor improves the value creation mechanism, enabling new business opportunities for the current complementors and attracting innovative partners. Collaborating with these partners allows the existing complementors to modify and extend their contributions to the ecosystem, stimulating radical adaptations. Boundaries between

hitherto distinct ecosystems become blurry, and meta-ecosystems for realizing the value delivery emerge (cf. Palmié et al., 2022).

In contrast to the previous archetypes, the new complementor has the potential to become an orchestrator itself. As the new complementor sets up a platform, it provides connectivity mechanisms between the different ecosystems. Consequently, the new complementor becomes the anchor of this emerging meta-ecosystem and uses its platform to coordinate the other complementors with the final customer (B2B2C). By bringing the different complementors and their services together, the new complementor becomes an orchestrator:

The automotive world is, of course, also relatively straightforward, and [Automotive OEM’s Financial Services Unit] is also the partner of [car importer]. [Gas Station Brand] also has partnerships with [Car Importer]. They know each other, they definitely talk to each other. Specifically, on the subject of [DELTA], it is more likely to go through us; we’re more likely to be the hub. But networking within and between the ecosystem does take place. – C-Level (new complementor), DELTA

Fig. 2 summarizes our findings, the four archetypes an incoming complementor can use to connect itself to existing ecosystems, and how it can configure its business model. The figure shows that the degree of innovativeness a strategy implies for the incumbents (orchestrator and/or current complementors) varies according to our first dimension, ‘transformation of the ecosystem value proposition’: When a new complementor is deepening the ecosystem value proposition, the ecosystem participants only have to deal with incremental innovation. When the new complementor is broadening the ecosystem value proposition, ecosystem participants (orchestrators and/or complementors) face the need for radical innovation. In contrast, the value capture model of the new complementor varies according to our second dimension, ‘target stakeholders’: When new complementors replace existing competitors, their value capture mechanism follows a B2B logic. When they attract new or existing customers, their value capture mechanism follows a B2B2C logic. Finally, Fig. 2 illustrates that the implications for the value creation, delivery, and capture mechanisms are specific to each individual quadrant.

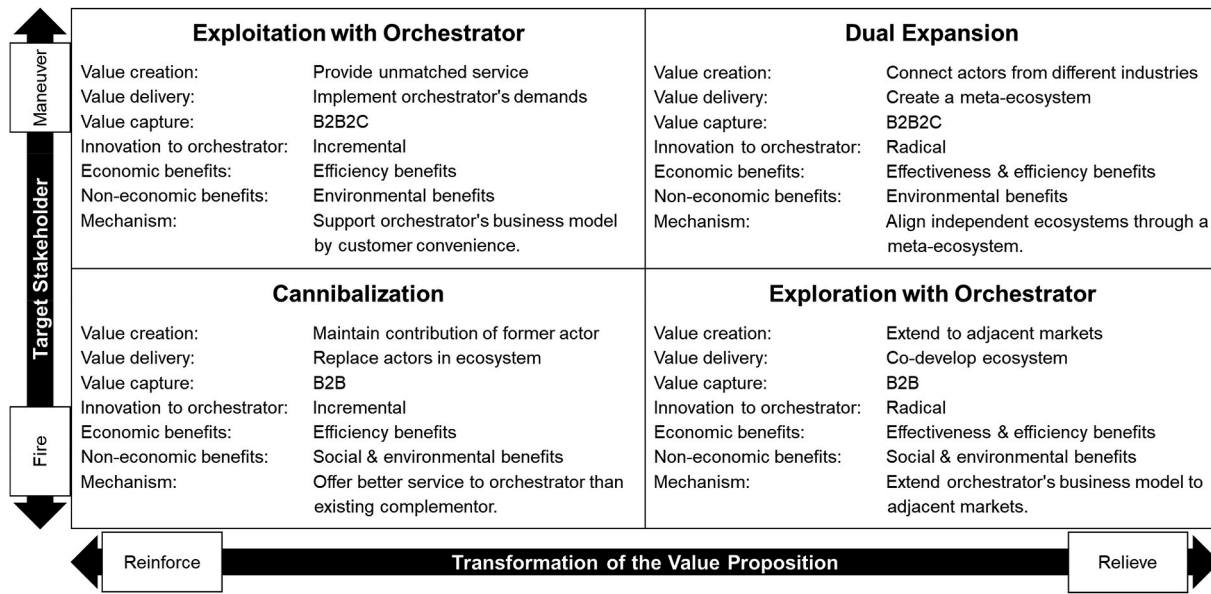


Fig. 2. Archetypes of complementor strategies.

4.4. Implications of leveraging connectivity technologies: How new complementors affect ecosystem performance

Across all four cases, the new complementors used the enabling potential of connectivity technologies to offer several economic and non-economic benefits to other firms in the ecosystem and their customers. First, the new complementors increased the efficiency of the ecosystem value proposition in every case. In case ALPHA, the blood samples are loaded onto the drones by automated docking stations, reducing personnel costs. Similarly, the self-driving shuttles in case BRAVO can reduce personnel costs. The platform's redesigned app in case CHARLIE paid great attention to the customer interface. Travelers need less time to identify suitable connections than they used to and do not have to buy individual tickets for their journey anymore – they sign in and out of the app whenever they use a service. If customers use the connectivity technology of case DELTA, they only have to drive to the gas station and refuel their car; payment is handled automatically via the platform, allowing gas stations to reduce personnel and drivers to save time.

In addition to increases in efficiency, cases BRAVO and DELTA also experienced increases in effectiveness. In case BRAVO, the self-driving shuttles make it possible to offer a greater variety of routes, including transportation in areas that could not be reached before (e.g., pedestrian zones) and on-demand services. In case DELTA, the new complementor enabled the ecosystem to offer several new functionalities, such as car analytics, trip journals, and vehicle localization. That cases BRAVO and DELTA seem to entail greater improvements in effectiveness than cases ALPHA and CHARLIE could indicate that broadening an ecosystem value proposition is associated with both efficiency and effectiveness benefits, whereas reinforcing (deepening) an ecosystem value proposition is primarily associated with efficiency benefits.

Second, the new complementors increased the environmental sustainability of the ecosystem value proposition in every case. In case ALPHA, the drones can usually take shorter routes between the hospital and the laboratory than a taxicab, reducing energy consumption. Moreover, they do not get stuck in traffic and reduce noise emissions and air pollution in cities relative to gasoline- or diesel-powered cars. Similarly, autonomous vehicles like the shuttles in case BRAVO tend to consume less energy than vehicles operated by a human driver (cf. Schweitzer et al., 2022). For instance, they adjust their speed to reach a traffic signal when it changes to green and thus do not have to dissipate

energy by braking. In case CHARLIE, the higher level of convenience induced by the user-friendly platform and app are likely to foster people's inclination to use environmentally friendly means of public transportation more frequently. In case DELTA, vehicle tracking provides suggestions for more environmentally friendly driving behavior. Another function allows users to offset their emissions by contributing to sustainable projects. Furthermore, the car analytics feature informs customers about upcoming maintenance, which will help to extend the vehicle's lifecycle.

In addition to environmental advantages, cases ALPHA and BRAVO also entail social benefits. In case ALPHA, the transportation of blood samples by drones can save valuable time when patients' lives depend on them. In case BRAVO, autonomous shuttles reduce the adverse health effects of accidents caused by human errors. That cases ALPHA and BRAVO seem to emphasize social benefits more than CHARLIE and DELTA could indicate that social sustainability is not linked to deepening a value proposition (as in cases ALPHA and CHARLIE) or broadening it (as in cases BRAVO and DELTA) in an overarching pattern. Rather, social sustainability could display a general pattern with the target stakeholders that the new complementor addresses – whether the newcomer replaces current complementors and outside service providers (as in cases ALPHA and BETA) or attracts customers (as in cases CHARLIE and DELTA).

5. Discussion and conclusion

Our study examined how firms can use connectivity technologies to enter an existing ecosystem as new complementors and link themselves to the ecosystem value proposition. Our findings show that four archetype strategies towards this end differ regarding their implications for the ecosystem value proposition and the stakeholders that the new complementor targets. For each archetype, we also described the mechanisms of the new complementor's business model (value creation, value delivery, and value capture), the degree of innovativeness for ecosystem incumbents induced by the new complementor, and its effect on ecosystem performance. Our findings make important contributions to the academic literature and management practice.

5.1. Theoretical contributions

First, we contribute to the digitalization literature by responding to

calls to improve our knowledge about the implications of digital technologies for B2B relationships (Kohdamäki et al., 2019; Paiola and Gebauer, 2020). Prior research has pointed out that B2B relationships can be affected by digitalization in three ways: (a) ‘activity-links-centered digitalization’ seeks to optimize already existing activities between partners; (b) ‘resource-tie-centered digitalization’ supports the creation of new activities between existing partners; and (c) ‘actor-bond-centered digitalization’ supports the formation of new bonds between hitherto unconnected actors (Pagani and Pardo, 2017). Our study, focusing on complementors entering an existing ecosystem, represents an instance of ‘actor-bond-centered digitalization.’ This type of digitalization was recently explored by Palmié et al. (2022), who found that firms can digitalize their value proposition by collaborating with digital service providers rather than applying digital technologies themselves. In line with Palmié et al. (2022), our study shows that incumbents can pursue digital opportunities by including digital service providers in their ecosystem. Extending Palmié et al. (2022), our study identifies different strategy archetypes, with some involving incremental adaptations of incumbents’ business models and others involving radical changes in their business models. Our insights let us better understand how firms can deal with a common challenge of digitalization – many incumbents struggle to incorporate digital innovations into their business model (Tongur and Engwall, 2014; Vinokurova and Kapoor, 2020). We illustrate that incumbents can reap the benefits of digitalization without having to bear the burden of digitalization all by themselves. They could explore which strategy archetype prospective new partners intend to pursue and enter a collaborative agreement with a candidate whose strategy suits their willingness and ability to innovate their value proposition. Turned the other way around, we find that connectivity technologies provide new entrants with four archetypal strategies for approaching incumbents with whom they want to collaborate.

Second, our article contributes to the digitalization literature by studying the sustainability implications of connectivity-enabled strategies. Prominent scholars have recently argued that “environmental and social issues [...] will provide the greatest challenges” to the strategic management of technology and innovation (Dodgson, 2021: p.16) and called for more research on the digitalization-sustainability nexus (Bansal, 2019; George et al., 2021; Parida et al., 2019b). A holistic review of extant work on this topic concludes that digitalization can make three contributions to sustainability: (a) overcoming a data vacuum; (b) improving analytical capacities for monitoring, assessment, etc.; and (c) expanding collaboration by enabling the establishment of “highly connected digital ecosystems” (Del Río Castro et al., 2021: p. 22). The review subsequently notes that the role of the digital ecosystems in fostering sustainability remains poorly explored. A notable knowledge gap identified by the review concerns the impact of digitally enabled value propositions on sustainability, especially their impact on the three pillars of sustainability (Del Río Castro et al., 2021: p. 16). Our study makes two important observations in this regard. For one thing, we show that connectivity-enabled strategies can provide economic and non-economic benefits simultaneously, allowing firms to strengthen multiple pillars of triple-bottom-line performance simultaneously, reconciling potential conflicts between economic and non-economic motives (Bansal, 2005; Elkington, 2018). For another thing, we observe that environmental advantages could be realized in the four archetypal strategies, whereas social advantages were emphasized in only two of them. Specifically, social benefits were found for the two strategies seeking to replace existing complementors (archetypes ‘Cannibalization’ and ‘Exploration with Orchestrator,’ cf. section 4.4), but not for the two strategies primarily appealing to customers. An explanation for these findings could be that organizations use social performance as a decision criterion when selecting partners and technological solutions to work with (Friedrich et al., 2021; Pache and Santos, 2010). Organizations are generally held more accountable for the social implications of their actions than individuals (Goodpaster, 1983; Piquet-Pissaloux, 2022), increasing the significance of social

advantages as drivers of change. This effect is not limited to digitally enabled changes, but extends to other changes in firms’ value creation, value delivery, and value capture. For example, many organizations modified their supply chains to replace suppliers utilizing child labor. According to another possible explanation, strategies appealing to customers may not emphasize social sustainability because people who value social sustainability the most (the elderly, people with special needs, the unemployed, etc.) often have limited purchasing power and hence do not make for attractive customers. The existence of multiple plausible explanations, which need not be mutually exclusive, corroborates the relevance of conducting further research on the association between digitalization/connectivity and social sustainability.

Third, we contribute to the ecosystem literature, which has so far mostly focused on ecosystem orchestrators (e.g., Iansiti and Levien, 2004; Li, 2009; Williamson and de Meyer, 2012) and their strategies (Masucci et al., 2020; Ozalp et al., 2018; Parida et al., 2019a; Ritala et al., 2014). Our study contributes to the emerging literature stream on ecosystem complementors (e.g., Kapoor and Agarwal, 2017; Miric et al., 2019; Rietveld and Eggers, 2018). While existing research on complementors deals with whether complementors join a single ecosystem or diversify across multiple ecosystems (e.g., Cennamo et al., 2018; Tavalaei and Cennamo, 2021), we focus on how complementors strengthen or diversify the ecosystem value proposition. This finding extends Kamalaldin et al.’s (2021) theoretical framework on ecosystem strategies. Kamalaldin et al. (2021) derive four ecosystem strategies for digitally enabled process innovation: orchestrator, dominator, protector, and complementor strategies. We refine our knowledge about complementor strategies by unveiling four alternative configurations of business model mechanisms a complementor can choose to align itself with the orchestrator’s business model in the ecosystem and to contribute to the ecosystem value proposition. These findings advance the literature on the meta-organizational design of ecosystems, which concerns ecosystems’ structures and activities (Adner, 2017). While prior research focused on the orchestrators designing the ecosystem (Lingens et al., 2021), our study demonstrates that complementors also influence ecosystem design. Based on our archetypes of complementor strategies, Fig. 1 draws ‘ecosystem pictures’ (cf. Aarikka-Stenroos and Ritala, 2017) which illustrate the major changes induced by the new complementors and can help us grasp their implications for collaboration and strategies in the ecosystem (Adner, 2017).

Finally, our study contributes to the literature on ecosystem evolution. This stream has examined how ecosystems emerge (Hannah and Eisenhardt, 2018; Thomas and Ritala, 2022) and how their value proposition evolves (Thomas et al., 2022). Our study complements prior efforts in this area in two ways. For one thing, it corroborates the recent notion that interdependencies between different ecosystems emerge and result in so-called ‘meta-ecosystems’ (Palmié et al., 2022). Palmié et al. (2022) show that digital service providers can stimulate the convergence of two independent ecosystems into a meta-ecosystem. Our contribution highlights that the involvement of digital service providers as complementors does not necessarily lead to meta-ecosystems, as the complementors can join an existing ecosystem. We also extend Leminen et al. (2017), who demonstrate that actors assume different roles in ecosystems. Our archetype model expands the literature by illustrating the transformation process between multiple roles in a (meta-)ecosystem, showing that complementors can become orchestrators.

5.2. Managerial implications

Our study entails three core insights for managers. First, it offers guidance on how digital service providers can enter existing ecosystems. Managers must decide how their firms should contribute to the ecosystem’s value proposition, whether they want to deepen or broaden it. For another thing, managers need to decide which stakeholders of the ecosystem they wish to target. Do they want to replace and thus substitute the orchestrator’s current business partners or competitors in

adjacent markets, pursuing a B2B approach, or do they want to attract customers, pursuing a B2B2C approach? Our insights into complementor strategies should be relevant to many firms. Even though orchestrators tend to attract more attention, only one or a small number of firm(s) can be orchestrator(s) in a given ecosystem, and most ecosystem participants will actually assume a complementary role.

Second, our study shows how managers of incumbent firms can profit from digitalization without having to make cumbersome changes to their existing business models. Thanks to connectivity technologies, incumbents can team up with digital service providers and allow them to add additional services to their existing value proposition. Our findings illustrate that firms can use connectivity technologies to generate economic value by increasing the effectiveness or the efficiency of their ecosystem-based value creation and delivery. Connectivity technologies further allow firms to generate environmental and social value and, in particular, to generate economic and non-economic value at the same time.

Third, our study demonstrates that ecosystem incumbents should not take their role for granted. More efficient complementors may enter the ecosystem and replace prior partners. A former complementor can develop into the natural ecosystem orchestrator (e.g., by providing data platforms), pushing the previous orchestrator ‘off the throne.’

5.3. Limitations and paths for future research

Like all empirical research, our study has some limitations that provide opportunities for future work. First, as a typical limitation of qualitative designs, the number of cases is limited (Eisenhardt, 2021). Our cases are all situated in the mobility context of the same country. We encourage future work in additional settings to strengthen the external validity of our research (cf. Gibbert et al., 2008; Yin, 2018). Second, the improvements we observe with respect to efficiency, effectiveness, environmental sustainability, and social benefits are closely associated with the ecosystem value proposition. A large-scale quantitative study of the transformation of ecosystem value propositions could provide more general findings on the economic and non-economic benefits of leveraging connectivity technologies. Third, the business models of the emerging complementors are described on a rather abstract level. Using

APPENDIX

Table 3
Exemplifying evidence

Dimensions and categories	Representative quotes	Informant	Case
<i>Transformation of the value proposition</i>			
Broadening	The idea was to test in the area of public transport: Can autonomous buses work? Can they play a role in public transportation, and can they add operational value at [Public Transportation Company]?	Manager (orchestrator)	BRAVO
	[Insurance] brings into this ecosystem a whole new group of customers, new use cases, in order to deliver an add-on afterwards that we can scale the product. That’s specifically at [DELTA] the ecosystem. It’s a vehicle importer, the largest car dealer in [Central European Country], with garages, with service, with corresponding infrastructures. It’s an insurance company that brings in the insurance expertise, and it’s [ICT Provider] that brings in the connectivity expertise plus software expertise.	C-Level (current complementor)	DELTA
Deepening	You have an innovative solution. You have something you can communicate, and it makes your processes leaner and more efficient and increases the quality of treatment [of your patients].	Director (new complementor)	ALPHA
	We have reach, the largest in [Central European Country]. For topics that involve mobility, we are an attractive platform. If next to it, a luggage service and you buy a train ticket, but you don’t want to take your luggage yourself, the [luggage service] then simply jumps onto the platform and offers its service through us.	Director (orchestrator)	CHARLIE
<i>Target stakeholder</i>			
Replace	We had a pretty interesting lens when we were working with [Drone Operator], which is a company that was, in many ways, not just building a product, and it had a very different approach than competitors out there, [...].	C-Level (new complementor)	ALPHA
	Accordingly, we said: Okay, we have a problem on the last mile side. Is it okay to use these shuttles to cover the last mile or to make public transportation more attractive?	Manager (new complementor)	BRAVO
Attract		Director (orchestrator)	CHARLIE

(continued on next page)

a finer-grained account and investigating a greater number of cases could generate further insights into the business models associated with our four strategies. Fourth, our study represents an instance of complementor strategies ‘for digitally enabled process innovations’ in the terminology of Kamalaldin et al. (2021). Future work could examine the other complementor strategies from this framework. Finally, we encourage scholars to evaluate the performance implications of the four archetypes in greater detail. The question of how much the new complementor, the orchestrator, other ecosystem players, but also society as a whole and the environment benefit from each archetype and under which conditions which archetype is particularly beneficial seems interesting. Our study is only a first step in understanding how ecosystems can expand their value propositions by integrating new complementors. We hope that it stimulates much more research into this underdeveloped domain.

CRediT author statement

Lucas Miehé: Conceptualization, Investigation, Project administration, Writing – original draft, Writing - Review & Editing, Visualization. Maximilian Palmié: Conceptualization, Writing – original draft, Writing - Review & Editing. Pejvak Oghazi: Conceptualization, Writing - Review & Editing.

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Data availability

Data will be made available on request.

Table 3 (continued)

Dimensions and categories	Representative quotes	Informant	Case
	That is, of course, the effective platform change, that then really partners come to our platform, who address the same end customers, but can just achieve more via our high-reach channel. We are all concerned with increasing customer retention, customer loyalty. Not to at best chase customers away from our competitors.	Director (current complementor)	DELTA
<i>Value creation</i>			
Maintain contribution of former actors	I'm not saying they [hospitals] haven't contributed anything, just that they haven't contributed more to technical development. At most indirectly, by defining the requirements they have in the hospital.	Director (new complementor)	ALPHA
Extend to adjacent markets	The goal is really to build something that will improve the entire value chain of mobility and also the customer experience.	Manager (new complementor)	BRAVO
Provide unmatched service	The [new complementor] sort of took open data and made a timetable and said, "It can be done better." And that's how they got on our radar. [...] they subsequently became the technology provider [for us].	Director (orchestrator)	CHARLIE
Connect actors from different industries	The motivation behind this at our company is that we can develop faster when different industry players join forces and everyone can contribute their core competencies.	Director (current complementor)	DELTA
<i>Value delivery</i>			
Replace actors in ecosystem	They [hospital/incumbent] were encountering challenges with that transportation and this is why they were keen to implement drone technology.	Director (new complementor)	ALPHA
Co-develop ecosystem	Co-creation is perhaps a term that is a bit overused and perhaps misused, but in the sense of our ecosystem, it thrives on it. How can we come together, create a product or service, evaluate, test, definitely drive it further?	Manager (new complementor)	BRAVO
Implement orchestrator's demands	In principle, we are the ones who look after them [orchestrator] and the competence then also lies with us. We know that when we integrate the component [...].	C-Level (new complementor)	CHARLIE
Align independent ecosystems	The approach that we want to have an open ecosystem, that has always been the case. Of course, we also looked at which partners are relevant. Refueling, parking, insurance, leasing – these are all services that are relevant.	Manager (new complementor)	DELTA
<i>Value capture</i>			
B2B	[Logistics Company] is the intermediary, but we have that direct relationship in terms of setting up the operations and running them. We actually wanted to stop the project because we said: We have achieved the project goals, the two that I described to you before. And then the city [name] came and said: Extend this, this is such a success. And that also has a media impact for us as a city.	Director (new complementor) Manager (orchestrator)	ALPHA BRAVO
B2B2C	The business model of almost all large companies has actually always been bidirectional. I am a company, I have products and services, I bring that to my customers. [...] I just create the marketplace and let providers and customers play on my platform. What I find exciting in the sense of our case, we are the mixed case, like Netflix and Amazon: Amazon has themselves, bidirectionally sell things to their end customers and they said: "If we already have this fancy machine [platform], we could" – that is much more prominent in Germany than with us [in Central European Country] – "we can still let all the other providers on it."	Director (orchestrator) C-Level (new complementor)	CHARLIE DELTA
<i>Innovation to incumbent</i>			
Radical	Relevant all the more is that open innovation is actually about innovation from the outside. It wasn't until the two [core actors] plus still the extended partners talked together that you saw a golden way to implement the whole [value proposition]. Technologically, it's not trivial to get something like this off the ground. The level of complexity is relatively high.	Manager (new complementor) Member of the Board of Directors (new complementor)	BRAVO DELTA
Incremental	I am a hospital. I treat patients. I don't do the logistics. The external logistics do the logistics. I want to have a supplier who is specialized in this area. And [B2B Partner] is the best specialist in this area. I wanted to give [B2B Partner] the responsibility. And there I don't want responsibility, that's not my business. Plus just a little bit of the innovation character, the [user interface] we showed that obviously we can innovate in an industry.	C-Level (orchestrator) C-Level (new complementor)	ALPHA CHARLIE
<i>Mechanism</i>			
	Our business model is not to offer the drone to a customer. We're not going to offer the drone to a customer in the future. We will simply say, "Look, you have a transportation need." The customer says, "Within 15 min, a product A needs to be at a destination B," and after that, our system generates a price and decides after that what kind of transportation that will be. So, it's really about working out innovation possibilities and opportunities in an existing company. The platform is actually the combination of all the backend services and the touchpoints where you reach the customers. It's a somewhat more complex environment, and that's actually multiple ecosystems interwoven together.	Director (new complementor) Manager (new complementor) Director (orchestrator) C-Level (current complementor)	ALPHA BRAVO CHARLIE DELTA

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