

The ecosystem blueprint: How firms shape the design of an ecosystem according to the surrounding conditions

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ARTICLE INFO

Keywords:

Ecosystem
Ecosystem design
Ecosystem structure
Alignment structure
Attention-based view of the firm

ABSTRACT

Ecosystems are formed by organisations that jointly create a value proposition that a single firm could not create in isolation. To deliver this value proposition, the partners need a focal firm, the orchestrator, to be align them towards the joint value proposition. Thus, how orchestrators design the alignment structure of an ecosystem is at the very heart of the ecosystem concept – yet it has not been sufficiently addressed by extant research. This is all the more true for the question of how the design of an ecosystem is shaped depending on surrounding conditions. This paper applies a qualitative study with ten cases and, based on the attention-based view of the firm, contributes to research on ecosystems in several ways. First, it explains which ecosystem designs are beneficial under which conditions. Second, it elucidates the structure and activities within ecosystems and shows that start-ups can be just as good ecosystem orchestrators as incumbents. Third, it explains the circumstances under which single vs. multi orchestrator ecosystems occur. Fourth, it presents the conditions when incumbents or start-ups make better orchestrators. Finally, it is among the first studies to apply the attention-based view to business ecosystems, and shows that doing so yields intriguing insights into this emerging field of research.

1. Introduction

Recent years have seen a boom in the ecosystem concept (Adner, 2017; Jacobides et al., 2018; Moore, 1993; Rong and Shi, 2015), in fields such as strategy (e.g. Iansiti and Levien, 2004a; Moore, 1996; Parente et al., 2019), innovation (e.g. Adner and Kapoor, 2010; Dattée et al., 2018; Davis and Eisenhardt, 2011), and organisation (e.g. Davis, 2016; Kapoor and Agarwal, 2017). Expressed in numbers, the frequency of articles published on this topic in the leading strategy journals has grown sevenfold over the last five years (Autio and Thomas, 2019; Jacobides et al., 2018; Kapoor, 2018) and ‘[...] the term “ecosystem” has become pervasive in discussions of strategy, both scholarly and applied’ (Adner, 2017, p. 39). At the same time, in industry practice, firms are increasingly building ecosystems (Alturi et al., 2017; Fuller et al., 2019; Palmié et al., 2020) and the ecosystem concept is even expected to take over traditional thinking in products and markets (Catlin et al., 2018; Rong, Hu, Lin, Shi and Guo, 2015a; Rong, Wu, Shi and Guo, 2015b), since ‘individual corporations are no longer adequate to serve as the primary unit of analysis’ (Baldwin, 2012a, p. 20). Instead, the key challenge for organisations will be the management of distributed activities within ecosystems (Keupp et al., 2012).

The core of the ecosystem concept is the creation of a joint value proposition for the customer that a single firm cannot achieve in isolation (Adner, 2017; Autio and Thomas, 2019; Kapoor, 2018; Moore, 1993; Parente et al., 2019; Shipilov and Gawer, 2019), and which is based on complementary modules, i.e. the organisations involved in the ecosystem need to either specifically develop or, at

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least, mutually adjust their respective modules for the joint value proposition to be delivered (Jacobides et al., 2018). In order to achieve this, the ecosystem partners need to be aligned towards the value proposition (Adner, 2017) by a central player, the orchestrator¹ (Adner, 2017; Altman and Tushman, 2017; Dattée et al., 2018; Jacobides et al., 2018; Kapoor, 2018; Moore, 1993, 1996; Nambisan and Baron, 2013). This is essential since all ecosystem partners have individual goals and agendas but, at the same time, must develop and mutually adapt their modules in reciprocal relationships with the other partners (Adner, 2017; Jacobides et al., 2018; Kapoor, 2018; Masucci et al., 2020).

Thus, what makes ecosystems unique (Ganco et al., 2020), and what defines them, is ‘the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize’ (Adner, 2017, p. 40; see also Autio and Thomas, 2019; Kapoor, 2018; Shipilov and Gawer, 2019). The design of the alignment structure is particularly crucial since all partners involved in an ecosystem pursue their individual agendas, which requires joint decision-making by all partners involved (Jacobides et al., 2018). From the perspective of the attention-based view of the firm (Ocasio, 1997), such decision-making requires the decision maker to focus their attention on available information about the environment and to understand alternative possible decisions (Ocasio, 1997; Weick, 1979). Additionally, for the same reason, ecosystem actors can only create a joint value proposition if they focus their attention on relevant innovation opportunities, since individuals are unlikely to act on opportunities that do not catch their attention (Barnett, 2008; Ocasio, 1997). Attention, in turn, is influenced by the structures that decision-makers find themselves in (Ocasio, 1997; see also Gavetti et al., 2007; Joseph and Ocasio, 2012; Ocasio and Joseph, 2005). Thus, it is essential to understand how the orchestrator designs the alignment structure of an ecosystem to facilitate appropriate distribution and allocation of attention and, thus, joint decision-making and the creation of a joint value proposition. Answering this question addresses three crucial gaps in current literature on ecosystems and the attention-based view of the firm. First, to our knowledge, the attention-based view has not yet been used to study ecosystems or other forms of inter-organisational networks or meta-organisations (with the noteworthy exception of the study by Maula et al. (2013) on the saliency of industry peers and VC-funds and their influence on the attention of managers to technological change). Second, within the ecosystem domain, insights on how firms shape the design of ecosystems is still insufficient (Adner, 2017; Dattée et al., 2018; Jacobides et al., 2018; Phillips and Ritala, 2019). This is because the majority of publications on ecosystem design are merely conceptual, thus they lack an empirical foundation (e.g. Baldwin, 2012b; Brusoni and Prencipe, 2013; Ganco et al., 2020; Teece, 2007; Williamson and de Meyer, 2012; Zahra and Nambisan, 2012). This leads to a high level of abstraction in previous findings (Kapoor and Lee, 2013) and a lack of in-depth insights into how ecosystems are being designed (Adner, 2017). Thus, researchers have repeatedly called for research along these lines (c.f. Jacobides et al., 2018; Laamanen, 2017; Phillips and Ritala, 2019). Also, these conceptual works are usually based on existing theoretical reasoning that might not be suitable to ‘help explain the distinct value creation and capture dynamics within and between ecosystems’ (Jacobides et al., 2018, p. 2256). And, third, ecosystem design differs depending on the surrounding conditions (Iansiti and Levien, 2004b), i.e. different ecosystem structures are beneficial under different conditions (Jacobides et al., 2018). This raises ‘the need to revisit assumptions of ecosystem uniformity and to establish a typology of ecosystem designs best suited to varying contexts’ (Dattée et al., 2018, p. 493).

In order to address these gaps in the existing literature, we use a qualitative multi-case study (Eisenhardt, 1989; Yin, 2014) with ten cases. In particular, we focus on the design of ecosystems in the early stages of their lifecycles (Moore, 1993, 1996; Rong and Shi, 2015) since the emergence of ecosystems is still an unexplored field of research. However, it is particularly essential for firms to understand the design of ecosystems in these early stages since ecosystems do not emerge on their own, but must be purposefully built (Dattée et al., 2018; Fuller et al., 2019; Jacobides et al., 2018). In order to achieve comparability across our cases, all of our cases are characterised by value propositions that can be defined as digital services (c.f. Chatman and Jehn, 1994; de Wulf et al., 2001; Schoenecker and Cooper, 1998).

Our research reveals two surrounding conditions that must be considered when shaping an ecosystem’s design – and both playing a crucial role within the attention-based view as well: 1) the substantive uncertainty of the environment (Dosi and Egidi, 1991) and 2) the effective distance of knowledge between the orchestrator’s existing knowledge and the knowledge required to align the ecosystem partners (Afuah and Tucci, 2012). We therefore develop four propositions that contribute to research on ecosystems in several ways. First, and foremost, we shed light on the under-researched topic of how the orchestrator designs the alignment structure of an ecosystem, thus providing a better understanding of how ecosystems are structured and governed. Second, we contribute to the understanding of the surrounding conditions in which ecosystems might be particularly beneficial, and address the related calls for research by Adner (2017), Dattée et al. (2018), Jacobides et al. (2018), and Phillips and Ritala (2019). Third, we help understand what makes a ‘good’ orchestrator, depending on the surrounding conditions of the ecosystem. Fourth, in so doing, we contradict existing findings and show that in some situations, start-ups are excellent ecosystem orchestrators. Fifth, we reveal differences in ecosystem design between single- or multi-orchestrator ecosystems. Sixth, by being among the first to apply the attention-based view of the firm to the emergent phenomenon of ecosystems, we show that ecosystems can both focus attention on novel fields of knowledge, i.e. distant search, and also overcome limitations of innovativeness when focusing attention on local domains of knowledge, i.e. local search.

¹ In this paper, we use the term ‘orchestrator’ without distinguishing from other phrases currently used in existing literature. For instance, other terms in use include: ‘keystone’ (Clarysse et al., 2014; Iansiti and Levien, 2004a); ‘hub firm’ (Jacobides et al., 2018; Masucci et al., 2020; Nambisan and Baron, 2013); ‘focal actor’ (or ‘focal firm’) (Adner, 2017; Adner and Kapoor, 2010, 2016; Autio and Thomas, 2019; Dattée et al., 2018; Ganco et al., 2020; Kapoor, 2018); and ‘ecosystem leader’ (Moore, 1996; Teece, 2016).

2. Literature background

2.1. The attention-based view of the firm

Based on earlier work (Cyert & March 1963; March and Simon, 1958; Simon, 1997; Weick, 1979), Ocasio (1997) introduced an attention-based view of organisational decision-making and innovation. This view claims that the actions of decision-makers, and subsequent organisational moves, are dependent on their attention – ‘the noticing, encoding, interpreting, and focusing of time and effort’ (Ocasio, 1997, p. 189) – to issues and answers – information about the environment and the available action alternatives (Ocasio, 1997; Weick, 1979). Attention, in turn, is affected by the situation decision-makers find themselves in – thus, the attention-based view links decision-makers’ attention to issues and answers via the design of an organisation (Gavetti et al., 2007; Ocasio, 1997). Organisational design, in turn, can be distinguished in aspects of structure, which are long-term and stable, as well as the more short-term processes/activities that take place within these structures (Davis and Marquis, 2005; Delbecq, 1967; Hall, 1972; McCaskey, 1974; Mintzberg, 1979; Nadler and Tushman, 1970; Ocasio, 1997; Ray et al., 2004; Tushman and Nadler, 1986; see also Rong and Shi, 2015). Thus, in order to cover ecosystem design comprehensively from an attention-based view, we can expect the ecosystem design to cover the three aspects of structure, activity, and the orchestrator, as the key decision-maker within the ecosystem.

The attentional capacity of decision-makers is finite: They can only absorb a limited amount of information and only this information will influence their decisions (Ocasio, 1997; Simon, 1997). Accordingly, decision-makers can have a smaller or wider focus of attention; a small focus increases the speed and accuracy of perception and action, but might lead to potential neglect of information located outside of the attention focus, whilst a wide focus has the opposite effect (Bansal et al., 2018; Barnett, 2008; Ocasio, 1997). At the same time, attention can be focused in a flexible or an inflexible way. The first way means that decision-makers focus their attention flexibly on information that becomes salient in their environment, which allows them to react flexibly to opportunities that arise around them. The second way means that they pre-define their focus of attention as a specific set of information, which allows for preparatory attention and, as a result, increased speed and accuracy of perception and action but, again, introduces the risk of overlooking opportunities outside the focus of the attention (Barnett, 2008; Ocasio, 1997).

In this regard, the orchestrator’s knowledge base plays an important role since an organisation is more likely to pay attention to and make sense of information that is closely related to its existing knowledge and past experiences (Cohen and Levinthal, 1990; Cyert & March 1963; Zahra and George, 2002). How easily firms can pay attention to novel information is a function of two factors: First, the distance of the firm’s existing knowledge base to the new knowledge and, second, the depth of knowledge required to make use of the new information – both from the ‘effective distance of knowledge’ (Afuah and Tucci, 2012). Thus, the effective distance of the orchestrator’s knowledge determines how easily or how likely it is that this firm will focus its attention on available information.

On the other hand, uncertainty plays a central role for the distribution of attention as well, since uncertainty impedes the focusing of attention on relevant information (Cyert & March 1963; Gavetti et al., 2007; Ocasio, 1997). In this regard, uncertainty can be described using Dosi and Egidi’s (1991) concept of the exogenous substantive uncertainty²: Weak substantive uncertainty is present if information is lacking but possible outcomes are known and decision-makers can roughly evaluate the likelihood of these outcomes. Also, necessary information can be gathered and processed in order to reduce the uncertainty at hand. Strong substantive uncertainty is present if possible events are unknown or if the probability distribution of these events cannot be defined. In this vein, we view the substantive uncertainty as exogenous uncertainty from the perspective of a focal firm (Beckman et al., 2004): In situations of strong substantive uncertainty, the focal firm cannot reduce the uncertainty at hand, since market uncertainty (as a part of this type of uncertainty) is externally determined. The causes of market uncertainty cannot be controlled or reduced by the activities of a single firm, as a firm cannot determine customer preferences, which are unstable and changing (c.f. March, 1978). In general, the type of information needed can be about the market (i.e. expected revenues, competition, likelihood of adaption of the product by customers) or about the technologies needed for the value proposition to be delivered (Cooper, 1979; Souder and Moenaert, 1992; Yap and Souder, 1994).

2.2. The ecosystem concept

The ultimate purpose of an ecosystem is the materialization of a joint value proposition by several players that cannot be achieved by any one of these players in isolation (Hannah and Eisenhardt, 2018; Jacobides et al., 2018; Kapoor, 2018; Masucci et al., 2020; Moore, 1993; Parente et al., 2019). This offers opportunities for companies, for instance, by allowing them to tap into novel markets or to create novel products, as well as allowing firms access to resources and competencies that a single company would not have on its own (Adner, 2006; Moore, 1996; Nambisan and Baron, 2013). On the other hand, a joint value proposition can only be achieved by several partners if it can be successfully broken down into several independent modules. This allows these modules to be produced independently by the various actors involved (Baldwin and Clark, 2000; Jacobides et al., 2018; Rong et al., 2015a). For an ecosystem concept to be relevant, each of these complementary modules must be non-generic (Jacobides et al., 2018). This implies that the interconnected complementarities are either unique, i.e. unable to function without the other component(s) (Teece, 1986), or increase the value of the other modules (so-called supermodularity, Milgrom and Roberts, 1990; Topkis, 1998; Topkis, 1978). Thus, actors need

² The concept of substantive uncertainty has been used across a range of publications in management and strategy research, as well as in studies in the context of the attention-based view, and in studies on behavioural aspects (Dionysiou and Tsoukas, 2013; MacCormack and Verganti, 2003; Palmié, Lingens and Gassmann, 2016a; Rindova, 1999).

Table 1

Case and data overview.

Case	# Inter-views	Interviewee positions O = Orchestrator company CO = Co-Orchestrator C = Complementor company	Key People 1) Top management 2) Partner manager 3) Project manager 4) Ecosystem partner	Inter-viewee	Interview duration (min)	Additional data	Source (additional data)
Keyless Access	6	Chief Executive Officer (O) Chief Sales Officer (O) Head Ecosystems & Venturing (C) Venture Fund Manager (C)	1 & 2 2 & 3 4 4	A1 A2 A3 A4	62 + 20+66 81 60 21	Company website documents Blog post & online articles	internal external
Virtual Mobility	6	Co-Founder & CEO (O) Head of Marketing (O) Electrical Engineer (O) Entrepreneurial Manager (C)	1 & 2 1 & 2 3 4	B1 B2 B3 B4	34+ 93 + 62+59 25 60	Company website documents Blog post & online articles	internal external
Contactless Payment	8	Chief Innovation Officer (C) Head of Marketing (O) Head Mobile Payments (C) Innovation Strategist and Project Manager (C) <i>former</i> Chief Executive Officer (O) <i>current</i> Chief Executive Officer (O)	4 1 & 2 4 4 1 1	C1 C2 C3 C4 C5 C6	55 49 45 + 60 76 99 + 58 48	Company website documents Blog post, newspaper & online articles Radio & TV reports	internal external external
Insured Factoring	8	Chief Product Officer (O) Chief Executive Officer (O) Innovation Manager (C)	1 & 2 1 & 3 4	D1 D2 D3	140 + 81+48 + 23+69 + 81 60 36	Online articles about the orchestrator Company website documents	external internal
Intelligent Insurance	5	Founder & CEO (O) Head of Sales Europe (O) Head of Strategy and Planning (C)	1 & 2 2 & 3 4	E1 E2 E3	80 + 44+46 60 51	Company website documents Blog posts & online articles Radio & TV reports	internal external external
Simple Relocation	9	Business Development Key Account Manager (O) Business Development & Innovation Manager (O) Founder & CEO (O) Head of Business Development (O) Innovation Manager (C) Business Development Manager (O)	2 2 & 3 1 2 & 3 4 3	F1 F2 F3 F4 F5 F6	9 + 38 85 66 + 60 49 40 + 60 75	Company website documents Participant observation in workshop Online & magazine articles Newspaper articles	internal internal external external
Autonomous Delivery	6	Head of Autonomous Delivery (CO) Head of Open Innovation (CO) CEO & Investor (CO) Corporate Account Executive (CO)	2 & 3 1 1 2	G1 G2 G3 G4	36 + 60+60 53 39 60	Company website documents Expert board final report Blog post & online articles	Internal external external
Digital Prescription	5	Chief Innovation Officer (CO) Product Manager (CO) Corporate Account Executive (CO)	1 & 2 3 2	H1 H2 H3	55 + 64+19 51 60	Working documents Direct observation in workshop	Internal internal
Autonomous Busses	7	Head of Open Innovation (CO) Head Project Lab (CO) Lab Coordinator (CO)	1 3 2	I1 I2 I3	52 76 + 49 45 + 13	Company website documents Technical report	internal internal

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Table 1 (continued)

Case	# Inter-views	Interviewee positions O = Orchestrator company CO = Co-Orchestrator C = Complementor company	Key People 1) Top management 2) Partner manager 3) Project manager 4) Ecosystem partner	Inter-viewee	Interview duration (min)	Additional data	Source (additional data)
		Head of Strategy & Innovation (CO)	1	I4	57	Newspaper, online articles & TV reports	external
		Operational Director (CO)		3	15	26	
Smart Commuting	6	Project Manager Ecosystem Initiative (CO)	2 & 3	J1	51 + 60+120 + 30	Participant observation in workshop	internal
		Head of Business Development (CO)	4	J2	60 + 60	Working documents	internal
Total	66				3690	= 61.5 h	

Table 2
Exemplary quotes about case value propositions and ecosystem designs.

Case	Quotes on the value propositions and ecosystem design
Keyless Access	'So, we first talked directly to [Car Rental Company], because we wanted to know if the use case we have is really of interest at all. And we got feedback that "Yes, it is of interest". But they are only interested in it if they can order it directly from the [Service Provider] as a retrofit solution and do not have to install and remove it manually.' (A1) 'Well, I would say retrospectively that we were not even aware that we were building ecosystems [...] and that we needed different players at the table to create this network effect. That was our perspective at the very beginning.' (A1) 'A single partner like [Car Rental Company], if it addresses a solution now, it will build a solution that is as cheap as possible and can be easily integrated into its specific fleet of cars. What we [within the ecosystem] in turn offer is: we try to think about the platform as broadly as possible and also to include partners beyond the horizon. So, what do I mean by that? The [Car Rental Company] thinks only about its rentals, the [Service Provider] thinks only about its normal keys and not at all about digital keys, and the post office thinks: "How do I now deliver a package into a trunk?" If everyone builds their own solution, every solution looks completely different. And the solution that we build together fits all of these use cases that I just mentioned.' (A1) 'And so, we have deliberately worked together with the investors for this network. I know today I would best describe it as an ecosystem orchestrator, we have invested in it together with them. And that's why this theme "we build partners, we develop partners" has always been a core component.' (A1) 'So, from our market participants around us, I would say yes [about being the orchestrator]. From what drives us, I would say because we have a broader perspective on the vision and the market and, therefore, the ecosystem than our customers alone have.' (A1) 'They [Service Provider] designed the [box for the car] according to their requirements, compared it directly with the hardware manufacturer, and then developed it with the hardware manufacturer, so to speak, and we [Access Provider] were also part of this development.' (A2) 'The complexity of customer adaptation is always very individual and time-consuming You may have standard interfaces, but they have to be adapted very elaborately every time.' (A2)
Virtual Mobility	'So, we create digital copies of the world basically, that's in one sense what we do. And these digital copies entail 3D models which are very, very accurate and they also entail the ability towards a second stage interact with them, assimilate, make a basically dynamic environment which they can do predictive analysis and also enables you to incorporate third party data too, to actually overlay over the 3D models, [...]' (B1) 'Yes, but we're the ones creating the ecosystem because everyone is running through us, so, without us, the ecosystem doesn't exist.' (B1) '[...] there are basically three components [to our product]; there's the whole capture side and recording the whole data, then there is the side to make it interactive or to put it into a gaming engine to make it into a whole simulation, and then there is the part of processing all the data and also visualising all this data. The first part is what we excel in, so this is our core competence in that sense. The second part is where there is plenty of people who already have in this in terms of gaming engines, it's not something new, so it's something we don't want to build ourselves it doesn't make sense. And the third part is the computational power which is something we also need as a commodity. But it's a commodity which is costly, and it's a commodity where you want to have strong partners to get that commodity a bit cheaper or to be able to integrate better with that commodity. And one of these examples could be [Graphic Processing Units Manufacturer] a provider of graphic cards, so they are providers of computational resources, [Game Engine Developer] is a provider of gaming engines so they're the provider of that particular part of the product, and we're the provider of the 3D model. Then we, as a company, are bringing all of these three parts together and, in the end, sell one single product to [the] car manufacturer. And why we're really pushing for this is because in the end we have really strong synergies.' (B1) 'In the end, they have to interact with each other as well because the gaming engine has to run on the computational resources and they already do; they already optimize, so they have to interact as well. If they don't interact, in the end it makes it much more difficult, or then another partner for instance, [Graphic Processing Units Manufacturer], it would make more sense who is more willing to interact in that triangle. So, the more they interact, the better it is for the product.' (B1) 'It's just too complex of a topic at the moment [...], you need the independency, I think it's super strong.' (B3)
Contactless Payment	'The motivation to participate there [Contactless Payment] was originally: Mobile Payment is coming. That's what the customers said. Mobile payment, international solutions – they're all based on credit cards. And today we pay with cash, with debit cards, and a small proportion with credit cards by the number of transactions in physical stores. Online it's different. And, of course the retail industry has said: When mobile payment come ... And it's coming, then it comes with credit card prices. And this is something the trade strategically wants to avoid.' (C2) 'But we believe that we can offer the customer more than an Apple Pay can offer. Because an Apple Pay is ultimately no more than a credit card that is on deposit. And we have many more possibilities: We are closer to the [Country] and can build special solutions for [Retailer 1] or [Retailer 2]. (C2) 'Actually, the enemy [= competitor] is outside [Country]. And outside of banking. So, we work together better.' (C2) 'And you had to connect the beacon to a cash register via USB. Every cash register, every merchant had to do an integration. That was very complex. And that's certainly an advantage that we now have in the new constellation, where you have acquirers with terminals that already have the entire infrastructure at the point of sale.' (C2) '[...] principally, the idea was to bring the [bank] card into the new world [of smartphones]. And then we said: we have to make it with external partners. Actually, not necessarily because of the idea of partnership. But it was more IT driven, which required external IT skills.' (C2) 'It was important that all banks participated. And that nobody was exposed.' (C5) 'And it was certainly important that the banking centre simply said: "Hey, we want a joint solution here because of mobile payment, because if we don't cooperate, the market is gone for us." (C5) 'What you ultimately do with [Contactless Payment], you say you're making a new scheme and it won't be on the existing schemes like Mastercard, Visa, Maestro, David Scheme, or American Express, but you build a new one.' (C5) 'We are as [Digital Payment Provider] the arm [with all] data, so to speak; relatively, we can't do anything without the bank.' (C6) 'Some banks, not all of them, use the [Data Centre] as a kind of customizer, so we develop the app and then make it available to the banks. [Bank 1] because it's here and [Bank 2] only use the library and build their own apps with all the downstream processes [...]' (C6)
Insured Factoring	'Without [Insurance Company], who provided us with the very, very special insurance solution that we developed together, the whole thing would of course not have flown.' (D1) 'So practically, we really came out of the good cooperation between a founding team, where [Insurance Broker] guy and [Insurance Company] were involved. That was the very first thing and from there we started looking for other partners.' (D1) 'This [value proposition] was somehow relatively strongly driven commonly. Our value proposition has, in a way, evolved together with the patent we got. That sounds a bit, how should I say it, unguided, but it was just that all our partners wanted to have a say in the value proposition.' (D1) 'At the end of the day, we all want to provide a service for SMEs together. And then all the people who are actually specialists in their field come

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Table 2 (continued)

Case	Quotes on the value propositions and ecosystem design
	together.' (D1) 'And the third thing that would affect us, how shall I put it, more in the medium term, is certainly that if the [Bank] didn't like us as a partner anymore, then that would have a direct effect, they wouldn't take away our customers or whatever, but our pipeline would dry up halfway. That doesn't mean that people come via the homepage, people come via other brokers, but as I said, half of our customers come via the [Bank].' (D1) 'We're still very strong now with the ecosystem, but the idea is that we should have more funding partners onboard, so we just signed a contract with [Bank] for fifty million funding again a month and a half ago.' (D3) 'But somehow they [banks and insurance companies] have never managed to align their processes with each other. And, at the same time, the benefit for the customer is that this is exactly what [FinTech] does.' (D3)
Intelligent Insurance	'We [Data Analyst] have developed a health index [...]. If something consists of 100 data points, then you already know that nobody does it alone. [...] That means that a huge ecosystem is being created within itself.' (E1) 'To sum up, [Data Analyst] floats in an ecosystem where several star systems move around the sun [Data Analyst].' (E1) 'This means that the [Data Analyst] platform runs as Software as a Service. That is very important. And [Data Analyst] makes this Software as a Service available to the insurance company. The insurance company makes a so-called pass through [of customer data].' (E1) 'We'll give him [Reinsurance Company] risk models. This is very, very important. So, he doesn't get raw data, he gets risk models [...]. And in this [intelligent insurance] risk model, he [Reinsurer] calculates his pricing or goes up to the primary insurer. So that means from there up to here, there is a pricing. But only after he [Reinsurer] got this risk model from [Data Analyst]. Our data is fed into it and an offer goes up to the primary insurer.' (E1) 'Let me put it this way: there are technology partners that we will need, because many of these efficiency improvements are, of course, only possible if we provide technical support.' (E3)
Simple Relocation	'What we actually have is really the moment when the customer moves. And that is just mega interesting for many companies. Because the basket of goods is much higher in furniture stores, for example.' (F1) 'We have guidebooks, and we involve partners more closely there, for example, we write SEO-optimized texts together.' (F1) 'And the problem is: We really want exclusivity, i.e. branch exclusivity for the furniture sector.' (F1) 'And this ecosystem thinking is more in line with [Insurance Company].' (F2) 'What we offer our customers is a contact point and a single source that solves everything around the topic of relocation. The first step is mainly about finding offers for removal and final cleaning companies with all-inclusive prices [...]. A very central point of the whole thing is that we have Move Captains, our customer advisors, who independently accompany the customer through the whole process and help in case of difficulties, which is, of course, an advantage compared to having to deal only with the company and if you have difficulties, you have no one who can help you.' (F3) 'Now the question is what do we define as the ecosystem. Certainly, in the strictest sense, it is the removal and final cleaning companies with whom we work.' (F3) 'I think the idea came from a pain: because I think [name], the CEO, his parents moved and he helped a little bit and then ... He was also involved in the moving company and then he realized: "hey, it's kind of disorganized, but there are so many things that could be optimized". And it is time-consuming and somehow exhausting. And then he also helped, I think, to look for a company, because his parents didn't know where to look. And one was too expensive, one was somehow a bit suspicious, and so on.' (F4) 'You make an update, you have to connect to the partners again and say, "Hey, you in?"' (F4) '[Relocator] is a digital relocation platform, perhaps a more natural administrator than [a] platform [...]. [Relocator] as a platform brings moving and cleaning companies together with the customer, so in that sense it's an intermediary. You can go to [Relocator] and get five moving offers from different companies and now with our [Insurance Company] role, which was added in this cycle, you get free moving insurance when you move [limited insurance coverage] now [...].' (F5)
Autonomous Delivery	'Making transport faster, more readily available and, if necessary, cheaper. And from political and legal points of view, the partner is [Governmental Authority]. From a technology point of view, we have the partnership with [Drone Technology Provider].' (G1) 'I have now thought about [how we tried redundant drone technology providers], because I thought that he [another drone technology provider] did not deliver. And with him we ended the cooperation.' (G1) '[Logistics Company] brings logistics expertise and [Drone Technology Provider] brings expertise in the drone business. The [Logistics Company] provides access to customers through its expertise in logistics. [Drone Technology Provider] would probably never have been able to win the hospital [as a customer] on its own, clearly.' (G2) 'You need different types of partners that may either be channel partners or industry partners Obviously, [Drone Technology Provider] has been able to provide a really great technology [...].' (G3) 'Most of the time, the value proposition is in being able to transport blood for laboratory testing.' (G3) 'Naturally, technology is never absolutely perfect at the beginning, but what's really interesting is trial and error. Obviously, at the beginning, they understood how to build a viable technology, they needed the alignment of all these other adopters in the form of regulation and strategic channel partners, they needed those partners aligned to create a viable commercial network.' (G3) 'Together with the drone manufacturer [Drone Technology Provider] and partners from the healthcare sector, [Logistics Company] uses drones to transport laboratory samples.' (Secondary source) The [Governmental Authority] was involved in the project from the beginning, has thoroughly examined the intended drone model, and, after numerous successfully completed test flights, gave permission for the flights.' (Secondary source)
Digital Prescription	'If this is an e-recipe that is stored on the blockchain, then I don't have any fraud, so then nobody can cheat. That means this thing only exists once, all incidents on a blockchain are in the end. The [insurance companies] have an advantage from being in the system and their costs go down.' (H1) 'The customer also wants convenience and, on the other hand, he has the advantage that if the health insurance company refuses something somewhere, the whole thing is written on the blockchain again. And when he is at the doctor's, the medication is always issued correctly from the beginning. So, if it is not paid once, it is automatically saved and the next time the doctor will notice that the medicine is not covered by the insurance.' (H1) 'That means I can't avoid talking to these partners. The same goes for a pharmacy: without it, there will be no introduction to the prescription, just like the doctor who actually always originally issues it. That means these are exactly the partners I need.' (H1) 'The health system is too expensive. The business cases don't pay off in there from a traditional point of view. I have a new technology that allows me to eliminate intermediaries like [Digitizer of Prescriptions]. And I'm actually designing new solutions based on that. And then I looked at the necessary parameters to satisfy all the personas.' (H1)

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Table 2 (continued)

Case	Quotes on the value propositions and ecosystem design
	'So, if you only build something for the [Country] market, then it will only work if all the players do it together.' (H1) 'That is then left to each individual to decide. So, how an insurance company, a pharmacy, or a doctor uses it for himself in any other way is not really important. Because it's just a matter of saving the data on the protocol level.' (H1) 'There is no added value in the ecosystem itself, but the ecosystem must be able to generate added value for the other members of the ecosystem and allow [them] to benefit.' (H2) 'This means ... looking at the ecosystem first, that all players have an advantage from these peer-to-peer transactions and also from the value streams.' (Statement from direct workshop observation)
Autonomous Busses	'We identified a vision: we did not want to be a public transportation provider anymore; instead we wanted to be a multi-modal integrated mobility provider. This was really the vision. And we identified some immediate challenges on the path to this vision. But we knew that alone we could not manage to further develop our vision.' (I1) 'Such disruptive topics, like autonomous driving, we do not manage alone. Therefore, it is important to find the right partners to work on it. We were already a partner of [University 1] and naturally, when there is data analytics, we said [University 1] is very interesting and so we continued with them.' (I1) 'In the field of data analytics, they [University 1] have done a lot. Then we also found the software start-up from [University 1] and the [Fleet Manager]. Then we further activated our start-up screening. We brought a start-up [Bus Manufacturer] from [Country]. [...] And after that, the [City] offered the Playground; where the city really brought support was also in communications. [Canton] did a lot of work lobbying with [Governmental Authority]. So, everybody really took part utilising their core assets and competencies.' (I1) 'The pilot project implemented in public areas in [City] can also be used to develop the [University 1]'s algorithms.' (Secondary source) '[Public Transportation Provider] and [City] intend to collaborate with their partners to find out whether the use of autonomous shuttles in public areas gives customers added value.' (Secondary source)
Smart Commuting	'The value proposition is to offer the customer a platform that fully integrates various mobility solutions and, in the medium term, even solutions that go beyond mobility from a single source [...].' (J1) 'The trigger was our realization that in the future we will no longer be able to map services alone, because these customer journeys are actually merging more and more, becoming more and more a single point of contact.' (J1) 'With our ecosystem, we actually want to offer the mobility customer greater added value by combining core competencies from different industries and different companies.' (J1) 'We are only now so far that we have actually consolidated the cooperation in this multi-orchestrator approach. There is [Software Company] in there, there is [Consulting Firm] in there.' (J1) 'In concrete terms, you can imagine that we are striving for a platform on which you enter your desired route from A to B, just like on Google Maps, for example, but the platform also physically depicts your Pin Journey from A to B, in other words, you want to be able to rent a car-sharing vehicle via the platform, but you also want to be able to purchase a public transport ticket via the platform [...].' (J1)

to specifically create new modules, or at least mutually adapt existing modules, that complement the modules provided by the other partners (Baldwin and Clark, 2000; Jacobides et al., 2018; Liu and Rong, 2015). This requires that the various actors are mutually aligned with one other towards the joint value proposition (Adner, 2017; Nambisan and Baron, 2013). The alignment is inherently multilateral, i.e. the connections among the players cannot be composed as bilateral arrangements, in order to ensure that all modules function with each other and make use of the full potential of complementarity (Adner, 2017; Autio and Thomas, 2019; Jacobides et al., 2018; Shipilov and Gawer, 2019).

This implies a strong dependency among the players, especially since the mutual adaption of modules causes significant ramp-up costs (Adner, 2017; Jacobides et al., 2018; Kapoor and Lee, 2013; Ozalp et al., 2018). Consequently, if one player fails or leaves the ecosystem, it fails, or at least struggles, as a whole. This makes ecosystems all the more critical since actors within it are still independent economic actors with individual agendas and goals (Dattée et al., 2018; Moore, 1996). Hence, the design of the alignment structure between the partners is at the very heart of the ecosystem concept (Adner, 2017; Jacobides et al., 2018).

2.3. Current findings related to ecosystem design

So far, research on ecosystem design has been the subject of many studies, which have looked at single elements or aspects of alignment in isolation. Links among the actors are certainly a cornerstone in this regard (Adner, 2017) and deal with the exchange of money or goods, as well as influence and, thus, the question of how ecosystems are governed. Ecosystems are less hierarchical than supply chains, yet, on the other hand, they require some hierarchy and control to ensure the alignment of actors towards the value proposition (Autio and Thomas, 2019; Jacobides et al., 2018). Additionally, other authors claim that ecosystems are loosely connected networks of actors (e.g. Clarysse et al., 2014; Iansiti and Levien, 2004b; Moore, 1993, 1996). The importance of links between actors for technological progress has been subjected to simulations and empirical research (e.g. Ganco et al., 2020; Masucci et al., 2020; Ozalp et al., 2018; Rong et al., 2015a).

In terms of the actors involved in an ecosystem, the orchestrator clearly plays a key role, as the orchestrator is the actor in charge of designing the alignment structure, as well as the main decision-maker within an ecosystem (Dattée et al., 2018; Jacobides et al., 2018). In this vein, authors have claimed that the orchestrator brings in key resources and infrastructure (e.g. Clarysse et al., 2014; Kapoor and Lee, 2013; Zahra and Nambisan, 2012) or dynamic capabilities (Teece, 2007). Thus, these works consider the orchestrator to be a large, powerful, and established company. Some articles, however, claim that the orchestrator might not always be the most powerful firm within the ecosystem, but rather one using other means to exert control based on knowledge, status, or key resources and technologies (e.g. Brusoni and Prencipe, 2013; Gulati et al., 2012; Williamson and de Meyer, 2012). In general, most works on ecosystem partners

consider ecosystems to be based on specialised firms, which have very specific roles and activities within the ecosystem (e.g. Brusoni and Prencipe, 2013; Moore, 1996; Williamson and de Meyer, 2012).

3. Methods

A case study is an ideal approach if a (complex) phenomenon is little known and existing aspects are incomplete, fragmented, or contradictory (Eisenhardt, 1989, 1991; Yin, 2018). As shown in our introduction and literature section, this is the case for ecosystems and, even more specifically, for its design. We use a multiple-case approach for our research since it allows for the collection of comparative data and is likely to provide more accurate and generalizable insights than a single case would (Eisenhardt, 1991; Ozcan and Eisenhardt, 2009), and this approach strengthens the external validity of a case study (Eisenhardt and Graebner, 2007; Gibbert et al., 2008; Goffin et al., 2019; Yin, 2018). On top of this, since many studies in the ecosystem field remain conceptual, the rich empirical insights generated by a multi-case study may be of particular value to understand this rising phenomenon.

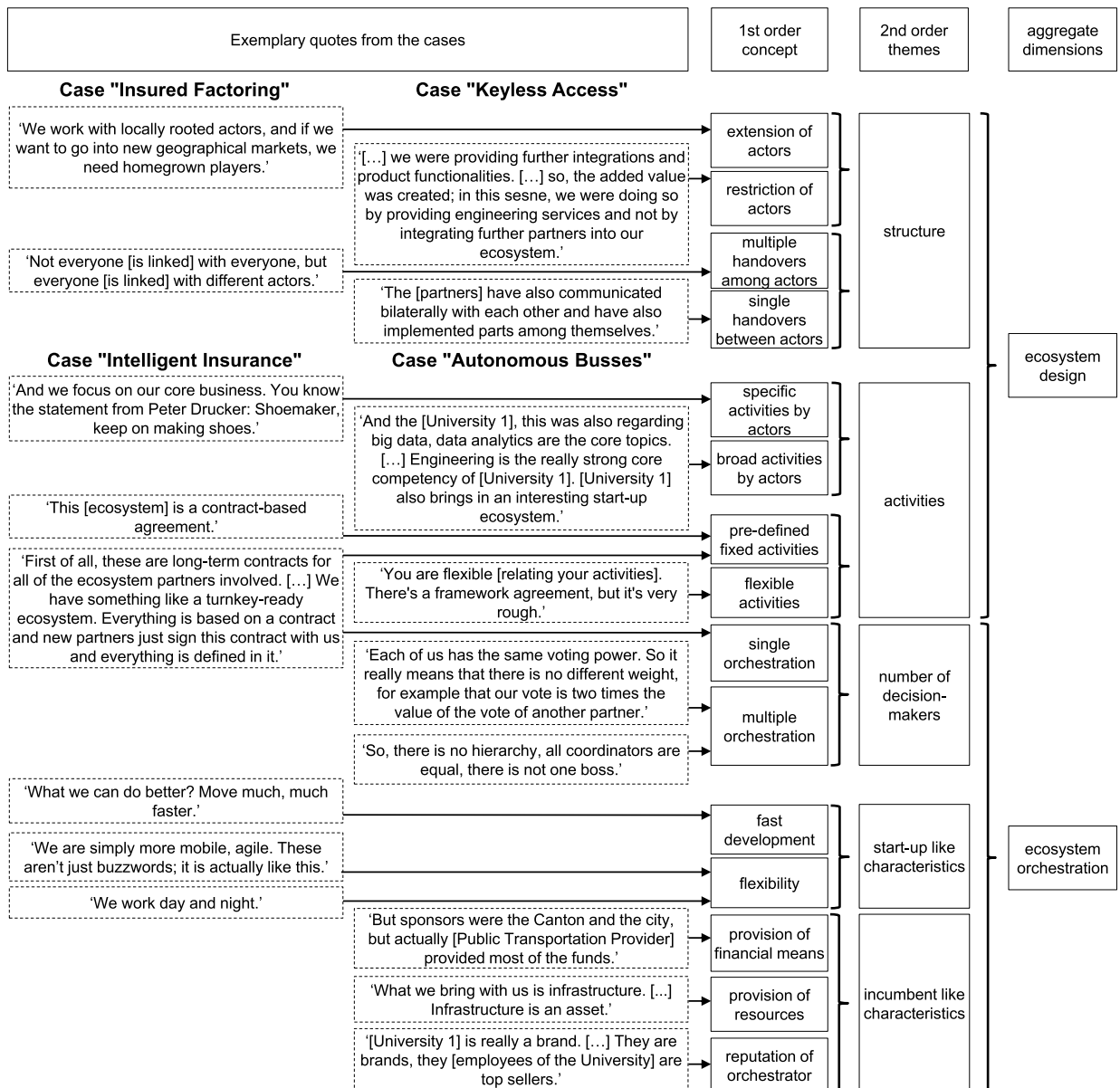


Fig. 1. Exemplary coding scheme.

Table 3
Proof quotes³.

		Keyless Access Classification/ Supporting Quotes	Virtual Mobility Classification/ Supporting Quotes	Contactless Payment Classification/ Supporting Quotes
Structure	Characteristic Quote/Argument	<i>Restriction of actors</i> ‘[...] we were providing further integrations and product functionalities. [...] so, the added value was created; in this sense, we were doing so by providing engineering services and not by integrating further partners into our ecosystem.’ (A1) ‘And I would base it on the fact that I would say that building the ecosystem and orchestrating the whole thing has taken us much longer [...]. Because with an ecosystem, you always take longer to manage the partners, that’s obvious, yes.’ (A1) ‘Once you have convinced him [the partner for your value proposition], the effort can only be controlled by keeping the number of partners reduced.’ (A2)	<i>Restriction of actors</i> ‘To be frank, there are not that many partners you can choose from.’ (B1) ‘[...] we have larger contracts with a smaller amount of people [...]’ (B1) ‘[...] for the final value proposition, very few business partners have been involved [...]’ (B3)	<i>Restriction of actors</i> ‘The only partnership we actually made was the model of saying: We make a pact with the retail trade.’ (C2) ‘We let them [Retailers] go a little bit, since we said: The retailers, the [ir] systems are on it. We make sure it keeps running. And new ones? We need to rebuild more of the systems [first].’ (C5) ‘They [customers] were relatively less important, because we knew: We had to bring the system up first.’ (C5)
	Evidence	Strong	Strong	Strong
Structure	Characteristic Quote/Argument	<i>Single handovers between actors</i> ‘The [partners] have also communicated bilaterally with each other and have also implemented parts among themselves.’ (A1) ‘[...] are rather in a give-and-take relationship [...], than in a real ecosystem relationship.’ (A1) ‘So, in this sense, there was actually only one customer in the game and one partner in the game, who – so to say – then coordinated and assembled its components itself.’ (A2) → The partner coordinated directly with the customer by leaving out the orchestrator.	<i>Single handovers between actors</i> ‘[...] but we’re the ones creating the ecosystem because everyone is running through us, so, without us, the ecosystem doesn’t exist.’ (B1) ‘So, the [partners] have also worked together in part. But on the whole they didn’t.’ (B3) ‘[...] if you look at it in retrospect, they [partners] were certainly not really connected or haven’t really had connections.’ (B3)	<i>Single handovers between actors</i> ‘So, the ecosystem is just old world to me. You just digitized standard processes and built an ecosystem out of them.’ (C1) → The actors were already tightly connected to each other through the collaboration necessary to run conventional payments via credit cards, which is the foundation of the value proposition of the newly founded ecosystem. Thus, only a few very simple links had to be implemented between the orchestrator and the existing partners. Therefore, only one position (the orchestrator’s) has been added. ‘So, the relationship of the partners among themselves within [Contactless Payment], I can say by now regarding my own bank [that] with the others I do not have actually large contact, is actually quite collegial now.’ (C3)

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Table 3 (continued)

	Evidence	Strong	Strong	Strong
Activities	Characteristic Quote/Argument	<i>Specific activities</i> ‘The one who owns the hardware is also the one who provides the service, and of course you’ve left out many levels [= activities] in the ecosystem.’ (A2) ‘In fact, at such [large] companies you have often difficulties to receive sufficient attention. Therefore, we decided to merely collaborate with specialised partners [...]’. (A1)	<i>Specific activities</i> ‘[...] [Graphic Processing Units Manufacturer] a provider of graphic cards, so they are providers of computational resources, [Game Engine Developer] is a provider of gaming engines so they’re the provider of that particular part of the product, and we’re the provider of the 3D model.’ (B1) ‘[...] the capture technology from our side, which is unique in our position.’ (B1) ‘The first part is what we excel in, so this is our core competence in that sense.’ (B1) ‘[...] we have already developed a lot ourselves in-house. We built a lot ourselves and the whole interaction of hardware and software, that needs quite a unique team [...]’. (B3). → Underlines that their [3D cartographer] has quite a specific and unique contribution to the ecosystem. ‘[The Complementors] are, of course, specialised in that. So, anybody can order such a [graphic] chip.’ (B3)	<i>Specific activities</i> ‘So, the ecosystem is just old world to me. You just digitized standard processes and built an ecosystem out of them.’ (C1) The actors were already tightly connected to each other through the collaboration necessary to run conventional payments via credit cards, which is the foundation of the value proposition of the newly founded ecosystem. Thus, only specific activities were implemented between the orchestrator and the existing partners. ‘And we have many more possibilities: We are closer to the [Country] and can build special solutions for [Retailer 1] or [Retailer 2]. I mean, Apple Pay will probably never be able to integrate a [loyalty scheme] into the payment process.’ (C2) ‘We are as [Digital Payment Provider] the arm [with all] data, so to speak; relatively, we can’t do anything without the bank.’ (C6)
Activities	Characteristic Quote/Argument	<i>Pre-defined fixed organisation structure</i> ‘[...] the basis of the expectation is that at some point one’s technology will become a de facto standard. I believe that every company has this conviction when it delivers a kind of basic innovation, i.e. a truly fundamental, new approach. All these companies want their approach to become the de facto standard at some point’. (A2) ‘[...] we are now considerably better at standardising our contract structure, simply because we also have more experience [...]’. (A1)	<i>Pre-defined fixed organisation structure</i> ‘[...] we have larger contracts with a smaller amount of people [...]’. (B1) ‘I mean we had early proof of concepts [...]’. (B1) ‘[...] we have contractually set this [activity] up and then had the corresponding agreements in it [contracts], certain deliverables, certain time/ time frame and so on.’ (B3)	<i>Pre-defined fixed organisation structure</i> ‘The idea behind [Contactless Payment] was: We make the pact with the retailer. We offer him favourable prices, very favourable. We have been at half the price of a debit card.’ (C2) → Because the orchestrator digitized an existing value proposition, the company knew which modules it needed. Therefore, it was able to design the activities in advance. ‘For [the payment ecosystem] there exists a huge rule book defining all the rules for the partners involved. And everyone who takes part in the scheme has to sign the rule book. [...] These are books full of rules for them.’ (C2) ‘And these contracts [...], the Rules and Regulations, (continued on next page)

Table 3 (continued)

				which then make up the scheme, they are already formulated as clearly as possible, of course, as watertight as possible. '(C3) 'No, the roles were always relatively clear. [Digital Payment Provider] makes the system as such. The banks bring the end customers into the system. And that was ultimately their goal. ' (C5) Strong
	Evidence	Strong	Strong	Strong
Ecosystem orchestration	Characteristic Quote/Argument	Single orchestration 'So spontaneously, I'd say we're the ones who bring technological components together to make the whole system work. '(A1) 'We proactively decided at that time for the partner network, for the approach to orchestrate it. '(A1)	Single orchestration '[...] we're the ones creating the ecosystem because everyone is running through us, so, without us, the ecosystem doesn't exist. ' (B1) 'Then we, as a company, are bringing all of these three parts together and, in the end, sell one single product to [the] car manufacturer. '(B1)	Single orchestration '[Digital Payment Provider] makes the system as such. ' (C5) '[Digital Payment Provider] is on the move as a scheme. That's correct, it's in the centre., so to speak. "(C6) '[Contactless Payment] creates digital innovations in the financial sector. Since being founded in 2014, it has been developing [Country name]'s digital wallet. '(Secondary source) Strong
	Evidence	Strong	Strong	Strong
Orchestrator characteristics	Characteristic Quote/Argument	Fast development 'Well, we were dependent on partners to provide our front end at that time. And that didn't happen fast enough for us in that sense. '(A1) → The orchestrator [Access Provider] was waiting for its partners (they slow the orchestrator down) to finalize the final value proposition. 'They [start-ups] are of course much faster, because they are not dependent on any product integration and lifecycles of partners, but they control this cycle themselves [...]. ' (A2) 'Everybody knows if we have something, we can work pretty fast. ' (A2)	Fast development '[...] I'm just starting these relationships [with partners] and then it has to shift very fast to the technical team. ' (B1) 'I mean, it [being a start-up] is a disadvantage in terms of resources, for sure. But I think it's an advantage in terms of capability to move fast and to also change direction fast, if needed" (B1) '[...] we have been able to adapt a lot and very quickly. ' (B3)	Fast development '[We increasingly live] in a digital world, the young [companies] need to be fast and agile. ' (C2) 'We said: we have to do something, we have to do it quickly, we have to be able to do it agile. ' (C2) 'The pace [of our system] is too high that [Banks] can only follow with the basic system, not to mention that you could somehow load new services onto it. ' (C6)
	Evidence	Strong	Strong	Strong
Orchestrator characteristics	Characteristic Quote/Argument	Flexibility 'But you also talk to very different partners that you manage. And, so, you have to somehow try to reconcile more demands and more strategies and the self-motivation of the customers. ' (A1) 'You have to be very	Flexibility 'I don't know, take a car company; you don't make [Car Company] change their internal procedure no matter what you bring, it just doesn't happen. And so, as a start-up, I think you need to be flexible enough to say: Okay, we can't fit	Flexibility 'And afterwards we started and looked at what we had to do with the system to make adjustments [for the partners]. And then we conceptualize and realize it. ' (C2) 'Now, you have to imagine you have about six banking

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Table 3 (continued)

		flexible about this. That's why flexibility is so important, so that your solution can fit into many different configurations just by the way it's built. ' (A2) 'And many large corporations are still not in a position to implement agility cleanly. [...] That's why I believe that the development methods, the "agility" mindset, is really an essential building block. And younger companies bring it along more than established, conservative companies. ' (A2)	ourselves into this structure and we accept them. ' (B1) '[...] the car companies don't exactly know in the end what they need, so we have to be very agile in realizing it. ' (B1) 'For corporations, our product would be too risky. As a start-up, you are much more courageous, you have this start-up mentality, like agility and flexibility. ' (B3) '[...] we have been able to adapt [ourselves] very, very much and very quickly. ' (B3)	systems. Those were all legacy systems. That wasn't standard. You had six banking systems hooked up to the [Contactless Payment] system. ' (C5)
	Evidence	Strong	Strong	Strong
		Insured Factoring Classification/ Supporting Quotes	Intelligent Insurance Classification/ Supporting Quotes	Simple Relocation Classification/ Supporting Quotes
Structure	Characteristic Quote/Argument	Extending partnerships 'We work with locally rooted actors, and if we want to go into new geographical markets, we need homegrown players. ' (D1) 'Since the ecosystem is expanding and there are a number of positions and links, the activities are also numerous. ' (D1) 'We're all bankers. This is about money. Short-term growth, growth, growth. Money after that. ' (D1) 'The most important thing for us is that the start-up must be successful, [it] must grow. ' (D3)	Extending partnerships 'We actually started without a partner in the ecosystem. ' (E1) 'We are in contact with the very important partners almost every day. [...] Maybe not daily, but certainly weekly. ' (E1) 'In the beginning, the Reinsurers didn't play along at all, [...] maybe we talked to ten [Reinsurers] [...] [Later] I feel now with two, three, they take me seriously and they want to participate. And then you actually generate the [Reinsurers] as primary partners in your value system. ' (E1) 'Whatever we did, we built an external stakeholder system. ' (E1) These quotations show that the ecosystem has expanded permanently.	Extending partnerships '[...] mostly we approached them [complementor] [to integrate new partners]. ' (F1) '[...] we've been able to add so many partners that if one falls away it doesn't hurt so much, or if we don't find a replacement it doesn't matter. ' (F1) '[...] the first five years of our company history will probably only be about growth. ' (F3) '[...] if a channel works well and we get a lot of leads, we want to keep it in the long run and keep expanding it. ' (F6) 'Yeah, well, they [Relocator] grew pretty fast and fast in the beginning. ' (F6)
	Evidence	Strong	Strong	Strong
Structure	Characteristic Quote/Argument	Multiple handovers among actors 'Not everyone [is linked] with everyone, but everyone [is linked] with different actors. ' (D1) 'They [Orchestrator] have two models: The first model is that they [Orchestrator] go directly to the customer or indirectly via the bank [which acts as a complementor as well], or they go further. Both models have their advantages and disadvantages. ' (D3) → The indirect way	Multiple handovers among actors 'And [Data Analyst] makes this Software as a Service available to the insurance company. The insurance company makes a so-called pass through [of customer data]. ' (E1) 'Bigger insurance companies, they want to control everything themselves. Even in larger insurance cases the [health score] is run by their own computer centre. Then this is no longer Software as a Service. For smaller	Multiple handovers among actors 'But that's not the case, so a lot of it has always been through us, through [Simple Relocation] [...] With [Simple Relocation] it's a fact that a lot of things still happen personally via the call centre, actually. ' (F2) 'He [the customer] chooses the appropriate company through us, so he almost places the order through us, but we actually act in that sense as intermediaries, legally speaking. ' (F3)

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Table 3 (continued)

		shows that more actors are involved than necessary, which demands more handovers among actors. <i>'But somehow they [banks and insurance companies] have never managed to align their processes with each other. And, at the same time, the benefit for the customer is that this is exactly what [FinTech] does.'</i> (D3) → FinTech coordinates the partners, which requires establishing links between the partners themselves directly, but also with FinTech.	insurance [companies] or insurance [companies] that want to concentrate more on my daily business, there's software as a service.' (E1) → This shows that the position in the flow of activities is designed and used differently. E1 explained the relationships between the various partners (insurance company, client, reinsurance company, public health organisation, and reward partner) and how they benefited from the mutual exchange of data via the platform. E1 summed up his remarks: <i>'To sum up, [Data Analyst] floats in an ecosystem where several star systems move around the sun [Data Analyst].'</i> (E1)	<i>'We just get the customer back into the touchpoint [for the complementors] at the right time.'</i> (F3) → The customer reaches the complementary gate via the orchestrator. Thus, more actors are involved than is actually necessary. <i>'Yes, there are slightly different partners, but it is actually already so that the main partners, they are very close, so they work very closely with [Relocator].'</i> (F2) <i>'A central point of the whole is that we have [Simple Relocation] Captains, our client advisors, who independently guide the client through the whole process, and help with difficulties, which is, of course, an advantage over dealing only with the company, and if you have difficulties, of course, you'd have no one to help you.'</i> (F3) → Orchestrator coordinates with complementors; this results in multiple links between actors as they all pass through the orchestrator. Strong
Activities	Evidence Characteristic Quote/Argument	Strong <i>Specific activities</i> <i>'[...] because every one of them [complementors] is a specialist: The insurance company can insure, the broker can find customers, the funding partner can give money.'</i> (D1) <i>'At the end of the day, we all want to provide a service for SMEs together. And then all the people who are actually specialists in their field come together.'</i> (D1) <i>'The strength of them is that they extremely minimize the effort at the bank, that they have to do almost nothing. And the same with the insurance company: They do almost nothing and can actually earn a little bit more and somehow, I'm exaggerating somewhat, they [only] have to make a few clicks.'</i> (D3) <i>'The advantage is that they already know the process</i>	Strong <i>Specific activities</i> <i>'They [risk models] can be both. They can be standard models or they can be optional models.'</i> (E1) → Standard products with minor adjustments. <i>'So, in our business, thank God, you have more than one potential partner. [...]</i> <i>In our ecosystem, it's built so that everyone is replaceable. And I would say, the bigger you [as the orchestrator] become, the less important the different participants become as single values in this ecosystem.'</i> (E1) <i>'And we focus on our core business. You know the statement from Peter Drucker: Shoemaker, keep on making shoes.'</i> (E1)	<i>Specific activities</i> <i>'A bit of their expertise, our expertise. For example, an interior designer writes an article about interior design, and then that the customer has something and then there is more traffic [thanks to our SEO].'</i> (F1) <i>'We just really try to optimize the partner ourselves.'</i> (F1) <i>'[...] if you do it directly through us, then you profit from special offers, whether it's cheaper to buy furniture at [Furniture store] [...].'</i> (F2) <i>'But also relatively many additional services, in the sense of furniture vouchers, re-registrations, Internet service discounts, other discounts, cutters, boxes, rental boxes, rental cars – simply everything that affects the topic of moving in any form, we want to offer on our site. [...].'</i> (continued on next page)

Table 3 (continued)

		exactly, know where the strengths and weaknesses are, and how to address them. [...] They know the business and the processes much better than I do.' (D3)		There are relatively many such possibilities.' (F3)
	Evidence	Strong	Strong	Strong
Activities	Characteristic	Pre-defined fixed organisation structure	Pre-defined fixed organisation structure	Pre-defined fixed organisation structure
	Quote/Argument	'[...] the most valuable work of the setup, before there was the last comma setting in the contracts, we actually did it alone.' (D1) 'And contracts are also very important for us [...]' (D1) → Requires that tasks are defined in advance. 'These are core elements where [FinTech] is very good at what it does and has set certain standards. A bank does not have that.' (D3)	'First of all, these are long-term contracts for all of the ecosystem partners involved.' (E1) '[...] I would say that we have chosen a clear structure from the beginning.' (E1) 'This [ecosystem] is a contract-based agreement.' (E1) 'We have something like a turnkey-ready ecosystem. Everything is based on a contract and new partners just sign this contract with us and everything is defined in it.' (E1) 'I would say that we have more specific contracts with service providers throughout [Country].' (E3) → In order to create specific contracts, the activities must be known before.	'[Simple Relocation] was organised in such a way that there is one in the marketing area, [...]. Leads to [Simple Relocation] and had its own compensation model. [...] The other stream was not made by marketing, but by business development. That was to generate an additional source of income. [...] And then the third stream is actually the core stream of the business actually, are commissions from removal and cleaning companies. That is perhaps the main source of income and the other was lead income.' (F2) 'They [complementors] get guidelines from us on how we would like them to work.' (F3) '[...] what we demand from them is, of course, a standardization of their processes or their customer experience according to our ideas.' (F3) '[...] we set a quality standard that must be maintained. If not, then we do not work together with the companies.' (F4)
	Evidence	Strong	Strong	Strong
Ecosystem orchestration	Characteristic	Single orchestration	Single orchestration	Single orchestration
	Quote/Argument	'[...] we do the administrative tasks and orchestrate the whole thing.' (D1) 'Well, we actually built the entire ecosystem.' (D1) '[...] but not right now in my ecosystem!' (D2) 'For us, it [the orchestrator] must clearly be the [FinTech]. We can support them in that, but in the driver's seat it has to be [FinTech]. And I say we strap them into the seat.' (D3)	'We have something like a turnkey-ready ecosystem. Everything is based on a contract and new partners just sign this contract with us and everything is defined in it.' (E1) → The single orchestrator sets the rules of participation.	'A central point of the whole is that we have [Simple Relocation] Captains, our client advisors, who independently guide the client through the whole process [...]' (F3) '[Simple Relocation] as a platform is the more natural player as orchestrator.' (F5)
	Evidence	Strong	Strong	Strong
Orchestrator characteristics	Characteristic	Fast development	Fast development	Fast development
	Quote/Argument	'Because you need a strong core somewhere. And even if you want to expand the ecosystem around it with	'What we can do better? Move much, much faster.' (E1) 'The insurance company,	'They [Relocator] essentially helped us get to a point more quickly because our own systems

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Table 3 (continued)

		other value props, the core has to grow very fast. That can never be neglected.' (D3) 'They [FinTech] are faster.' (D3)	they're sluggish, slow, and so on. And we are trying to be super-fast, super agile, so we do everything as rapid prototyping and wire frames. This also means we can actually generate a product within four weeks or in a two-week sprint, and that would take a classic insurance company three to five years.' (E1)	were simply not capable of doing this themselves, at least not quickly.' (F5) 'But already for [Relocator], they did it somehow, they quickly expanded their business with partners.' (F6) 'And in comparison, to the others, we were able to implement many things much faster.' (F6)
	Evidence	Moderate	Strong	Strong
Orchestrator characteristics	Characteristic Quote/Argument	<i>Flexibility</i> 'With some [partners] it goes moderately and we just try to complement them, that's the part where we say we need to become more flexible.' (D1) 'As an orchestrator, you need to adapt to your partners. If one of these big companies orchestrated the ecosystem, they would not be able to adapt to other big corporations. [...] We do not have structures, so we can adapt to everyone.' (D1) 'I'm not saying that this is just a start-up. But show me the big corporation that can really work flexibly [like a start-up such as FinTech].' (D3) 'In a corporation you have, of course, the employment law, maximum working hours, certain times when you are allowed to work, when you are not allowed to work. Sure, actually this would also apply to the start-up, but per se you can't stick to it.' (D3) → Start-ups like FinTech need to remain flexible to survive.	<i>Flexibility</i> 'We work day and night.' (E1) 'The insurance, what you were talking about before, they're sluggish, slow, and so on. And we are trying to be super-fast, super agile [...]'. (E1) 'We are simply more mobile, agile. These aren't just buzzwords; it is actually like this.' (E1)	<i>Flexibility</i> 'And at the beginning of a new partnership, you are very much in touch, always looking to see what kind of offer we can make [...]'. (F1) 'And that will probably be one of the biggest distinguishing features of our company: that we really have a neutral contact point that tries to find a solution for both parties.' (F3) 'I would say that this is my perception, even if it might take a meta-look at us [Insurance company], it is what happens in front of us. The reasons include a lack of flexibility, lack of speed when you do it yourself, and how you are perceived.' (F5) → Employee of incumbent recognizes that his company is too big to be flexible enough. Therefore, they used the start-up as the orchestrator. 'This is the case when we acquire a completely new partner: as a rule, we always start with a pilot phase, whereby we set the requirement that this must last at least 6 months. Because what we want, and the advantage of a start-up is, that you can be very flexible and agile.' (F6)
	Evidence	Strong	Strong	Strong
		Autonomous Delivery Classification/ Supporting Quotes	Digital Prescription Classification/ Supporting Quotes	Autonomous Busses Classification/ Supporting Quotes
Structure	Characteristic Quote/Argument	<i>Restriction of actors</i> 'You have to optimize the whole logistics chain from the station to the warehouse or hospital and how can we do that? And for us, it's very, very interesting to learn how we can optimize these logistics	<i>Restriction of actors</i> 'The problem is always if there are too many players, it gets complicated and you can't agree on anything.' (H1) 'There are intermediaries we can take out.' (Statement during	<i>Extending partnerships</i> Next to the five co-orchestrators, the consortium integrated additional partners for each specific value proposition: 'We've picked up more

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		processes before or after the drone flights, precisely because these are their competencies.' (G2) → No new actors or positions are engaged, compared to standard processes, and existing processes (and thus positions) are optimized by the drones. [Drone Technology Provider] replaces the taxi service the hospital used before. The fact that an accelerator was only used temporarily, and that a cargo company withdrew from the ecosystem, shows that the ecosystem consisted of only a few partners – only those necessary for the minimum viable product.	workshop) A current analogue system is digitized in this ecosystem: the drug prescription. Thus, similar to [Contactless Payment] and [Autonomous Delivery], the drug prescription is based on an existing structure and does not require more actors. The [Technology Provider] can be seen as an additional partner, but only replaces the physician's paper and pen supplier.	partners [for the respective ecosystems]. ' (I1)
	Evidence	Strong	Strong	Strong
Structure	Characteristic	Single handovers between actors	Single handovers between actors	Multiple handovers among actors
	Quote/Argument	'And from [the point of view of] the partners, we [from the Logistics Company] have political and legal points of view, the partner is [Governmental Authority]. From a technology point of view, we have the partnership with [Drone Technology Provider].' (G1) 'And I don't think the [Governmental Authority] and [the] hospitals have [exchanged a lot]. But [Drone Technology Provider] [has exchanged] with [Governmental Authority] and [Logistics Company] and the hospital [have exchanged] with [Drone Technology Provider].' (G2) → Not all partners were interwoven with each other.	'When I want to do a peer-to-peer transaction, I always need parties. That's one thing. And on the other hand, (...) it's like a digital transformation driven by a new technology. Without the blockchain, I could not build such a decentralized system. Well, I wouldn't be able to build a peer-to-peer system without a trustworthy middleman.' (H1) → The blockchain technology used in the ecosystem makes it possible to enable the handovers between actors on bilateral exchange with a minimum number of handovers, even if information comes from a third party.	'[...] we nominated a project manager really quickly, and this person really managed the whole project and especially interlinked the partners [...].' (I1) 'There, all partners are affected, involved [...].' (I3) The technology of autonomous driving busses [Bus Manufacturer] and the software for the fleet [Fleet Management Programmer] were supervised during the testing period by [Public Transportation Provider], who additionally had to staff a security person within the busses that were driving in [City] providing the playground. This shows the interwovenness of the actors (Summarized form secondary source).
	Evidence	Strong	Moderate	Strong
Activities	Characteristic	Broad activities	Broad activities	Broad activities
	Quote/Argument	'[Logistics company] also brings the brand, so I also mean a bit of security and [Logistics company] also simplifies the regulation. This means that [Drone Technology Provider] and [Governmental Authority] would never have the same power as [Logistics company] if [Drone	Only the [Technology Provider] co-orchestrator has to take on additional tasks to motivate the partners to cooperate and convince them that the system generates added value. This coaching extends far beyond its core business, which is technology.	'And the [University 1], this was also regarding big data, data analytics are the core topics. [...] Engineering is the really strong core competency of [University 1]. [University 1] also brings in an interesting start-up ecosystem.' (I1) 'Partially, we [public

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		Technology Provider] had gone to [Governmental Authority]. And that is very important, too. [Logistics company] also simplifies and accelerates processes.' (G2)		transportation company] took over the translator role [...]. Simply not only translating the language, but the mentality.' (I1) 'That is logistics, mobility. This is the most important thing for [autonomous driving]. But also, communication skills. Physically and digitally. And financial services with [subsidiary] is part of it. Our companies. So, very broad competences, these four fields. What we bring to the table.' (I1) → This example shows that single actors contributed not only broad, but also different (and with it various) activities.
	Evidence	Strong	Moderate	Strong
Activities	Characteristic Quote/Argument	Flexible activities 'Well, the first stage of the project was to test the technology in [Country]. So, the first flights were tested [...] we were the three partners together. [...] we tested the technology and it worked well and we really did test flights and so on. After that the next stage [...] was really the concrete use case to discuss [...] So, there are thoughts that someone introduced to us and there are thoughts that you never expected and then there are inquiries that come, you never expected them.' (G1) 'Yeah, not everything was predictable.' (G1) '[...] I'm sure a lot of it [the development of the value proposition] was flexible and opportunistic. Naturally, with any new company or technology it would have to be.' (G5)	Flexible activities 'That's why you look at the ecosystem at the beginning, take it up as it exists today. And you see if you can build it more efficiently through different iterations.' (H1)	Flexible activities 'No, we first mentioned the vessel, the environment, the test environment. Then the project.' (I1) 'No one knew in which direction it [the ecosystem] went. Kind of a value proposition existed but we did not see it clearly.' (I2) 'You are flexible [relating your activities]. There's a framework agreement, but it's very rough.' (I2) 'Because there is the framework agreement, which is written very openly actually.' (I2) 'The contract says what we are not, but not what we are.' (I3) 'In the contract you already write in such a way that you somehow come together in a partnership approach and think about the future of mobility and want to test something.' (I3) 'In the beginning you signed and didn't know what you were going to do, it was unclear.' (I3)
	Evidence	Strong	Strong	Strong
Ecosystem orchestration	Characteristic Quote/Argument	Multiple orchestrators 'And the project with [Drone Technology Provider] was actually started with [Cargo Company] as another partner, so we were co-partners.' (G1) '[...] each one of these players brings something to the table. The delivery of the solution is very	Multiple orchestrators 'As the initiator, what I'm currently trying to do doesn't work with [Technology Provider] alone, of course.' (H1) 'We are looking for an active partnership. We have now in the first phase of validation of the use cases, both [co-orchestrators] have	Multiple orchestrators 'But we knew that alone we could not manage to further develop our vision.' (I1) 'Everyone [of the co-orchestrators] has an employee detached for the coordination of the ecosystem. But as we are the primus inter pares among the initial partners,

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		undefined [at the beginning]. In many ways [Drone Technology Provider] is very opportunistic and malleable, and being able to find good partners that can inform findings, and feedback that can optimize the maximization and delivery of that solution was very key. I would say it was very much collaborative, especially in those networks.' (G3) 'I think [Drone Technology Provider] is a really good example of one that has had to think broadly about not just a technological or a product innovation but, more importantly, how do you orchestrate of maximise the alignment between all these inter-dependant stakeholders? I think [Drone Technology Provider] is definitely a really great example of a company that, out of necessity, had to do that versus just develop a really good product.' (G3)	provided resources.' (H2) 'We're having a discussion right now where we're actually discussing an ecosystem. Let me say: The decisive point is to reach the critical mass of partners [...] you have to formulate a vision together, from which this win-win-win can be derived.' (Statement during workshop)	[...].'(I1) 'So, there is no hierarchy, all coordinators are equal, there is not one boss.' (I1) 'Each of us has the same voting power. So it really means that there is no different weight, for example that our vote is two times the value of the vote of another partner.' (I1) 'I have zero power over the [other] partners.' (I3)
Orchestrator characteristics	Evidence Characteristic Quote/Argument	Strong Provision of funds '[We] make strategic investments, but with a minority stake.' (G2) 'I think the ecosystem project you're looking at is very much the investment piece that we have developed [...].'(G3)	Strong Provision of funds 'There is no ecosystem functioning where you do not invest initially. Many companies also make the mistake of investing in technology or in products or services, but you need to have just as much money again to keep that ecosystem alive.' (H1) 'In general, it is not a world for a lean-Start-up, because it needs a huge investment, because it needs to build the whole infrastructure, it needs political support, it needs all the things that a small start-up normally does not have from the beginning.' (H2)	Strong Provision of funds 'We also bring project financing opportunity. Typically, if a project is ratified, then the question is how do we finance it. We have this innovation fund, for example, and there are other channels.' (I1) 'But sponsors were the Canton and the city, but actually [Public Transportation Provider] provided most of the funds.' (I2) 'These people have no authority to decide on financial resources for projects for the mobility lab, but each of these partners has money pots and there are third-party money pots.' (I3) → The project did not have funds by itself, but the co-orchestrator had funds to invest in the ecosystem initiative.
Orchestrator characteristics	Evidence Characteristic Quote/Argument	Strong Provision of resources '[Drone Technology Provider], of course, has two people on site who monitor the whole thing all the time and that's why the greatest effort is made by	Strong Provision of resources 'There is one who simply provides the infrastructure. And we see ourselves through our market position.' (H1) 'We are looking for an	Strong Provision of resources 'What we bring with us is infrastructure. [...] Infrastructure is an asset.' (I1) '[City] surely brings that to Playground for (continued on next page)

Table 3 (continued)

		<i>[Drone Technology Provider] in terms of quantity.'</i> (G1) <i>'Basically, there must always be a part of us in it. And [a] very strong [one], you know. It must always be [of] all, but some of our resources must always be behind it [the ecosystem].'</i> (G2) When the Cargo company was still part of the ecosystem, the Logistics company was able to use its infrastructure (aircrafts).	<i>active partnership. We have now in the first phase of validation of the use cases, both [co-orchestrators] have provided resources.'</i> (H2) <i>'You [Technology Provider] practically need an ecosystem in which the business players, who don't have the technology or the infrastructure, invite you to supply them.'</i> (Statement during workshop)	<i>autonomous driving.'</i> (I1) <i>'All partners are involved with resources and qualified people.'</i> (I1) <i>'I think that's a set of resources [all partners bring in].'</i> (I2)
Orchestrator characteristics	Evidence	Strong	Strong	Strong
	Characteristic	<i>Reputation</i>	<i>Reputation</i>	<i>Reputation</i>
	Quote/Argument	<i>'And a very important point, for example, the hospital director in [City of Hospital] once told me that he would never have gotten involved in such a project if there hadn't been a company with a good name behind it.'</i> (G1) <i>'[Logistics company] also brings the brand [...]. And this is very important, too. [Logistics company] also simplifies and accelerates processes.'</i> (G2)	<i>'We also have a reputation in the field [of telecommunications], we also make sure that communication between people is trustworthy. And [Technology Provider] has already done a lot in digitizing other areas, such as banking and so on.'</i> (H2) <i>'Because you [Technology Provider] can provide an infrastructure throughout [Country] that enables data exchange between several players? I mean, there is simply no doubt about that.'</i> (Statement during workshop)	<i>'[University 1] is really a brand. We also have [sponsored] a chair at [University 1]. Such chairs, you know, cost a lot. They are brands, they [employees of the University] are top sellers.'</i> (I1) <i>'They [University 1] also bring in reputation, this is also important since this is what we lack here.'</i> (I1)
	Evidence	Strong	Strong	Moderate
		Smart Commuting Classification/ Supporting Quotes		
Structure	Characteristic	<i>Extension of actors</i>		
	Quote/Argument	<i>'We are in talks with further partners.'</i> (J1) <i>'Well, they are extremely well connected and, of course, have access to other potential partners, such as a telecommunications provider who will certainly need to build people in the retail sector around smart retail cases, and so on.'</i> (J1) <i>'We have also made one or two attempts to get more partners on the platform, to bring them into the ecosystem. [We] are already trying to extend the offer.'</i> (J1)		
	Evidence	Strong		
Structure	Characteristic	<i>Multiple handovers among actors</i>		
	Quote/Argument	<i>'And that's why our idea is to combine the core competencies of different companies on this mobility</i>		

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		customer journey and offer the customer a complete service from a single source, which ultimately also represents the value proposition of the ecosystem.' (J1) → To offer such a value proposition, the partners need to collaborate closely in order to provide a seamless mobility customer journey between the different mobility providers. 'The colleagues from the [Software Company] are [co-]orchestrators, because it actually needs an IT partner who builds a cloud in the general sense in order to connect the individual services.' (J1) → All actors need an extra channel to [Software Company]. Strong
Activities	Evidence	
	Characteristic	Broad activities
	Quote/Argument	'Well, the [Consulting Firm] is extremely well networked and of course has access to further potential partners [...]. It has to be said, however, that the criteria for the selection of all partners were actually the network itself, in addition to the competencies in the relevant areas.' (J1) 'They [Consulting Firm] had no specific product or ability to bring in. They took over a multitude of tasks, whatever was needed. Doing project management, developing the governance model, and so on.' (J1) 'The [Software Company] has a strong network on the other hand because they're already represented in all the communities and so on.' (J1) → In addition to the special competences, the network of the partners is also relevant. Strong
Activities	Evidence	
	Characteristic	Flexible activities
	Quote/Argument	'But as I said: not yet fully defined. This is simply the current state of definition.' (J1) 'That means we are currently planning a larger project in a city in [Country] where we are

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		dealing with Smart Mobility and, in the medium term, also with Smart City topics, where the Smart Mobility field is actually part of it.' (J1) 'At the beginning, they worked for free for the ecosystem and showed us how important they are. But later, they wanted to be paid for their man-hours. So, in order to define the contract, we had to calculate our contributions as well. And this was excessively difficult, since we contributed technologies and knowledge, for example. How could we quantify this? As a result, we got stuck in these negotiations.' (J1) 'As I said, the concrete cooperation contracts between the orchestrators have not even been signed yet, which is an extremely complex set of contracts.' (J1) → Because not all of the activities could be defined, contracts could not be signed.
	Evidence	Strong
Ecosystem orchestration	Characteristic	Multiple orchestrators
	Quote/Argument	'We are only now so far that we have actually consolidated the cooperation in this multi-orchestrator approach. There is [Software company] in there, there is [Consulting Firm] in there.' (J1) 'The third orchestrator is [Consulting Firm], which serves as a neutral brand towards future partners in the ecosystem, especially the city administrations we want to involve.' (J1) 'If you steer an ecosystem jointly with two other orchestrators, [...]'. (J1)
	Evidence	Strong
Orchestrator characteristics	Characteristic	Provision of funds
	Quote/Argument	The ecosystem founders need to invest in the smart city, as the potential customers don't want to do that: 'And so we also wanted to simplify this purchasing process very considerably for the cities by offering everything from a single source with a compatibility guarantee, and also to take away the investment fears for the

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		cities, because the cities are investing in infrastructure that will be in use for 20–40 years.’ (J1) Strong
Orchestrator characteristics	Evidence	
	Characteristic Quote/Argument	<i>Provision of resources</i> ‘[...] because we can’t do this on our own at the moment. But that’s also one reason why the [Consulting firm] is there.’ (J1) We used probing to get detailed information from J1. He answered: ‘This is a resource question. Absolutely.’ J1 stated that they were depending on the infrastructure of a co-orchestrator: ‘We would not have had the manpower to orchestrate this ecosystem. They [Consulting Firm] had around ten people working for this project, and we do not have that kind of budget.’ Strong
Orchestrator characteristics	Evidence	
	Characteristic Quote/Argument	<i>Reputation</i> ‘We need them [Consulting Firm] as a brand name for future partners since it would not be credible if we, as a leading car manufacturer with the image we have, did this by ourselves.’ (J1) ‘The third orchestrator is [Consulting firm], which serves as a neutral brand towards future partners in the ecosystem, especially the city administrations we want to involve.’ (J1) Strong
	Evidence	Strong

3.1. Case selection

We used a theoretical case sampling (Eisenhardt, 1989; Yin, 2018) based on several criteria. First, and most obviously, the cases selected needed to represent the literature’s view of an ecosystem. Given the novelty of the concept, there are still different views on the ecosystem construct, which creates some confusion about what is or is not labelled an ecosystem (Adner, 2017; Jacobides et al., 2018; Oh et al., 2016; Ritala and Almpantopoulou, 2017). Another issue with many existing concepts about ecosystems is that it is often difficult to decide whether a certain company is a part of the ecosystem or not. For this reason, we apply Adner’s (2017) structural stream as it is ‘more clearly distinguishable from other available strategy constructs’ (Adner, 2017, p. 40; see also Autio and Thomas, 2019; Ganco et al., 2020; Jacobides et al., 2018; Kapoor, 2018; Shipilov and Gawer, 2019). On the other hand, it does not rule out related research streams on ecosystems, which ensures a greater impact of the resulting findings (Adner, 2017). On top of this, recent and essential works on ecosystems (e.g. Ganco et al., 2020; Jacobides et al., 2018; Masucci et al., 2020) build upon this, which demonstrates the relevance and usability of this foundation. Thus, all of our ecosystem cases, and all of the companies within these ecosystems, needed to fulfil the following criteria derived from Adner (2017) and supplemented and reinforced by Jacobides et al. (2018, see also Autio and Thomas, 2019; Kapoor, 2018; Shipilov and Gawer, 2019). In the case descriptions, as well as in the findings section, we describe the ecosystems studied in detail and show how they match these criteria:

1. All of the ecosystems studied focus on a fully developed and clearly describable value proposition for the ecosystems’ customers (e.g. a product or service).

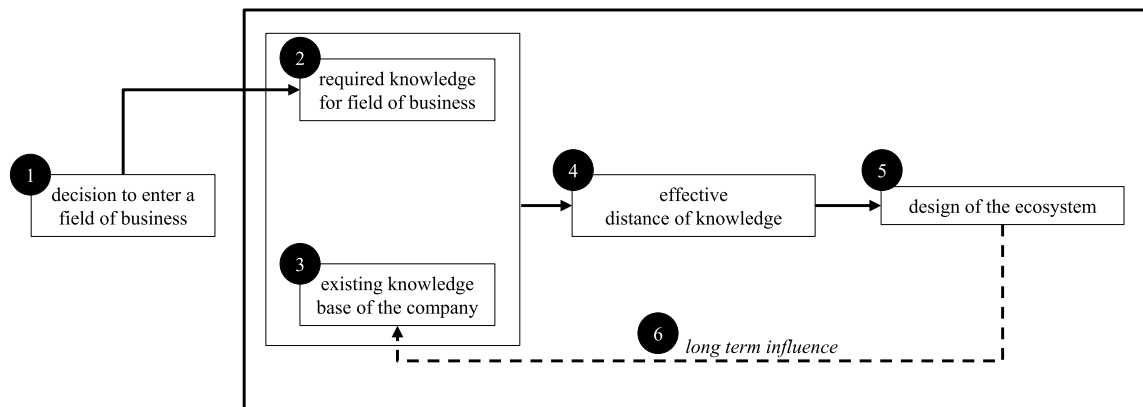


Fig. 2. Framework regarding the effective distance of knowledge.

2. The modules provided to the joint value proposition by the ecosystem partners can be characterised by non-generic complementarities (i.e. unique or supermodularity complementarity).
3. We only used cases that exhibit multilateral links among the partners. This means that there is a critical interaction across the relationships between partners, i.e. they cannot be fully broken down into independent bilateral relations.

Based on these criteria, we were able to decide whether companies can be viewed as being part of an ecosystem: Companies must be engaged in multilateral relationships with the other partners, are being aligned towards the value proposition by the orchestrator, have a clearly defined position and role in this regard, and provide non-generic/complementary modules to the value proposition.

As an additional criterion for the case selection, we selected ecosystems ‘with an understanding of where there was likely to be variation and where there was not’ (Eisenhardt and Ott, 2017, p. 86). For instance, the cases varied by the orchestrator’s background and company size. Additionally, the orchestrators of the ecosystems studied are established firms, spin-offs/joint ventures, and start-ups. All value propositions can be assigned to the same sector, digital services. This approach to comparing cases from different industries by the formation of a common cluster has been used before (e.g. Chatman and Jehn, 1994; de Wulf et al., 2001; Frankengerger and Sauer, 2019; Schoenecker and Cooper, 1998). In addition, prior research on ecosystems has also used such sampling strategies in order to obtain a more comprehensive view, whilst still making sure the findings are not distorted by cross-industry differences (e.g. Davis, 2016; Mäkinen and Dedehayir, 2013; Rong et al., 2015b).

The case selection was not entirely a straightforward process. Rather, it can be described as an iterative approach with constant adjustments between case selection, data collection, and data analysis. We started with an initial set of 20 short cases and, based on our sampling criteria, selected around five of them as an initial sample. After the first rounds of interviews and data analysis, we began searching for additional cases to extend and enrich our original sample, as well as to yield a better understanding of the emergent theory (Eisenhardt, 1989). Consequently, we added further cases but also excluded those cases from our sample that turned out to not ideally match our criteria until we reached a state where additional cases did not significantly enrich the understanding of the context anymore (Eisenhardt, 1989). Our final sample of cases is shown in Table 1.

3.2. Case description

To increase the reliability of the case study, the organisations’ actual names should be used (Gibbert et al., 2008; Yin, 2018). However, in our study, this was not possible because not all informants agreed to publish their company’s name or the name of the ecosystem. We are aware that this methodological constraint is not unusual in qualitative research (c.f. Dattée et al., 2018; Frankengerger and Sauer, 2019; Hannah and Eisenhardt, 2018; Velu and Stiles, 2013). By highlighting the methodological audit trail and providing in depth information on our collection and analysis processes, we aim to maintain trustworthy qualitative research (Pratt et al., 2020).

3.2.1. Keyless access

The value proposition in this first case is a digital solution, which allows people to open doors by using a temporary smartphone code, technology that was developed by the ecosystem orchestrator. One of the use cases of this technology is keyless access to rental cars. An ecosystem-approach was necessary for the implementation of this use case given the interplay of several players involved: The car rental company had to modify its cars for the new system and provide end customers with a mobile app, and the car fleet had to be equipped with additional hardware and software provided by other ecosystem partners.

3.2.2. Virtual Mobility

The orchestrator in this case develops 3D-model maps of cities with two possible value propositions for different customers: First, the 3D model enables cities to assess whether their infrastructure is ready for autonomous, self-driving cars (e.g. if kerbstones are high

Table 4
Classification of cases.

Case	Effective distance of knowledge			Substantive uncertainty		
	Category	Argumentation	Background information/ Quotes	Category	Argumentation	Background information/ Quotes
Keyless Access	low strong evidence	The founders already worked in related field of businesses prior to starting their own company, as did the engineering team	Founder and CEO (A1) previously worked in programming for control systems and telematics infrastructure systems Head of sales (A2) worked in the mobile communications industry Firm hired engineers with extensive experience in the respective field of business	strong strong evidence	Underlying technologies were immature and it was not clear which technical standard was expected to dominate. Market-wise, acceptance of the solution by customers was totally unclear and each customer would have different requirements and likelihood of adaption. The market was also volatile with unclear development.	<i>'But from my knowledge, the framework conditions were that, first, we did not know which technical standard would be the right one. Is it Bluetooth? Is it NFC? Is it online, is it offline?'</i> (A2) <i>'And there you have to handle many trends, which change quite rapidly.'</i> (A2)
Virtual Mobility	low strong evidence	Orchestrator developed the underlying technology; Founding team with PhD related to the technology, thus, several years of experience related to field of business	<i>'[...] I think we are the ones having certainly the knowledge, or the big overview [of our field].'</i> (B1) <i>'Because they [the partners] don't have the technical capabilities [to provide the value proposition themselves, only the orchestrator has the required knowledge and skills].'</i> (B1)	strong strong evidence	The market was unpredictable since it is based on the acceptance and future developments in self-driving cars. Technologies were unclear and immature and it was not certain how and whether technological difficulties could be tackled.	<i>'I think there is a lot of volatility in that particular market for the next, let's say, five years, because no one knows exactly what's going to happen, there are still so many open questions, and I think the longer we go, the more questions pop up.'</i> (B1) <i>'At least from our psychological minds that we're in the exploring phase [...] because of the uncertainty in these fields is so high because it's such a new field.'</i> (B1) <i>'So I would say, because it's still something which is not established yet, so the uncertainty is still high [...].'</i> (B1) <i>'So, very provocatively I would say, right now it's very unpredictable.'</i> (B1)
Contactless Payment	low strong evidence	The orchestrator was formed as a result of a merger between two former companies, both of which were active in	<i>'[Acquirer] and the banks did not enjoy us so much in the past because we ruined their business. And now with the merger we actually</i>	strong strong evidence	Acceptance of the solution by the customers was unpredictable and recent trends and developments in terms of	<i>'It will show in the course of this or perhaps next year if the customer likes the idea – well, they might like it but do they really use it</i>

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Table 4 (continued)

Case	Effective distance of knowledge			Substantive uncertainty		
	Category	Argumentation	Background information/ Quotes	Category	Argumentation	Background information/ Quotes
		the digital payment systems field. The country's largest banks, the largest financial service infrastructure provider, and an international e-commerce payment provider jointly own the orchestrator.	went back to the classic model of payments. '(C2) 'For [Acquirer], [Contactless Payment] is much closer to a normal, different payment method. '(C5) '[Digital payment platform] belongs to [Country's] biggest banks, namely [Bank 1], [Bank 2], [Bank 3], [Bank 4], [Bank 5], and [Bank 6], as well as the financial services provider [Acquirer 1] and now [Acquirer 1]. '(Secondary source)		privacy policies were unpredictable. Underlying technologies are immature and no technological standards could be predicted.	regularly?' (C2) 'The technology [...], we didn't know in the beginning: keep it?' (C2) 'I am rather sceptical that this [Digital Payment Provider] is sufficient as a weapon, or rather that it is and was the right strategy. '(C3)
Insured Factoring	low strong evidence	The founders and employees have a profound knowledge and a very well- established network in the respective field of business because they had worked as higher-level executives for the leading companies in this field prior to starting their own business.	'We are all bankers. ' (D1) 'On the distribution side we had to find new partners, but there we have a broad network. '(D1) '[Fin Tech] went in here and they knew pretty much what they wanted because they were all people from the old banking sector. '(D2)	weak strong evidence	The market is predictable, stable, and can be clearly expressed in quantitative figures.	'But we know what our market is. It is very predictable but hard to penetrate. '(D1) 'The biggest problems are the regulatory conditions. And for this we found a solution. '(D1)
Intelligent Insurance	low strong evidence	The founder and members of the TMT of the orchestrator are experts in the respective field of business since they had founded several companies in this field already.	'I sold my former company to a big player in our industry and I've dealt with "quant" for many years. '(E1) 'Before [Data Analyst], we built [Data Base Company]. [Data Base Company] is the fifth largest data base manufacturer in the world. '(E1)	weak strong evidence	The insurance market is very stable and predictable.	'You know everything [about the insurance market] and you don't want to have any disturbing signals as it is an ideal business, as it is rich on cash flow. It is predictable. '(E1) 'And [the customer] can only quit the contract once a year. [...] It is ultra conservative [...]. You can also call it ultra boring. '(E1)
Simple Relocation	low strong evidence	Many potential partners exist that can be found	'So, I mean, you can estimate the market size	weak strong evidence	The expected returns can be calculated easily and	'How many people relocate? This is relatively

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Table 4 (continued)

Case	Effective distance of knowledge			Substantive uncertainty		
	Category	Argumentation	Background information/ Quotes	Category	Argumentation	Background information/ Quotes
		easily by online search. Technologies needed are simple and can be considered a commodity.	<i>well. There are statistical data from the postal company, from different real estate platforms, etc. ' (F3) 'And then I just thought about it a bit and realized that there is actually a lot of potential for digitization. And this is also an industry where very little has happened in recent years. I mean, the Internet came and then it quickly stopped. And we saw potential there. ' (F4)</i>		the market is very stable. The solution does not require specific technologies.	<i>predictable. ' (F3) 'The market is also very stable, it hasn't changed in the last ten years. ' (F3) 'But the market per se is very predictable. ' (F3)</i>
Autonomous Delivery	high strong evidence	As the orchestrator did neither have any network nor knowledge in the field of business, they had to engage an accelerator for screening. Also, the employees of the orchestrator were recruited directly from the university without previous experience and the parent firm had never worked in this field before	<i>'Exactly, as [Accelerator] acted simply as a screener or scout for us [the orchestrator]. ' (G2) 'We are running the business, just the two of us. My colleague is still studying, so she only works 50%. [...] I am quite young, I finished my master two years ago before starting here. ' (G1)</i>	strong strong evidence	Even though knowledge on technology and market existed, the orchestrator could not assess the market potential. In addition, the regulatory and technological situation regarding drones was unpredictable.	<i>'[...] in transportation, drone transportation already existed. But not in a really commercialised and generalised form. Therefore, there were always big discussions on the potential of drones in logistics and for us too. ' (G1) '[...] it was not the case [the regulator acted] by saying 'we are regulators, this is the regulation'. I had no regulation. ' (G1)</i>
Digital Prescription	high strong evidence	The orchestrator from telecommunications industry is only the technical enabler, therefore, they need the knowledge and network in health care to materialize the value proposition	<i>'It's about bringing in actors, who are actually relevant for the customer interaction and the process. ' (H1) 'Because we are actually not relevant for the process. We are an enabler to display [the system], but we are not the relevant ones for the process. ' (H1)</i>	strong strong evidence	There is no legal foundation for the use case the ecosystem is focusing on. Thus, legal uncertainty is prevalent and cannot be assessed.	<i>'Also, we are in a situation with the electronic patient record (EPR) that could not be worse. [...] EPR is a huge investment and the [Country] wrote a law that created a huge market uncertainty. No one knows in the end who will pay for these non-core services. In the worst case the cantons or the confederation will pay, but at the moment it is not clear. ' (H2) 'Engagement of (continued on next page)</i>

Table 4 (continued)

Case	Effective distance of knowledge			Substantive uncertainty		
	Category	Argumentation	Background information/ Quotes	Category	Argumentation	Background information/ Quotes
Autonomous Busses	high strong evidence	The initial orchestrator has a background in public transportation but no competencies and experience in software/ data analysis and autonomous driving.	<i>'In this new strategy, there are exciting new topics for us, like mobile ticketing, autonomous driving, sharing in general – shared mobility, car sharing, bike sharing and so on – data analytics and so on.'</i> (I1) <i>'Engineering is the really strong core competency of [University 1]. [University 1] also brings in an interesting start-up ecosystem. [...] They [University 1] also bring in reputation, this is also important since this is what we lack here.'</i> (I1)	weak moderate evidence	Underlying technologies are mature and the autonomous vehicles were supposed to drive in specific areas only. Thus, the regulatory situation could be assessed. The market was stable and easy to assess since the solutions under consideration were a mere adaption of existing products of the initial orchestrator.	<i>pharmaceutical companies is critical.'</i> (Secondary source) <i>'And we can then select fields [for ecosystem initiatives] with little risk.'</i> (I2) <i>'Because there's also the risk that you might approach a partner and maybe it is not optimal. That's also the risk; but basically I see a chance for added value here, that people know each other and start projects a bit faster.'</i> (I2) <i>'Internationally, [the Public Transportation Provider] wants to grow in clearly defined niche areas and build up additional sources of earnings.'</i> (Secondary source)
Smart Commuting	high strong evidence	The initial orchestrator is a car manufacturer without previous experience in smart city concepts.	<i>'There would have been far too much knowledge missing, and, from the network point of view, too much would probably have been missing there, too. Although it is faster to build a network. [...] you get a certain access to the right people in a certain time.'</i> (J1) <i>'And I just had a call today in the context of this project, where I wanted to tease out this knowledge with the appropriate people and they gave me the feedback: We don't know yet.'</i> (J1) <i>'As a mobility company, we did not have the necessary knowledge in the context of</i>	weak moderate evidence	There are technological forerunners for smart city solutions within the ecosystem. Market uncertainty exists, but it can be reduced by building business cases with potential customers.	<i>'And this [having technological forerunners within the ecosystem] gives us the advantage of being able to control where these technological issues take us and to react very quickly once a technology is defined.'</i> (J1) <i>'The market uncertainty is all very unclear and that is a huge challenge. So, we are trying to get a little bit of certainty in here by validating the individual business cases that we build with the potential customers.'</i> (J1)

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Table 4 (continued)

Case	Effective distance of knowledge			Substantive uncertainty		
	Category	Argumentation	Background information/ Quotes	Category	Argumentation	Background information/ Quotes
			<i>IT and smart cities. Building up this knowledge in such unrelated fields would have been almost impossible for us. Apart from us, our top management would never have accepted hiring people with these backgrounds since these profiles would not match with our company and our core competencies.</i> (J1)			

Table 5
Industry expert rating of the surrounding conditions.

Case	Effective distance of knowledge of the orchestrator(s)	Substantive uncertainty
Keyless Access	1.50 → low	3.67 → strong
Virtual Mobility	2.00 → low	4.17 → strong
Contactless Payment	1.67 → low	3.83 → strong
Insured Factoring	1.83 → low	2.00 → weak
Intelligent Insurance	2.00 → low	1.83 → weak
Simple Relocation	1.50 → low	1.33 → weak
Autonomous Delivery	4.50 → high	4.50 → strong
Digital Prescription	4.17 → high	4.67 → strong
Autonomous Busses	4.17 → high	2.25 → weak
Smart Commuting	4.17 → high	2.33 → weak

Values are the mean of the rating of three independent industry experts.

Scale: 1–5; Range 1–2.9 regarded as low/weak; 3–5 regarded as high/strong.

enough to be recognizable to such vehicles). Second, car manufacturers have the opportunity to use the model for digital test cycles of autonomous cars. An ecosystem-approach is necessary to create such maps since an intense co-specialisation of software and hardware providers is necessary, and authorities need to facilitate the creation of 3D models of the cities involved.

3.2.3. Contactless Payment

The value proposition of the digital payment provider is a payment transaction scheme for mobile phones with lower transaction fees than those of credit cards. To deliver the value proposition, an ecosystem was necessary: Retailers must adapt their cash register software for the new payment method and install Bluetooth beacons on their cash desks. The payment scheme needs to be integrated into existing systems of financial services providers and banks. Finally, end customers need to install an app and link it to their bank accounts, which requires the collaboration of the banks.

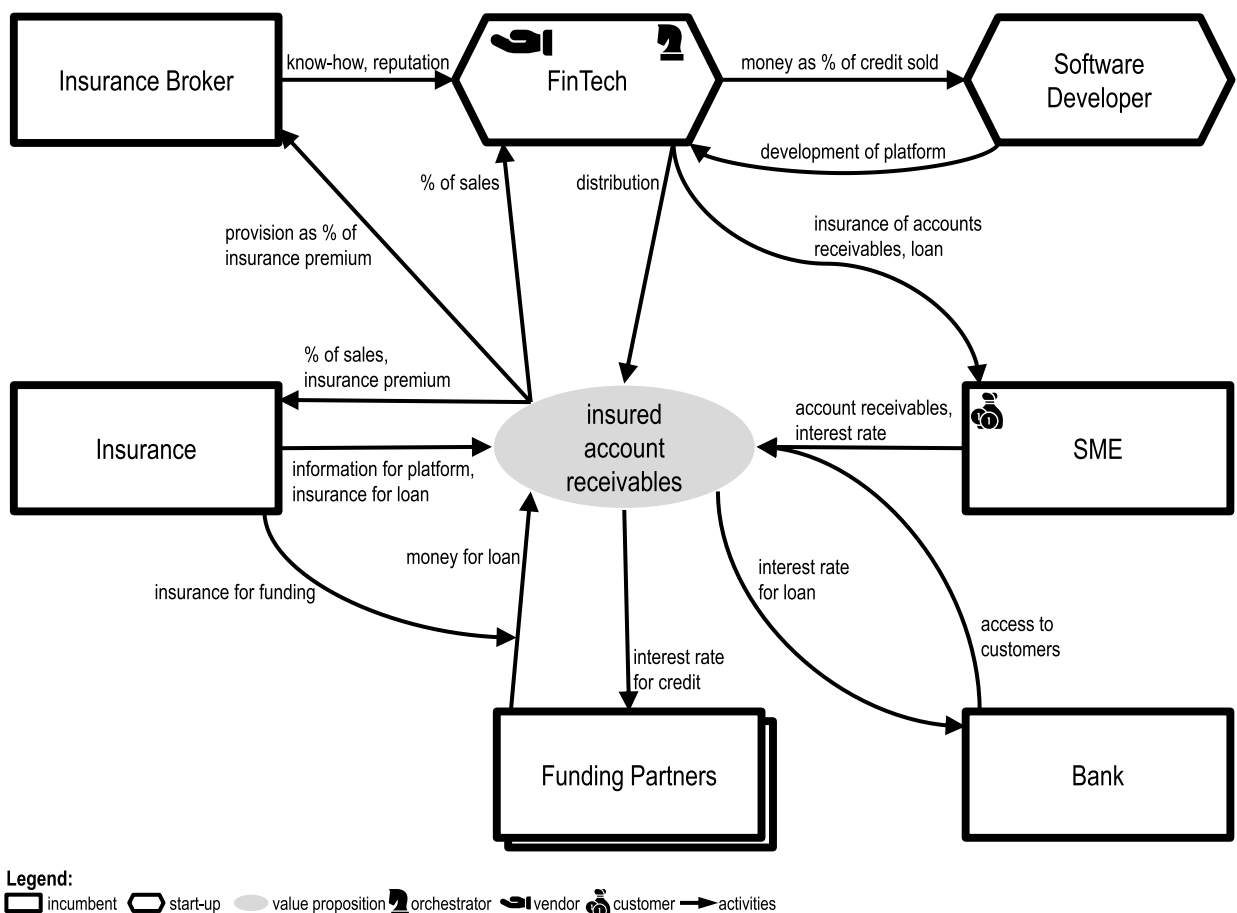


Fig. 3. Sketch case Insured Factoring.

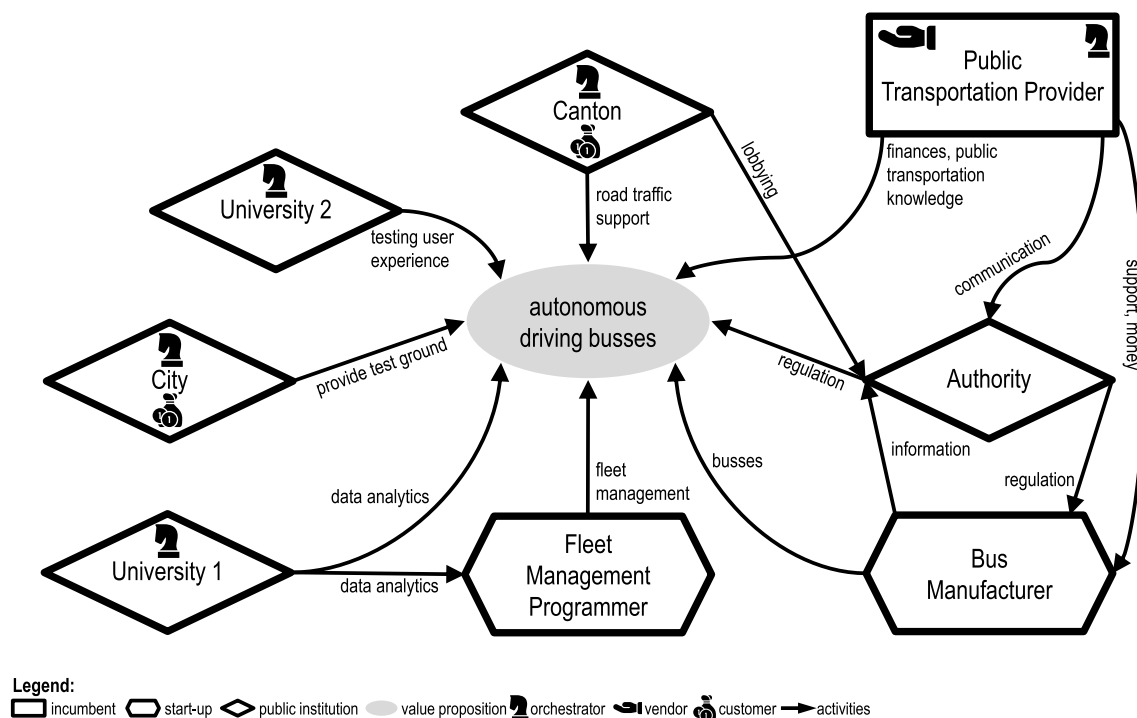


Fig. 4. Sketch case Autonomous Buses.

3.2.4. Insured Factoring

The value proposition allows SMEs to insure account receivables against non-payment and, thereby, use their subsidiary ledgers as

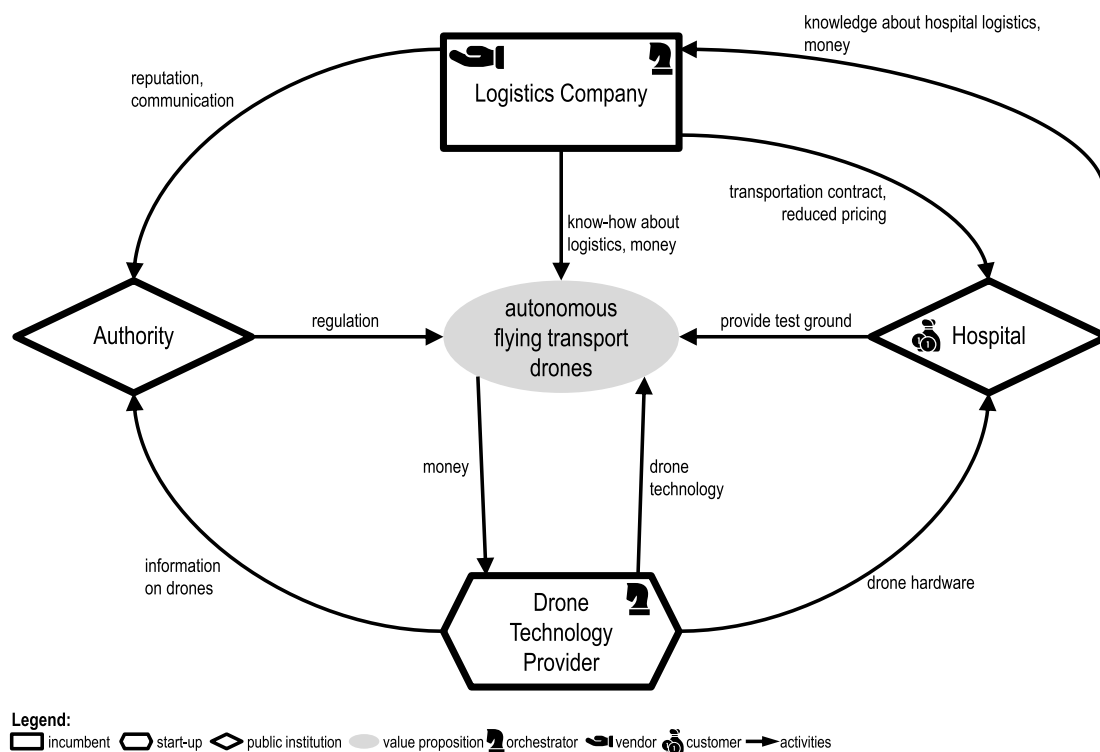


Fig. 5. Sketch case Autonomous Delivery.

collateral for a flexible credit line. The orchestrator developed this value proposition through an ecosystem involving investors who provide the monetary funds for the factoring, an insurance company that covers the risks of payment default, and a software company that provides an algorithm that scans through all the claims by the respective SMEs to assess and categorise the risks of their claims.

3.2.5. Intelligent Insurance

The orchestrator developed a health index using data available about the personal habits of the insured person, e.g. doing sports, smoking, or eating and drinking behaviours. An ecosystem approach was necessary given the following aspect: The alignment of health insurance companies, reinsurance firms, public data banks, and the health index provided by the orchestrator is essential to create such a customer-centric insurance offering.

3.2.6. Simple Relocation

The orchestrator (a relocation service) developed a personally tailed relocation process. Normally, the person moving must reach out to each of the companies involved in the relocation process individually (e.g. cleaning service, transportation of furniture, etc.) and deal with each of them separately. The orchestrator completes this task and aligns all ecosystem partners involved to enable a tailor-made relocation out of one hand.

3.2.7. Autonomous Delivery

In the Autonomous Delivery case, the value proposition is based on the transport of sensitive and high value medical materials (e.g. organs, blood, etc.) from one hospital to another. For this value proposition to be delivered, a logistics company collaborated with a flight cargo company (which later left the ecosystem) and a drone technology provider. A hospital brought in this use case and provided, in addition to the test ground, knowledge and experience of hospital logistics. Governmental authorities also became an ecosystem partner to develop a legal basis for the autonomously flying drones.

3.2.8. Digital Prescription

The orchestrator in this case provides a distributed ledger to store medical prescriptions, which is accessible to physicians, health insurance companies, pharmacies, and patients. The value proposition offered by the ecosystem is fraud protection, convenience, and automation (e.g. for the billing process). An ecosystem was set up in which one orchestrator provided the technological infrastructure. To benefit from automation and fraud detection, a health insurance company served as a co-orchestrator, aligning its systems to the

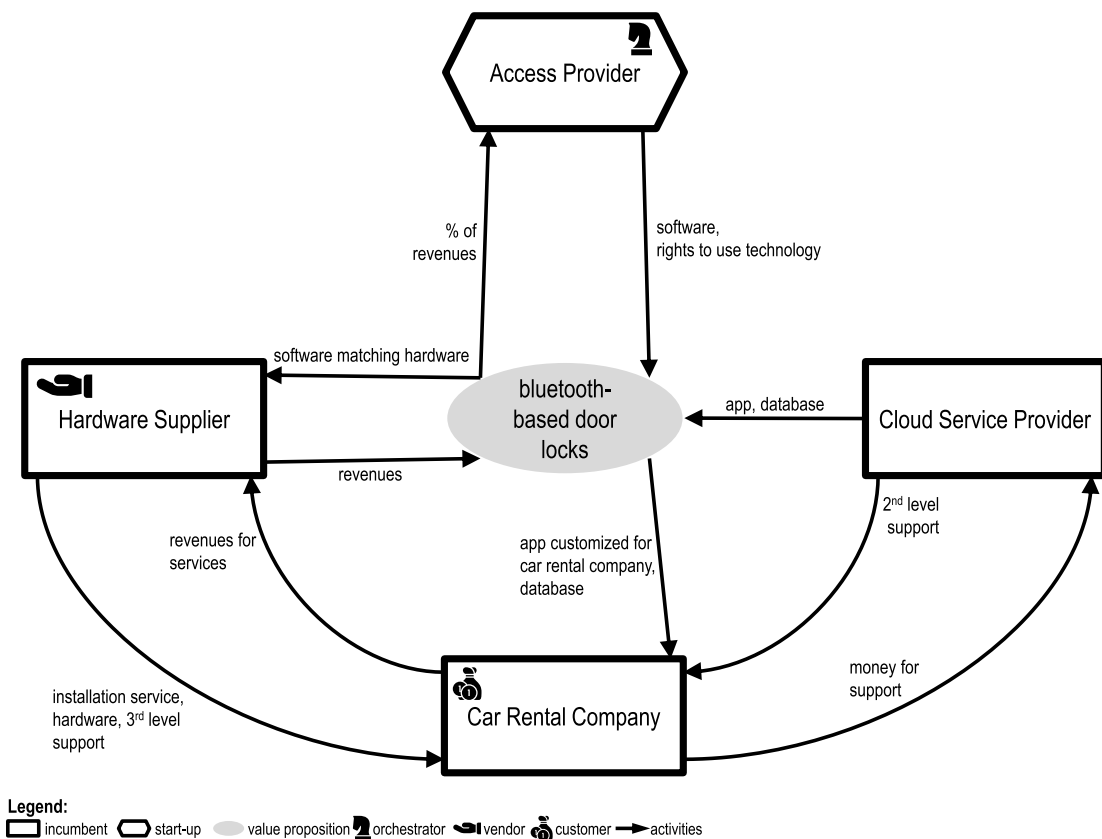


Fig. 6. Sketch case Keyless Access.

technology. Additional partners, such as physicians and pharmacies, were involved to deliver the value proposition. All parties involved needed to adapt their systems towards the new technology.

3.2.9. *Autonomous Busses*

The value proposition is an autonomous self-driving bus for use in pedestrian zones. To realize this offer, an ecosystem with multiple co-orchestrators who each provide different capabilities (e.g. knowledge on public transportation, data analysis, test ground, etc.) had to be implemented. In a later iteration, additional ecosystem partners (e.g. fleet manager, bus manufacturer) also had to be involved and aligned.

3.2.10. *Smart Commuting*

The value proposition in this case addresses the whole mobility customer journey for commuters in cities and suburbs. The initiator of the ecosystem is a European car manufacturer. Further co-orchestrators include a globally operating consulting company that provides the management skills as well as a network of relations and a globally leading software company that brings in communication capability and data processing technologies. Additional partners are being involved to refine and extend the services offered.

Please see [Table 2](#) for an explicit description of the value propositions and their required ecosystems.

3.3. *Data collection*

We collected our data along several steps. First, we conducted initial interviews (between 15 and 60 min) with the main contact person at the ecosystem orchestrator in order to find out whether the ecosystem fulfilled the sampling criteria and to get an initial understanding of these criteria. In a second step, we conducted an interview with one executive from the orchestrator who had an excellent overview of the ecosystem. This semi-structured interview was based on a questionnaire with a threefold structure: 1) Details about the orchestrating firm, such as number of employees, revenues, background, and company history; 2) description of the ecosystem; and 3) surrounding conditions of the ecosystem, such as environmental uncertainty, industry characteristics, or the competitive situation. This initial questionnaire helped to increase internal validity due to its formal method ([Gibbert et al., 2008](#); see also [Spieth et al., 2019](#)) and is shown in [Appendix 1](#). The interviews lasted between 60 and 90 min. We took detailed notes during each interview. Jointly with the respondents, we sketched graphical representations of the ecosystems (c.f. [Dattée et al., 2018](#)). All interviews were conducted by four researchers, two of which are the first and second authors of this paper, while the others two are members of the same research group and, while familiar with the paper, were only involved in its data collection (c.f. [Dattée et al., 2018](#)). In all cases, the interviewers independently took notes and analysed the information. When possible, the interviews were recorded and transcribed to maintain quality of data ([Gibbert et al., 2008](#); [Mayring, 2007](#); see also [Fernandez et al., 2018](#); [Frankenberger and Sauer, 2019](#); [Velu, 2017](#); [Velu and Stiles, 2013](#)). The authors guaranteed all informants who agreed to publish their titles/role within their firms in [Table 1](#) that they would remain anonymous ([Gioia et al., 2013](#)).

As a next step, we collected extensive supplementary data: External and (orchestrator-) internal documents, as well as those provided from third parties about the ecosystem and the aspects addressed in the initial questionnaire. These documents included press releases, media reports, company homepages, annual reports, and internal presentations and reports. This allowed us to enrich the insights we gained in through the first interviews, as well as for validating and triangulating those insights ([Jick, 1979](#); [Yin, 2018](#)). Collecting this supplementary data also helped us to detect potential inconsistencies between statements from the initial interviews and the internal and external documents.

Next, we conducted additional interviews with the orchestrator to deepen our existing findings and disentangle inconsistencies or misunderstandings. We also approached our interviewees by email and with short follow-up calls whenever needed (e.g. after the first rounds of analysis to validate constructs from literature in each case). We then initiated further interviews with additional informants from both the orchestrator firms as well as from other companies within the ecosystems in order to validate and triangulate our findings (c.f. [Hoppmann et al., 2019](#)). [Table 1](#) gives an overview of our data sources per case.

We took great care to mitigate potential biases in our data collection process, which are the usual biases related to case study research as well as those that arise from the ecosystem context. Regarding the usual biases, we followed several recommendations from previous works on qualitative research (e.g. [Eisenhardt, 1989](#); [Eisenhardt, 1991](#); [Eisenhardt and Graebner, 2007](#); [Gioia et al., 2013](#); [Yin, 2018](#)). In order to avoid respondent biases, we did not reveal any theoretical insights or reasoning to our respondents ([Huber, 1985](#); [Huber and Power, 1985](#)), and we avoided questions about specific theoretical constructs ([Ozcan and Eisenhardt, 2009](#)). We also used interview techniques, such as event tracking, to make sure respondents mentally returned to the situations the questions referred to, which is a means of increasing the accuracy of information ([Eisenhardt, 1989](#); [Ozcan and Eisenhardt, 2009](#)). Even though we used semi-structured interviews for the first two interviews per case, we avoided asking very broad questions. If respondents provided us with vague answers/information, we initiated a series of follow-up questions to encourage them to go into greater detail and to be as specific as possible. In general, rather than focusing exclusively on the questions in our questionnaire, we asked interviewees for additional information surrounding these topics. This allowed us to put the answers into a wider context and to check for consistency between the answers and additional background information provided.

One key to achieving a higher construct validity of our findings was extensive data triangulation with multiple sources of information, such as interviews, documentation, archival data, and, in few cases (e.g. the simple relocation, smart commuting, and digital prescription cases), direct observation and participant observation in workshops ([Eisenhardt, 1989](#); [Jick, 1979](#); [Patton, 2015](#); [Yin, 2018](#)). As for the interviews, in every case, we had multiple informants from at least two companies involved in the ecosystem. In most of our cases, information on the core aspects of the ecosystem was publicly available. For instance, companies described their joint

value propositions on their homepages or in sales brochures. Likewise, partners and collaborations were often publicly announced or, in the case of M&A or venturing activities within the ecosystems, described in annual reports. On top of this, several of the ecosystem activities studied received attention from the public, for instance, given their innovativeness or potential for disruption. In these cases, third party reports existed from newspapers or media in general. Thus, the availability of such additional material allowed for extensive triangulation and, in particular, to mitigate retrospective recall biases (Davis and Eisenhardt, 2011; Eisenhardt and Graebner, 2007; Frankenberger and Sauer, 2019; Gioia et al., 2013; Ozcan and Eisenhardt, 2009; Velu, 2017; Yin, 2018). Also, we were able to check whether key words and constructs from the first rounds of interviews were frequently mentioned in the additional documents. If we found additional key words in the reports that had not been mentioned in our interviews, we addressed them in short follow-up calls or emails with the respondents.

Another potential bias resulted from the ecosystem construct per se. Our paper is written from the perspective of the ecosystem orchestrator, or the company initially driving the ecosystem, since this actor is considered to be the designer of the alignment structure (Moore, 1993; Teece, 2007, 2016). Thus, the core interviews were only conducted with managers from an ecosystem's orchestrator firm. This could potentially lead to two different biases. First, a manager of an orchestrator firm might be tempted to present their firm and its role within the ecosystem in the best light. Second, these managers might not be aware of all activities within the ecosystem or they might misinterpret some of them. The risks arising from the first potential bias can be considered less significant since none of the aspects under consideration are particularly sensitive nor would they affect the perception of the orchestrator by other firms or people. Also, all of the firm names for all of the cases are used anonymously, which, arguably, reduces the incentive for respondents to present their firms in a specific way.

The second potential bias, misinterpretations (c.f. Fernandez et al., 2018) of ecosystem partners and activities by the orchestrator, was mitigated by several means. First, the core elements of our research, such as the value proposition, activities of partners, or links, were documented in the underlying contracts among the partners, thus clearly documented. Second, shaping and managing all these core aspects of the ecosystem is the main responsibility of the orchestrator as the key actor within the ecosystem (Moore, 1993; Teece, 2007, 2016). Thus, there is no other company within the ecosystem that can be considered to have the same insights into these aspects as the orchestrator. Third, we primarily interviewed managers who are in charge of managing the ecosystem, which means that they deal with the core aspects under consideration on a daily basis. In order to additionally address both potential biases, we used extensive data triangulation as described above. In all cases, the core statements of the interview respondents could be validated by this data, which significantly strengthened their credibility. Further, we purposefully established time lags of at least a few weeks up to several months between the interviews and follow-ups, and we did not provide respondents with transcripts or information from previous interviews in between. This allowed us to ask several questions from previous interviews in the course of the follow-ups and to check for consistency of the respective statements (c.f. Fernandez et al., 2018). In all of our cases, we did not detect significant discrepancies between the statements, which additionally confirmed the credibility of our respondents. Finally, in some of our cases, to further check for consistency, we conducted additional interviews with other firms involved in the ecosystems or with third parties.

All information (e.g. recorded interviews, transcripts, archival data, questionnaires, etc.) was stored in a database (Yin, 2018). As some cases were collected by different researchers, the academic research group uses detailed protocols for each case (write-up of a narrative, overview of which interviews were conducted with which researchers). This ensures reliability (Gibbert et al., 2008). Table 1 provides an overview of our data sources.

3.4. Data analysis

Inspired by recent publications (Frankenberger and Sauer, 2019; Lewis et al., 2011), our data analysis was based on two stages of 1) inductive analysis (Eisenhardt, 1989) and 2) deductive-inductive analysis (c.f. Kuckartz, 2018). This allowed us to approach our research questions with an open mind and to be open to emerging theoretical aspects, as well as to further deepen existing theory on ecosystems (Siggelkow, 2007; Yin, 2014).

3.4.1. Inductive analysis

As a starting point, we used our interview transcripts to create individual cases, which we enriched with the additional data sources (Yin, 2014). When information was missing, we asked our respondents for further information or conducted additional desk research. The individual cases were the foundation for the cross-case analysis, which we started with an open mind and without pre-defined constructs, theories, or hypotheses (Gehman et al., 2018). We searched for high-level themes in our data that referred to the ecosystems' design or to prevailing surrounding conditions, e.g. 'value proposition', 'partner', 'handover', 'input', 'module', or 'coordination'. Additionally, we used narratives drawings, tables, and other forms of visualization (e.g. post-it for recombination) to gain an understanding of our cases and an overview of our content, and to detect patterns in our data more easily (Miles and Huberman, 1994; Yin, 2014). For the same reason, we did case pairings to understand similarities and differences between the cases (Ozcan and Eisenhardt, 2009). Thus grounded, we followed the coding procedure of Gioia et al. (2013) and developed first themes in an iterative and recursive manner (e.g. Velu, 2017), representing the elements of design, as well as the surrounding conditions of the ecosystem. We used these themes to form first relationships between them and the surrounding conditions (e.g. strong substantive uncertainty leads to fewer actors being involved in the ecosystem) and discussed the causes of these effects (c.f. Frankenberger and Sauer, 2019). The resulting relations were cross-checked with the other cases to verify their occurrence (Ozcan and Eisenhardt, 2009) by using the themes for open coding from our transcripts (we highlighted and used the comment function within MS Word). This initial analysis was conducted by two of the three authors independently from each other, followed by a discussion between the authors and a synthesis. The primary idea of this first stage of inductive analysis was to detect interesting and relevant constructs (1st order constructs) that we

intended to deepen further and extend in the second stage of our research. By returning to literature (c.f. [Velu and Stiles, 2013](#)), we identified two key conditions: 1) the substantive uncertainty of the environment ([Dosi and Egidi, 1991](#)) and 2) the effective distance of knowledge ([Afuah and Tucci, 2012](#)). We used these factors from literature and searched through all of our cases for respective constructs. In this iterative process, we recognized that these conditions influence the ecosystem structure.

At the beginning of our analysis, we discussed whether these two factors are exogenous, since uncertainty can be reduced and knowledge can be gained. In the same vein, the degree of knowledge might influence the uncertainty as well, making these factors dependent upon each other. However, in the course of our analysis, we were able to sharpen the theoretical understanding of these two factors, based on our emerging findings and the related studies in literature. In section 3.5, we explain why these two factors are independent and exogenous in the context of our study. These initial findings, and especially the two surrounding conditions, pointed towards the attention-based view of the firm as an appropriate theoretical lens. After having gained such an initial understanding of the theoretical frame, constructs, and themes, we started the second stage of deductive analysis.

3.4.2. Deductive/inductive analysis

As a starting point for the second stage of analysis, we conducted a thorough literature analysis on ecosystems and the attention-based view of the firm, with a special focus on the theoretical aspects we derived from our first, inductive, round of analysis. Following [Yin's \(2014\)](#) recommendation, we developed a theoretical framework and outlined patterns of expected results prior to the next stage of our research. This 'will enable the complete research design to provide surprisingly strong guidance in determining the data to collect and the strategies for analysing the data' ([Yin, 2014](#), p. 38). Another 'benefit is a stronger design and heightened ability to interpret your eventual data' ([Yin, 2014](#), p. 38). Thus grounded, we used axial coding ([Strauss and Corbett, 1998](#)) to search for key words in our interviews that represent the patterns of expected results and the theoretical constructs we had previously defined. We highlighted the respective sentences in our transcript (a MS Word file), adding the relating codes (1st order concepts) as a comment. In MS Excel, we copied the representative quote and its code. By sorting the cases according to the respective codes, we gained a better overview of our 1st order concepts. This allowed us to build 2nd order themes, before finally defining the aggregate dimensions. We illustrate the final coding scheme in [Fig. 1](#). [Table 3](#) displays the proof quote scheme for all cases and elements of the coding scheme.

3.5. Definition and validation of the two surrounding conditions

It is important to understand that both surrounding conditions are independent from each other and exogenous as well. Regarding the uncertainty, we apply the concept of exogenous substantive uncertainty ([Dosi and Egidi, 1991](#), also see [Beckman et al., 2004](#)). In this vein, in a situation of strong substantive uncertainty, the uncertainty is inherent in the environment/the situation at hand and, thus, cannot be reduced. For instance, in the Virtual Mobility case, the ecosystem creates a digital map that a city can use to simulate urban traffic involving autonomous cars. The market success of such a simulation is almost entirely dependent on the evolution of autonomous driving in general, which, in turn, is dependent on a variety of factors, including regulation, technological developments, co-evolution of solution providers, end-user acceptance, and so forth. Given the complexity of the situation, the orchestrator in this case is unable to assess the market and its development. Instead, the company can only 'wait and see' what happens and try to adapt to it. Thus, even by designing the alignment structure or getting access to novel sources of information, the uncertainty cannot be reduced in such a situation of strong substantive uncertainty. On the other hand, if weak substantive uncertainty prevails, it is possible to conduct research or collect information in order to reduce the uncertainty ([Dosi and Egidi, 1991](#)). Thus, we use substantive uncertainty as an exogenous factor. If substantive uncertainty is exogenous, it won't be influenced by characteristics of the ecosystem or the orchestrator, which, in turn, makes it independent from the knowledge base of the orchestrator as well. Therefore, exogenous substantive uncertainty is independent from the effective distance of knowledge.

In terms of the knowledge distance, it is important to note that an ecosystem is defined by its value proposition ([Adner, 2017](#); [Jacobides et al., 2018](#)). In this vein, the effective distance of knowledge ([Afuah and Tucci, 2012](#)) refers to the orchestrator's knowledge related to the value proposition/the respective field of business that the ecosystem and its value proposition is focused on in relation to the knowledge needed to build an ecosystem in this field. An orchestrator can decrease the knowledge distance through, for instance, organisational learning or hiring experts – however, building new knowledge in unrelated fields is difficult and takes time ([Birkinshaw et al., 2007](#); [Meulman, Reymen, Podoynitsyna, & L. Romme, 2018](#); [Rosenkopf and Nerkar, 2001](#)). Therefore, the distance of knowledge is given exogenously in nascent ecosystems. This is explained in detail in [Fig. 2](#). In the following section, we explain the points of the framework one by one:

1. Initially, there is the decision to enter a specific field of business by using an ecosystem or not. Typically, the top management of a corporation takes this decision, which makes the decision exogenous for the managers who are assigned to implement the ecosystem, as highlighted in the Autonomous Delivery case:

³ The representation of our cases follows the approach of Gioia ([Corley and Gioia, 2004](#); [Gehman et al., 2018](#); [Gioia et al., 2013](#)). The second-order themes are represented as rows. Within each row, the first-order concepts are represented in italic to label first-order concepts ("Characteristics"). In the "Quote/Argument" column, are proof quotes supporting the concepts for each case. The letter-number codes identify the individuals designated (see [Table 1](#)). The strength for each attitude is indicated below: Strong evidence means that all principal informants agreed with an attribute. Moderate evidence means that more than one of the confirming informants agreed with an attribute. For the dimensions "structure", "activities" and "number of decision-makers", we used additional sketches of the ecosystem to validate our findings

'In principle, a setting has been built that does not exist by default in the [Logistics Company]. So, our project or our intention was directly subordinated to the CEO of [the Logistics Company] and [name], the head of innovation.' (G1).

'Such projects actually need approval at C-level, it doesn't work because some logistics specialist says "yes, come on, a drone is cool". Because if C-Level's not convinced, you'll never get this thing to fly. And we were really lucky in [City of the Hospital], we were always able to communicate with the CEO in person.' (G1).

What's more, in all companies, regardless of whether they are corporations or start-ups, this decision is being made because there is a significant market opportunity that is obviously worth the effort of building an ecosystem – otherwise the company would not start such an initiative. Our Intelligent Insurance case is a nice example of this (c.f. section 3.2.5 and Table 2): The start-up invested around CHF 50 Million into developing their health score to improve the underwriting of health insurance. The implementation of this underlying technology, however, would not have been possible without an ecosystem approach:

'We [Data Analyst] have developed a health index [...]. If something consists of 100 data points, then you already know that nobody does it alone. [...] That means that a huge ecosystem is being created within itself.' (E1).

Additionally, the insurance companies (complementors) benefit from the core value proposition, as they require partners to make the opportunity materialize (as they can't do it alone):

'Let me put it this way: there are technology partners that we will need, because many of these efficiency improvements are, of course, only possible if we provide technical support.' (E3)

Therefore, not building an ecosystem would not have been an option in this case. Which means that the decision to enter the field of business is exogenous for the people assigned to build the respective ecosystem. In any case, our paper does not focus on the decision of whether to enter a field of business or not, so this issue is beyond the scope of our investigations.

2. The field of business the ecosystem is focusing on requires a certain type and extent of knowledge (for instance, technologies, market players, customer demands, etc.). Obviously, this knowledge depends on the respective field of business and is, therefore, exogenous from the perspective of the company building the ecosystem. For example, in the Smart Commuting case, the respective field of business in the context of smart mobility required knowledge about mobility solutions, the underlying IT and data analytics requirements, and the specifics of cities and people commuting within these cities.

3. The knowledge base of the company at the time it starts the ecosystem initiative is exogenous as well, since building up new knowledge in unrelated fields is difficult and, even if the knowledge can be acquired, takes a long time (Birkinshaw et al., 2007; Meulman et al., 2018; Rosenkopf and Nerkar, 2001). Since our study focuses on ecosystems in nascent phases, the knowledge cannot change (quickly) at the time of the ecosystem initiative and is therefore exogenous at the moment the orchestrators are designing the ecosystem. As an example, in the Smart Commuting case, the project manager stated:

'As a mobility company, we did not have the necessary knowledge in the context of IT and smart cities. Building up this knowledge in such unrelated fields would have been almost impossible for us. Apart from us, our top management would never have accepted hiring people with these backgrounds since these profiles would not match with our company and our core competencies.' (J1).



Fig. 7. Distribution & regulation of attention.

Thus, if the company intends to enter a field of business, it must deal with its existing knowledge base. The alternative would be to wait for an indeterminate amount of time in order to build up the knowledge needed for that field of business. But, arguably, this is not a realistic option, especially not in the fast-paced environments and nascent phases in which our case companies operate.

- 4 As a result, the effective distance of knowledge is exogenously given in the short term our study examines.
- 5 As our findings reveal, the design of the ecosystem is driven by the effective distance of knowledge.
- 6 The ecosystem design might influence the knowledge base of the orchestrator (Velu, 2015). Such an effect, however, will only happen in the long term since building up knowledge in unrelated fields is difficult and takes time (Birkinshaw et al., 2007; Meulman et al., 2018; Rosenkopf and Nerkar, 2001).

As noted above, both factors could change over time: Effective distance of knowledge can be actively reduced in the long term, and substantive uncertainty of the environment can decrease. Accordingly, we study these two conditions at the moment the orchestrator designs the ecosystem, thus viewing knowledge distance and uncertainty as antecedents of the design of the alignment structure. In the long term, novel knowledge can be acquired, for instance by designing an appropriate alignment structure accordingly (which makes it endogenous, c. f. Velu, 2015). Thus, in the long term, organisational design can be seen as an antecedent of knowledge distance. In addition, the uncertainty might decrease over time. Thus, it would be interesting to study if and how the design of the alignment structure changes over time when uncertainty and knowledge distance are decreasing. We will return to this call for further research in the discussion section of the paper.

Since the surrounding conditions play a major role in our paper, we wanted to back up these aspects with an additional analysis. For this purpose, two of the three authors and two additional researchers, who have not been involved in this research project, estimated the degree of substantive uncertainty (Dosi and Egidi, 1991) and effective distance of knowledge (Afuah and Tucci, 2012) for each case. Afterwards, we discussed our individual estimations and came to final conclusions. Please see the proof quotes for the surrounding conditions in Table 4 (Gioia et al., 2013; Pratt, 2009; see as examples Hoppmann et al., 2019; Souitaris et al., 2012; Velu, 2017).

In order to validate our classifications, we invited industry experts to rate our cases along our identified surrounding conditions. Each case was rated by three different industry experts individually and independently from each other. Afterwards, we calculated the average estimation of these three independent evaluations. This ensured an objective verification of our classification (c.f. Crossland and Hambrick, 2011; Frankenberger and Sauer, 2019; Hambrick, 1982; Hambrick and Abrahamson, 1995; Souitaris et al., 2012). The evaluations of the industry experts corresponded perfectly with our initial estimation, apart from slight but insignificant derivations. The results of the industry experts' ratings are summarized in Table 5.

3.6. Validation of results and overview of applied constructs

The results of this study (i.e. findings, discussion, and practical implications) were presented to different audiences in order to review the researchers' results and to strengthen the construct validity (c.f. Gibbert et al., 2008; Goffin et al., 2019; Yin, 2018). The different audiences consisted of 1) researchers from the same research group, who also could review transcripts; 2) researchers in seminars (some of whom provided reviews on this manuscript) and at academic conferences; 3) Informants (from industry practice), who received the transcripts and participated in a workshop. In a few cases (e.g. someone was not able to participate at a workshop), one of the authors presented and discussed the findings with an informant in a bilateral setting; and 4) practitioners building their own ecosystems. They received some anonymized cases and were asked to develop some of our findings by themselves and/or explain them to each other in a workshop setting.

4. Findings

4.1. The design of ecosystems depending on the degree of substantive uncertainty

In some of our cases (e.g. Insured Factoring, Intelligent Insurance, Simple Relocation), firms were confronted with a weak substantial uncertainty, i.e. they were able to assess the market potential and foresee the events that would have an impact on the ecosystems' future business. The Intelligent Insurance case demonstrates this nicely: The orchestrator already knew which countries mandated health insurance and whether basic health insurance (or only supplementary policies) can be priced individually. In addition, industrialised countries in particular will face the challenge of exploding healthcare costs in the coming years. Therefore, it is certain that the financing of the health care system will have to be redefined – even if it is not yet clear what form this will take (there are already loud voices calling for a stronger polluter-pays principle).

Even when not all the information needed was available at the beginning, such as in the Smart Commuting and Autonomous Busses cases, the orchestrator was able to conduct market studies or ask experts in order to find all the information necessary to predict the future course of the ecosystem. In other cases, however, the situation was highly uncertain and necessary information on technologies or markets did not exist and could not be obtained. In the Autonomous Delivery case, for example, the decision-makers were not able to assess the future stance of the regulatory authorities regarding the drone transportation that the whole value proposition was built upon. At one point, a drone carrying blood samples crashed into a lake, which led to the shutdown of the transports for approximately two and half months. During that time it was unclear when, or even if, the business could continue, since the regulation authority involved in the ecosystem was using the business case to develop the legal framework for autonomous drones. This marked a major and

unforeseeable threat to the ecosystem's business case. In the Keyless Access case, underlying technologies were still very immature at the beginning of the ecosystem initiative and it was not possible to predict which technology would become the future standard, as the CEO of the orchestrator firm stated:

'But from my knowledge, the framework conditions were that, first, we did not know which technical standard would be the right one. Is it Bluetooth? Is it NFC? Is it online, is it offline?' (A2).

All of our cases that are characterised by weaker substantive uncertainty, such as the Insured Factoring case (Fig. 3) or the Autonomous Busses case (Fig. 4), serve as nice examples of ecosystems in which actors are intensively linked with each other by a multitude of connections and, therefore, occupy positions in several flows of activities at the same time. This allows the actors to mutually adapt their respective modules with several partners. For instance, in the Autonomous Busses case, the bus manufacturer, mobility provider, and regulatory authorities are closely collaborating to build autonomous busses that not only match the requirements of the public transportation provider, but also fulfil the regulatory requirements to get an exemption permit for the test phase, such as speed limitations, having an emergency brake button, as well as ensuring that during the test period a security escort is on board and able to stop the bus manually. On the other hand, given the novelty of the subject, the regulatory authorities had to develop specific requirements for autonomous self-driving passenger buses, which forced them to constantly exchange information with the bus manufacturer and the public transportation provider. In the Intelligent Insurance case, the data analyst, the primary insurance company, the secondary insurance company, and the public health institutions all have to collaborate with each other very closely: The primary insurance company provides the white label app (developed by the data analyst) to its customers to data of its insurees to the data analyst. The latter thereby acquires metadata, allowing it to increase the accuracy of the health scores it had previously received from public health institutions (which collaborated before the ecosystem was in place with primary insurance companies and reinsurance companies, e.g. by providing life tables), and in return, the data analyst provides reports. The primary insurance company had to integrate the data analyst's health scores into its actuarial system, and then this had to be reconciled with the reinsurance company's systems so that it could evaluate the valuation of the adjusted actuarial values. This ensures that the algorithms and calculations of the health index work perfectly with the data provided by all parties and, most importantly, that they can be fully integrated into the primary and secondary insurance companies.

Additionally, these cases that are characterised by weaker substantive uncertainty, nicely demonstrate two different ways of revenue sharing and contribution of activities among the actors involved. On the one hand, actors may have a direct exchange of goods against goods or goods against money. In the Intelligent Insurance case, for instance, the insurance company receives the app and software from the orchestrator who, in return, directly receives money from the insurance company. On the other hand, we can also observe complex connections involving several actors, for instance, between the insurance company, re-insurance company, and the data analyst in this case. The insurance company provides data analytics to the re-insurance company, which allows the re-insurance company to adjust, i.e. lower, the fees being paid by the insurance company to the re-insurance company. Finally, the insurance company forwards a share of these savings to the data analyst as a financial compensation for the data analytics it provided to the re-insurance company. Overall, in all of our cases characterised by weaker substantive uncertainty, the actors appear to have tight and intertwined channels between each other, in order to best adjust their respective modules to each other and to make the best use of the complementarity effects among them. In the Simple Relocation case, many more actors were integrated given the low degree of uncertainty: Since the management capacity could be fully directed towards partner acquisition rather than towards the management of uncertainty, the value proposition became more extensive as the additional players increasingly made the relocation process more and more tailor-made for the customers' needs. This allowed the offer to be better marketed, and additional partners were attracted.

The opposite appears to be true for cases with stronger substantive uncertainty. It becomes apparent that simple links involving just two actors prevail (e.g. as shown by the Autonomous Delivery case in Fig. 5). Typically, two actors within an ecosystem directly exchange goods for goods or goods for money without involving additional actors. The connections are still multilateral, since even these direct exchanges are influenced by, or not possible without, the contributions provided by the other actors in the ecosystem and their mutual connections (Adner, 2017). However, the ecosystems are based on a set of comparably simple links and connections between the actors.

The same is true for the co-creation and adaption of modules among the partners in the other cases characterised by stronger substantive uncertainty. As shown by the Autonomous Delivery case, the development of the value proposition took place primarily between the logistics company that brought in funds and knowledge on general distribution processes and the drone technology provider specialised in autonomous flying, which provided the technology. Also in the Virtual Mobility case, the main effort and co-creation takes place between the orchestrator and the graphic processing unit manufacturer – the city merely provides the playground for the tests, whilst the game developer provides the graphic engine that does not need to be aligned with the other modules on a daily basis. For the Keyless Access case, the modules for the value proposition can be easily disassembled: The access provider supplies the software to open the locks via the box, the box supplier configures the box to the vehicle type, installs it, and tests its functionality. The cloud service developed a special app for the car rental company to provide the functions provided to the car renters (cf. Fig. 6).

The Contactless Payment case seems to be an exception, as the actors are tightly interwoven despite the prevalence of stronger substantive uncertainty. This seems to contradict our findings as described above. However, the actors were already tightly connected to each other through the collaboration necessary to run conventional payments via credit cards, which is the foundation of the value proposition of the newly founded ecosystem. Thus, only a few very simple links had to be implemented between the orchestrator (the Digital Payment Provider) and the existing partners. Overall, in cases with strong substantive uncertainty, actors appear to be less tightly connected to each other and only adapt their respective modules with one or very few actors.

In addition to affecting the links between actors, the type and degree of uncertainty appears to have an influence on the number of actors and, thus, also on the number of activities performed in the ecosystem overall. In every case characterised by weaker substantive uncertainty, the ecosystem began with an initial group of partners necessary to realize the value proposition. Subsequently, these ecosystems have grown through the integration of additional partners, who either provide additional modules for the existing value proposition (to make it 'better') or extend the value proposition with additional offerings for the customer. In the Intelligent Insurance case, for instance, the initial value proposition of a health insurance policy with an individual fee was implemented by an initial set of actors. Subsequently, a reward partner was integrated to extend the original value proposition by offering people rewards for improving their health scores, which provides an incentive for healthier living. This additional module is complementary to the existing modules for the initial value proposition for several reasons, as it increases the value of the health index for the customer and creates a more healthy portfolio of insureds for the insurance company.

Similar findings can be observed in the ecosystems in the Autonomous Busses, Smart Commuting, Insured Factoring, and Simple Relocation cases. In the Simple Relocation case, which offers a tailor-made relocation service, the integration of more partners with additional modules extended the original value proposition: In addition to simply offering a relocation service, the ecosystem began offering additional insurances for the customers' furniture as well as complementary services, such as storage of belongings or integrated shopping for new furniture. All of these additional modules increase the value of the existing ones and contribute to greater product differentiation within the market, which leads to customers being willing to pay higher prices for the services.

However, this comes at a price: More actors and activities, as well as more links between the actors, arguably increases the orchestrator's efforts. For that reason, in all of our cases characterised by weaker substantive uncertainty, the orchestrators implemented technological platforms to coordinate the actors and to automatize the transfer of information and funds between them. For instance, in the Intelligent Insurance case, data from an insured is forwarded from their wearable device to the app, and is then automatically processed by the data analyst company. The same process coordinates the exchange of data between the orchestrator and the reward partner or the reinsurance company. Thus, the effort of orchestration required to run the whole ecosystem is greatly reduced.

Whilst the orchestrators in ecosystems with weaker substantive uncertainty were constantly involving additional actors in order to extend or improve the value proposition through the additional modules and activities provided (as described in the Simple Relocation case above), this did not appear to happen in ecosystems that face stronger substantive uncertainty.

These findings can be explained using several arguments. First, more actors in an ecosystem implies that there are more individual agendas to be aligned (Jacobides et al., 2018), and more issues and answers that actors need to attend to within the ecosystem. A greater number of links implies a more complex decision-making process, as well as more attention channels decision-makers would have to engage in. On the other hand, situations with stronger substantive uncertainty are generally more difficult to manage and significantly increase the required management effort due to the unpredictability of events (Galbraith, 1974; Ofek et al., 2007). Also, higher uncertainty generally impedes decision-making and focusing of attention (Cyert & March 1963; Gavetti et al., 2007). Thus, orchestrators might be reluctant to embrace a more complex ecosystem with additional partners and complex links between them when the situation is already difficult to manage and it is difficult to focus attention on the most relevant information. This is nicely demonstrated by the Keyless Access case. Once the box (the key hardware module) is integrated into a car, it is very expensive to exchange:

'And for example, the car box: Once it is finally integrated into a car an exchange towards another car is very costly. Principally, I would start with the integration from scratch. Therefore, instead we have this value added [approach].' (A1).

However, given the prevailing uncertainty, the orchestrator decided to tackle this issue by finding additional engineering services (rather than integrating additional actors):

'[...] we were providing further integrations and product functionalities. [...] so, the added value was created; in this sense, we were doing so by providing engineering services and not by integrating further partners into our ecosystem. [...] The key limitation really is the question of whether the integrator, manufacturer etc. Is willing to bring the solution to the market.' (A1).

Second, situations with stronger substantive uncertainty require organisations to remain flexible in order to swiftly react to changes in the environment (Galbraith, 1974). The quotes above demonstrate this: The orchestrator tried to retain a small ecosystem with as few partners as possible, as long as stronger substantive uncertainty prevailed. It is the same for all of our cases involving orchestrators in ecosystems surrounded that are by stronger substantive uncertainty; they seem to refrain from involving additional partners, even though this limits the chances of improving or extending the value proposition.

In the Autonomous Delivery case, the ecosystem tackled the challenge of technological uncertainty by doing extensive test flights and waiting both for the technologies to become more mature as well as for the regulatory situation to become more clear. In the end, the actual use case was brought in by a new partner, the hospital: They asked for the opportunity to transport laboratory samples using the drones after watching the drone tests on a TV news programme. In the Keyless Access case, the orchestrator began to build parallel ecosystems by relying on the same technology instead of trying to extend or improve the existing value proposition: In addition to equipping rental cars, the orchestrator started to build a value proposition targeting hotels. Given the fact that the actors were constantly changing, it was not feasible to implement advanced technological solutions to connect them. This led to a greater orchestration efforts.

Thus, regimes with stronger substantive uncertainty favour simple ecosystem designs that include few actors and activities to manage, and only simple links between the partners. On the other hand, in situations of weaker substantive uncertainty, it is possible to have a more complex design with more actors. As the ecosystems in situations of weaker substantive uncertainty evolve over time,

however, the existing value propositions are extended or improved – often by increasing the number of links and partners involved. This leads to the following propositions:

Proposition 1a. The weaker the substantive uncertainty of the environment, the larger the extent of the structure of the ecosystem should be.

Proposition 1b. The weaker the substantive uncertainty of the environment, the more multilateral the structure of the ecosystem should be.

4.2. The design of ecosystems depending on the effective distance between the orchestrator's existing knowledge and the knowledge relevant for the ecosystem's field of business

When building the ecosystems in the Keyless Access, Contactless Payment, Virtual Mobility, Insured Factoring, Intelligent Insurance, and Simple Relocation cases, from the very beginning the respective orchestrators possessed knowledge and connections to networks related to the ecosystem's field of business. Due to their existing knowledge and networks, the orchestrators were able to define the value proposition by themselves and to understand which partners, activities, and skills were required for its instantiation. For instance, in the Contactless Payment ecosystem, the orchestrator's top management had a clear plan of the value proposition and the resulting ecosystem, as explained by the head of marketing:

'[...] principally, the idea was to bring the [bank] card into the new world [of smartphones]. And then we said: we have to make it with external partners. Actually, not necessarily because of the idea of partnership. But it was more IT driven, which required external IT skills.' (C2).

The co-founders of the orchestrator in the Insured Factoring ecosystem, who have a background in banking (treasury and cash management, insurance sales in banking), seemed to be quite familiar with the niche for their value proposition and simply had to integrate partners who were already part of their personal networks:

'The platform is built in every country the same way, and it is available in four languages at the moment. And our bank would be active in the same areas. On the side of distribution, we would have to find new partners, but also there we have a network.' (D1).

Due to their knowledge and networks, all of these orchestrators started with a clearly defined value proposition. They were also able to determine through analysis which modules and activities were needed to deliver the value proposition, and to identify which partner profiles would be best suited to providing missing elements. Thus, partners were chosen based on their specific abilities to perform the activities needed to implement the value proposition. A perfect example of this is the Intelligent Insurance case: The (primary) insurance company creates the insurance solution, whilst the reinsurance company provides a tailor-made reinsurance solution for the primary insurance company. The public health organisation provides meta-data and the reward partner delivers the reward system. Thus, every actor brings in a clearly defined module based on its very specific competencies. It's a similar process in the Virtual Mobility case. In addition to capturing data and providing the final models, which was done by the orchestrator, actors focused on two skills and activities only: Computational power to render the 3D-model maps and an engine to process and visualise the data. Therefore, they engaged partners specifically for their contributions, as the founder of the 3D cartographer highlights:

'[...] [Graphic Processing Units Manufacturer] a provider of graphic cards, so they are providers of computational resources, [Game Engine Developer] is a provider of gaming engines so they're the provider of that particular part of the product, and we're the provider of the 3D model.' (B1).

In the Simple Relocation case, the orchestrator went a step further and made clear that the modules from the partners must also meet an agreed quality measure:

'[...] we set a quality standard that must be maintained. If not, then we do not work together with the companies.' (F4)

In other words, the orchestrators' understanding of the field of business allowed them to pre-define: the specific modules and partner profiles necessary, the positions the actors should have within the ecosystem, and how they should interact with each other. This allowed the orchestrators to define all of the key elements of the ecosystem design, even using clearly defined contracts that specify all structures and activities, as highlighted by an interview from the Intelligent Insurance case:

'First of all, these are long-term contracts for all of the ecosystem partners involved. There is no one who enters the ecosystem and could say he can cancel within two weeks. Nobody could do that. We have something like a turnkey-ready ecosystem. Everything is based on a contract and new partners just sign this contract with us and everything is defined in it.' (E1).

Additionally, in the Contactless Payment case, actors entering the ecosystem had to deliver specific modules that were pre-defined, e.g. the banks' needed to provide clients data towards the orchestrator or the retailers had to give access to the payment system for the acquirer. The head of marketing in the orchestrator firm stated:

'For [the payment ecosystem] there exists a huge rule book defining all the rules for the partners involved. And everyone who takes part in the scheme has to sign the rule book. [...] These are books full of rules for them.' (C2).

Obviously, the ex-ante definition of the ecosystem design allowed the orchestrator to build the ecosystem through a comparably straightforward process and to have well-structured discussions with potential partners, based on clearly defined structure and activities within the ecosystem.

Conversely, in the Autonomous Busses, Smart Commuting, Autonomous Delivery, and Digital Prescription cases, the orchestrators lack the knowledge and network connections for the field of business the ecosystem focuses on. In these cases, the orchestrators were

unable to define a specific value proposition – they had to define it together with partners. This is nicely explained by the head of open innovation and venturing in the Autonomous Busses case:

‘We identified a vision: we did not want to be a public transportation provider anymore; instead we wanted to be a multi-modal integrated mobility provider. This was really the vision. And we identified some immediate challenges on the path to this vision. But we knew that alone we could not manage to further develop our vision.’ (I1).

A project manager within the same ecosystem stated:

‘No one knew in which direction it [the ecosystem] went. Kind of a value proposition existed but we did not see it clearly.’ (I2)

Due to the lack of knowledge, the actors did not know which modules were required for further development of the ecosystems. Beyond that, the co-orchestrators had to perform additional activities with their partners, which could not have been foreseen at the start of the ecosystem initiative. For instance, in the Digital Prescription case, fulfilling basic functions – from entering the prescription from the doctor to automated billing by the health insurance company – was outlined in advance as a goal. Nevertheless, it was obvious to the participants that they had to implement additional activities (e.g. financial incentives so physicians have a greater motivation to participate, which is very important, as physicians are the most critical players in the ecosystem) in order to increase the attractiveness of the ecosystem, which makes it more established and thus more efficient. Efficiency will increase when more physicians participate, as the following quote from a product manager shows:

‘Therefore, perhaps the physician is the only one who can receive an incentive from the others in this model, who would ultimately benefit from an increase in efficiency.’ (H2)

This was confirmed by the chief innovation officer:

‘That’s why you look at the ecosystem at the beginning, take it up as it exists today. And you see if you can build it more efficiently through different iterations.’ (H1)

In the Autonomous Busses ecosystem, it turned out the one of the co-orchestrators had to take-over the role of mediator between other partners:

‘Partially, we [public transportation company] took over the translator role; imagine the official from [Country A] with the young, start-up entrepreneur from [Country B]. This does not work. Simply not only translating the language, but the mentality.’ (I1).

By mediating, the co-orchestrator ensured that the activities within the ecosystem remained flexible enough to enable the value proposition. In particular, the government authorities were critical for testing, so the mediation activity was key to influencing (link) the respective partner to agree to cooperate. It is the same in the Smart Commuting case, where the consulting company, as the co-orchestrator, performed a multitude of tasks: providing manpower, project management, doing analysis, and so forth. These orchestrators had to be flexible and agile enough to respond whenever tasks that had not been defined at the beginning had to be performed. According to the respondent from the car manufacturer:

‘They [Consulting firm] had no specific product or ability to bring in. They took over a multitude of tasks, whatever was needed. Doing project management, developing the governance model, and so on.’ (J1).

Given the unspecified value proposition at the beginning of the ecosystem initiative and the broad and unforeseeable activities of the co-orchestrators, it was not possible to define these activities beforehand. Thus, the initial partners in such cases agreed only on a framework contract or memorandum of understanding, which merely expressed the willingness of the various parties to collaborate without going into detail. The reason for these types of contracts was that, due to the lack of knowledge, no activities, and therefore no transfers among the ecosystem actors, could be predefined. As the head of the Autonomous Busses ecosystem stated:

‘You are flexible [relating your activities]. There’s a framework agreement, but it’s very rough.’ (I2).

Consequently, there is no clear hierarchy among the initial co-orchestrators as nicely illustrated by a quote from the same case:

‘Everyone [of the co-orchestrators] has an employee detached for the coordination of the ecosystem. But as we are the primus inter pares among the initial partners, [...] it is our employee who pushes the whole thing. So, there is no hierarchy, all coordinators are equal, there is not one boss. Yet it is our employee who is the primus inter pares, who is driving the whole thing a bit more than the others.’ (I1).

The framework agreement specifies structure elements only, as the actors and their organisational forms (positions) were stipulated in advance. Given the lack of a detailed contract specifying the form of contributions (activities), in almost all of the cases, the underlying foundation for the collaboration among the co-orchestrators turned out to be strong mutual trust in the ecosystems’ activities. Thus, it is no surprise that there had been prior collaborations and personal relationships (typically at the top-management level) amongst the co-orchestrators. For instance, in the Autonomous Busses case, the respondent stated:

'Such disruptive topics, like autonomous driving, we do not manage alone. Therefore, it is important to find the right partners to work on it. We were already a partner of [University 1] and naturally, when there is data analytics, we said [University 1] is very interesting and so we continued with them.' (I1).

We made similar observations in the Logistics case. From the beginning, there was an intention to conduct deliveries with drones. The logistics company therefore integrated an air-cargo company so that the ecosystem was able to cover all the activities necessary to realize the value proposition. For the ecosystem, the logistics company chose a known partner who was already pushing forward in the same field of business:

'The [Cargo Company], we brought in. We knew that [Cargo Company] worked on the same topics and we knew that they had an exchange with [Drone Technology Provider]. So, we said let's do it together.' (G2).

The Smart Commuting case sheds light on the role of trust and the lack of hierarchy among co-orchestrators. The automotive OEM that acted as the initial orchestrator and driver behind this case's ecosystem started initial partnerships with a consulting company and a software company to jointly orchestrate the smart city ecosystem. This was due to the access provider's (the orchestrator) large distance of knowledge related to smart cities. Naturally, the original orchestrator had clear expectations regarding the collaboration between the partners:

'If you steer an ecosystem jointly with two other orchestrators, you do expect that the whole profit-and-loss thing is fair and equal.' (J1)

However, the initial partners in the Smart Commuting case (unlike those in the Autonomous Busses or Autonomous Delivery cases) did not come together based on previous relationships or trust. Rather, the collaborators met at an industry fair. Given the lack of established trust, they attempted to pre-define their future collaboration using clearly defined contracts. This led to the whole ecosystem project being delayed for about a year, since it turned out to be highly difficult to agree on a contract about future returns and future activities related to an ecosystem that did not yet exist and whose value proposition had not even been clearly defined.

'It turned out that [Consulting firm], beyond the idea of the ecosystem, was on an acquisition tour as well and tried to sell projects. It was funny; they used, I think, a classical sales tactic. At the beginning, they worked for free for the ecosystem and showed us how important they are. But later, they wanted to be paid for their man-hours. So, in order to define the contract, we had to calculate our contributions as well. And this was excessively difficult, since we contributed technologies and knowledge, for example. How could we quantify this? As a result, we got stuck in these negotiations.' (J1).

Due to the distance of knowledge, an ex-ante definition of activities is difficult to achieve and can therefore only be defined (if at all) by broad and general framework agreements. However, if the distance of knowledge is small and the required activities are known, these activities can be defined ex-ante by using formal contracts. These findings lead to the following propositions:

Proposition 2. The larger the effective distance of the initial orchestrator's existing knowledge and the field of business the ecosystem focuses on, the more the activities remain flexible. The smaller the effective distance of knowledge, the more the activities are pre-defined and inflexible.

Proposition 3. The larger the effective distance of the initial orchestrator's existing knowledge and the field of business the ecosystem focuses on, the more ecosystem actors act as co-orchestrators of the ecosystem.

In our last finding, we delve deeper into the characteristics of the orchestrator(s). All cases showed the importance of the orchestrators remaining as flexible as possible. In the Contactless Payment case, the partner that initiated the ecosystem did so by founding a spin-off of an incumbent corporation, in order to be able to act as the orchestrators, since the spin-off has more flexibility and fewer compliance rules than its parent corporation. The same is true for the Insured Factoring case, as our respondent in the latter case stated:

'Our partners are large firms; they have their structures and rules. As an orchestrator, you need to adapt to your partners. If one of these big companies orchestrated the ecosystem, they would not be able to adapt to other big corporations. [...]. We do not have structures, so we can adapt to everyone.' (D1).

On top of this, our cases show the significance of this firm having a very fast pace of product development, agility, and innovativeness. For instance, as one of the respondents in the Intelligent Insurance case stated:

'The insurance company, they're sluggish, slow, and so on. And we are trying to be super-fast, super agile, so we do everything as rapid prototyping and wire frames. This also means we can actually generate a product within four weeks or in a two-week sprint, and that would take a classic insurance company three to five years.' (E1).

Highly motivated employees are essential for this, as the CEO of the Intelligent Insurance orchestrator highlights:

'Well, the agility, the innovations... Of course, you have people, who are ready to work extremely long and a lot when it matters. [...] We work day and night.' (E1).

He went on to describe the organisation of his company:

'We are simply more mobile, agile. These aren't just buzzwords; it is actually like this.' (E1)

Agility, highly motivated employees, and speed of development are features typically associated with start-ups or smaller companies. Thus, it is no surprise that in the cases characterised by small distance of knowledge, the orchestrator firm was either a start-up (e.g. Insured Factoring, Virtual Mobility), a spin-off from an incumbent with start-up-like organisation (e.g. Contactless Payment), or a young high-growth company (Intelligent Insurance). This is understandable since the ecosystems in these cases had the sole purpose of implementing the value propositions that the orchestrator had previously defined. The faster the orchestrator drive this development, the shorter the time-to-market will be. Thus, our cases clearly show that start-ups and firms with start-up-like characteristics make excellent orchestrators. Apparently, resources or superior power are not always necessary to orchestrate an ecosystem. For instance, in the Insured Factoring case, the orchestrator is a start-up with ten employees, which does not bring in any resources or take over any tasks beyond the mere orchestration of the ecosystem.

However, in all cases with larger effective distances of knowledge, it became apparent that resources provided by the orchestrator play an important role, in addition to the aspects already mentioned above. In the Virtual Mobility case, the initiator of the ecosystem is the *primus inter pares* among the orchestrators, since it provides the budgets for the development activities. In the Smart Commuting case, the consulting company is a co-orchestrator, as one of the respondents explained:

'We would not have had the manpower to orchestrate this ecosystem. They [Consulting Firm] had around ten people working for this project, and we do not have that kind of budget.' (J1).

Also, in all of these cases, the time-to-market, from defining the value proposition jointly with the other orchestrators, searching for and integrating further partners, and implementing the value proposition, took a very long time, typically more than two years. In the cases in which one orchestrator was driving the ecosystem, however, the same process lasted around one to one and a half years. Thus, it would be difficult for a start-up with a large distance of knowledge to: first, receive funding without a fully developed value proposition; second, provide the resources for the activities needed to define the value proposition jointly with the partners; and, third, have the credibility to attract other companies for such a project. Accordingly, and for these reasons, in all of these cases (Autonomous Busses, Autonomous Delivery, Smart Commuting, and Digital Prescription), the orchestrators were incumbents. Finally, this long process of identifying the issues and answers necessary to define the value proposition and searching for the partners needed for its implementation requires a larger attentional capacity, which is also true for larger firms with more manpower. On the contrary, if the effective distance of knowledge is small, the orchestrator needs to act quickly in order to address the market in a timely fashion. This requires delivering answers to issues with great speed, leaving out formalities and ordinary processes to easily adapt towards the partner. Such flexibility is required for start-ups and therefore a typical characteristic (c.f. Baert et al., 2016; Cainarca et al., 1992; Palmié et al., 2016b; Sirmon et al., 2011).

Therefore, this leads to the following proposition regarding the orchestrator as the firm that designs the ecosystem and is the core actor within it:

Proposition 4. The larger the effective distance of knowledge, the more it is beneficial if the orchestrator(s) is/are characterised by solid funding, substantial resources, and a strong reputation – all of which are typical for incumbents. The smaller the effective distance of knowledge, the more it is beneficial if the orchestrator(s) is/are characterised by flexibility and speed of product development – which is typical for start-ups.

5. Discussion

5.1. Introducing a framework of ecosystem design from an attention-based view

Our findings are summarized in the framework displayed in Fig. 7. This framework illustrates how the surrounding conditions of substantive uncertainty and effective distance of knowledge affect an ecosystem's design, and how the ecosystem perspective (Adner, 2017; Jacobides et al., 2018), in combination with the attention-based view of the firm (Ocasio, 1997), jointly elucidate the underlying mechanisms that link ecosystem design with these two surrounding conditions. Thus, the framework contributes to the respective call for research (c.f. Adner, 2017; Dattée et al., 2018; Jacobides et al., 2018; Laamanen, 2017; Phillips and Ritala, 2019) by providing an explanation for ecosystem design.

Before we discuss the framework, here is a brief recapitulation of the constructs contained in it:

The surrounding conditions that influence the design of ecosystems are first summarized. 'Substantive uncertainty' (Dosi and Egidi, 1991) describes a state in which there is a lack of information. In cases of weak substantive uncertainty, the exact state remains unknown but can be estimated, whereas in cases of strong substantive uncertainty, the missing information cannot be assessed. 'Effective distance of knowledge' (Afuah and Tucci, 2012) is the distance between the knowledge held by an orchestrator and the knowledge required to solve a problem, such as the creation of the value proposition. The distance consists of two components: the expertise of the orchestrator for the ecosystem value proposition, and the required in-depth knowledge for the value proposition compared to the knowledge the orchestrator has.

The design of an ecosystem can – like any organisational design – be examined via its structures and activities (c.f. Delbecq, 1967; Hall, 1972; Nadler and Tushman, 1970; for a pioneering introduction into the ecosystems concept please see Rong and Shi, 2015). Structures are driven by formal organisational arrangements, such as members and their links, while activities are the procedural actions of the actors for the provision of the value proposition, which is key for an ecosystem (c.f. Adner, 2017; Hannah and Eisenhardt, 2018; Parente et al., 2018).

Finally, we look at the ecosystem orchestrator. This is the key decision-maker as this firm determines the structure and activities

and, thus, the design of an ecosystem (c.f. [Autio and Thomas, 2019](#); [Moore, 1996](#); [Williamson and de Meyer, 2012](#)).

As displayed by the framework, our attention-based view on ecosystem design embraces the three elements of structure, activities, and the orchestrator. Whilst the first is solely influenced by the prevailing uncertainty, the other two are affected by the effective distance of knowledge.

Regarding the first, as our cases show, it would be beneficial from an ecosystem perspective to design an ecosystem characterised by a large and multilateral structure in order to achieve a stronger joint value proposition. However, this would increase the number of issues and answers decision-makers need to focus their attention on, as well as the number of attention channels they would need to be involved in. Given the difficulties of decision-making and attention distribution in situations of higher uncertainty ([Ocasio, 1997](#)), it becomes apparent that regimes of stronger uncertainty thus limit the size and the degree of multilaterality of ecosystem structure ([Propositions 1a, b](#)).

Activities are influenced by the distance of knowledge ([Proposition 2](#)), which shows a trade-off between an appropriate distribution of attention and the design requirements of an ecosystem. From the perspective of the distribution of attention, it would be beneficial to pre-define ecosystem activity in order to allow for preparator attention and, thus, a faster and more accurate distribution of attention ([Ocasio, 1997](#)). However, from an ecosystem perspective, such preparatory attention is difficult to achieve if the orchestrator lacks the knowledge to pre-define necessary activities.

Also, effective distance of knowledge influences the orchestrator as the key decision-maker within the ecosystem ([Adner, 2017](#); [Autio and Thomas, 2019](#); [Dattée et al., 2018](#); [Jacobides et al., 2018](#); [Masucci et al., 2020](#)). The greater the distance of knowledge, the more actors need to take over the role of co-orchestrator in order to bring in missing knowledge components, whilst a smaller knowledge distance allows the initial orchestrator to lead the ecosystem by itself ([Proposition 3](#)). Also, the greater the distance of knowledge, the more the orchestrators are involved in exploring suitable value propositions and opportunities for the ecosystem, which requires them to have a larger attentional capacity, and a broad and flexible focus of attention ([Barnett, 2008](#); [Ocasio, 1997](#)). In this case, it more beneficial if there are more orchestrators involved and if these orchestrators are large companies with substantial resources ([Proposition 4](#)). This also allows orchestrators to cover a broader range of activities and react flexibly if certain activities are required. However, if these aspects are less significant, i.e. in situations with a smaller distance of knowledge, from an ecosystem perspective, it is more beneficial if fewer actors are involved as co-orchestrators, as this reduces the need for co-operation among them. Likewise, start-ups as orchestrators can bring in the required flexibility and speed of product development, which are both beneficial for the development of the ecosystem's joint value proposition.

In the following, we explain how our propositions and the resulting model contribute to research on ecosystems.

5.2. Implications for existing and future research on ecosystems and the attention-based view of the firm

With our [Propositions 1a](#) and [1b](#), we show that the substantive uncertainty inherent in the environment is an important influencing factor for the structure of an ecosystem (i.e. the number of actors and modules provided), as well as for the density of links among the actors. Previous works on ecosystems, such as [Iansiti and Levien \(2004b\)](#), as well as [Clarysse et al. \(2014\)](#), view ecosystems as networks of loosely connected actors. Our [Proposition 1](#) specifies these findings: Actors in ecosystems tend to be loosely connected only in situations of stronger substantive uncertainty. This, in combination with the number of actors and activities, which depend on the uncertainty, has important implications for the value the ecosystem concept is able to create: An ecosystem's strength is providing a design through which complementarities among non-generic modules can be obtained ([Jacobides et al., 2018](#)). Such complementarities lead to higher returns than the sum of investments from all partners involved, or to the same investments with lower costs for all partners ([Arora and Gambardella, 1990](#); [Cassiman and Veugelers, 2006](#)). Arguably, the greater the number of actors involved in an ecosystem, the greater the number of modules provided. When more, complementary modules are provided, the overall effect of complementarity is stronger. On the other hand, since modules in an ecosystem are mostly non-generic, they need to be mutually adapted ([Jacobides et al., 2018](#)). The stronger the links between ecosystem actors, the easier it is for them to mutually adapt their modules.

According to our [Propositions 1a](#) and [1b](#), situations of weaker substantive uncertainty make it possible to involve more actors in an ecosystem and build more and more complex links between them, i.e. to extend the structure and activities of the ecosystem. Thus, only under these conditions, can the potential of an ecosystem to achieve complementarity effects among non-generic modules be obtained to the fullest extent. This is a significant implication for literature, since 'a litmus test for knowing where an ecosystem approach – or any approach – adds value is having clarity on where it does not add value' ([Adner, 2017](#), p. 56). According to [Jacobides et al. \(2018\)](#), ecosystems are most likely to occur in industries characterised by strong modularity, e.g. the gaming industry. Based on our [Propositions 1a](#) and [1b](#), we extend this finding by assuming that ecosystems might be particularly beneficial, and have a higher likelihood to emerge, in those industries or situations characterised by weaker substantive uncertainty.

This also demonstrates a significant difference between the logic of ecosystems and the stance of the literature on networks and alliances. The latter literature typically views such constructs from the perspective of information and knowledge exchange ([Ahuja, 2000](#); [Burt, 1992](#); [McEvily and Zaheer, 1999](#); [Muthusamy and White, 2005](#); [Powell, 1998](#); [Powell et al., 1996](#); [Tsai and Ghoshal, 1998](#); [Uzzi, 1996, 1997](#)): The more actors involved and the stronger the links between them, the better the exchange of information and knowledge will be ([Mariotti and Delbridge, 2012](#)). Thus, large and tightly linked networks are particularly beneficial in situations of strong uncertainty, whilst they are less necessary in situations of weak uncertainty ([Burt, 1992](#)). The ecosystem logic, however, focuses on the aspect of how partners can jointly create a value proposition, with very different results: The weaker the uncertainty, the greater the number of partners – and the greater the linkages between them – who can be involved in the ecosystem, providing more modules to the joint value proposition in general, which increases its overall benefit for the customer.

On the other hand, mutual dependency among the actors has been mentioned as a core aspect of ecosystems (Adner, 2017; Christensen and Rosenbloom, 1995; Ganco et al., 2020; Moore, 1996). According to our Propositions 1a and 1b, this dependency is particularly strong in situations of weaker substantive uncertainty, given the dense connections between partners involved, whilst it is less pronounced in situations of high uncertainty. Thus, mutual dependency as a key challenge of an ecosystem is less pronounced in situations of stronger substantive uncertainty.

Proposition 2 present a surprising finding in terms of whether the design of an ecosystem is pre-defined by the orchestrator or shaped by the situation. Based on conventional wisdom, one might expect uncertainty to be the key influencing factor in this regard – the higher the uncertainty, the more essential flexibility and adaption to changing environments become, especially in inter-firm settings, such as alliances or supply chains (Albers et al., 2016; Teece et al., 2016). In contrary to these findings, our proposition shows that in ecosystems uncertainty is not an influencing factor in this regard. If an orchestrator has a small distance of knowledge, it will pre-design the alignment structure and maintain it over time, regardless of the uncertainty at hand. As Propositions 1a and 1b show, uncertainty only has an influence on the size (number of actors) of the ecosystem and the density of links deriving from the positions. Therefore, the uncertainty at hand dictates the structure of an ecosystem, while the design of activities depends on the effective distance of knowledge.

The reason for this finding is the modular structure of an ecosystem (Jacobides et al., 2018): The partners are brought in to contribute specific modules to the value proposition, modules that only function in conjunction with complementary modules provided by the other partners. Arguably, the more the design can be defined ex-ante, the more it is possible to make best use of the complementarity effects among the modules and to involve only those actors who can provide modules in the most efficient and effective ways possible. This is another difference between ecosystems and alliances and networks, since those latter concepts lack the ecosystem-specific aspects of a joint value proposition based on complementary modules (Adner, 2017; Jacobides et al., 2018).

Propositions 2 and 3 discuss another important but under-researched topic: The question of how strictly the ecosystem partners are aligned towards the value proposition, which is directly linked to the aspect of hierarchy in ecosystems. This question has been discussed (with great controversy) in previous literature (see Jacobides et al. (2018) for an overview). Some authors (e.g. Gulati et al., 2012; Jacobides et al., 2018) consider ecosystems not to be hierarchically managed – others (e.g. Alexy et al., 2013; Baldwin, 2012a; Brusoni and Prencipe, 2013; Leten et al., 2013; Nambisan and Baron, 2013; Teece, 2016) claim formal mechanisms and rules are used by the orchestrator to steer ecosystem members, even in situations of high uncertainty (Furr and Shipilov, 2018). Our empirical findings help to disentangle these contradictory findings: In all of our cases, the orchestrator(s) are clearly designing the alignment structure and are, thus, hierarchically leading the complementors within the ecosystem, regardless of the prevailing uncertainty. However, in cases where the initial orchestrator has a larger distance of knowledge and is, therefore, not able to steer the ecosystem alone, there is no hierarchy among the co-orchestrators – yet there is still a clear hierarchy between orchestrators and complementors.

These findings show another aspect in which ecosystems are different from alliances. Previous findings on alliances (e.g. Gulati and Singh, 1998; Mowery et al., 1996; Williamson, 1991) have stated that they should be managed more hierarchically in situations of higher uncertainty. In ecosystems, however, the orchestrator tries to formalise the design and to govern the partners hierarchically if the orchestrator possesses the network and knowledge necessary to do so, regardless of the uncertainty at hand. This finding can be explained based on the modular nature of an ecosystem and the complementarity effects among the modules (Jacobides et al., 2018): In order to make best use of complementarity effects, and to cope with the problem of dependency among the actors (Adner, 2017), a clearly designed alignment structure and, thus, strict governance, seems to be key.

In general, our Propositions 2 and 3 provide insights into one of the key aspects that distinguishes ecosystems from networks or alliances: Ecosystems are characterised by a joint value proposition, which can only be delivered if all actors are aligned, i.e. stick to the designed structure and activities (Adner, 2017; Jacobides et al., 2018). This, in turn, implies the significance of the orchestrator as the central player ensuring this alignment. Propositions 2 and 3 shed light on the question of how and why the allocation of roles regarding orchestrators and complementors takes place, which is a unique feature of an ecosystem, as opposed to alliances and networks (Adner, 2017; Jacobides et al., 2018).

Propositions 2 and 3 also delve deeper into the characteristics of the actors involved in an ecosystem. An ecosystem consists of actors interacting in order for a value proposition to come true (Adner, 2017). As our propositions highlight, ecosystems can profit from specialisation (which can be regarded as initial capabilities) but they don't necessarily have to. Brusoni and Prencipe (2013) and Williamson and de Meyer (2012) found that ecosystems consist of specialised actors taking over specific roles and activities, especially when uncertainty is high. On top of this Brusoni and Prencipe (2013), as well as Williamson and de Meyer (2012), highlight the importance of specialised actors, particularly for tackling complex problems. This runs counter to the findings of Hannah and Eisenhardt (2018, p. 3190) who found that in more complex strategic settings, like ecosystems, specialisation (initial capabilities) have fewer consequences than strategy does, as some required activities could not have been foreseen ex-ante. Our Proposition 2 resolves this contradiction. The Autonomous Busses, Smart Commuting, Digital Prescription, and Autonomous Delivery cases have ecosystems specifically focused on the development of joint solutions for highly complex problems, e.g. autonomous flying and driving or smart cities. These ecosystems rely on co-orchestrators being actors with the ability to assume multiple roles and activities within the ecosystem, as well as specialised complementors being involved to implement the joint value proposition. The requirement of specialised activities in an ecosystem is influenced by the initial orchestrator's distance of knowledge, regardless of the prevailing uncertainty; this contradicts the findings of Brusoni and Prencipe (2013) and Williamson and de Meyer (2012), yet explains the findings of Hannah and Eisenhardt (2018).

Our Proposition 3 sheds light on a largely under-researched topic: The question of whether ecosystems have one or several orchestrators. Whilst the existence of an orchestrator is one of the fundamental characteristics of an ecosystem (Adner, 2017; Altman and Tushman, 2017; Iansiti and Levien, 2004a; Jacobides et al., 2018; Moore, 1996), until now it has been unclear whether ecosystems can

be successfully run by several co-orchestrators, and there has been uncertainty about the conditions under which such multi-orchestrator ecosystems emerge (c.f. [Autio and Thomas, 2019](#); [Hannah and Eisenhardt, 2018](#)). [Proposition 3](#) identifies the initial orchestrator's effective distance of knowledge as a key influencing factor that defines whether or not it is beneficial for this firm to involve additional firms as co-orchestrators.

This raises several important questions for future research. Ecosystems are not considered to be stable constructs, but are expected to change over time ([Moore, 1993, 1996](#); [Rong and Shi, 2015](#)). This might be particularly true for ecosystems with several orchestrators. The initial orchestrator might learn over time, thereby reducing its distance of knowledge (over time), which, in turn, reduces the need to involve co-orchestrators as a way of overcoming that distance. Yet, how do such multi-orchestrator ecosystems develop over time? Is there a fight for power until one orchestrator takes over? Which orchestrator leads the ecosystem into the next stage of development? And how stable are such constructs – do they split into several sub-ecosystems, each of them led by one orchestrator? Our research clearly shows under which conditions such multi-orchestrator ecosystems exist. But more research is needed to gain a deeper understanding of such constructs when ecosystems mature and reach the next stages of their lifecycles. The same is true given the general focus of our paper on the alignment structure of ecosystems in early stages of the lifecycle. Thus, we call for research on alignment structures in later stages of the lifecycle. This is particularly interesting since, as described in our methods section, the alignment structure might influence the orchestrator's distance of knowledge over time – leading to a cycle of knowledge distance influencing alignment structure and alignment structure, in turn, influencing knowledge distance in the long term.

[Proposition 4](#) shed new light on the role and profile of the orchestrator. Some previous works have highlighted orchestrators as being established companies that provide key resources and commercial infrastructures (e.g. [Clarysse et al., 2014](#); [Zahra and Nambisan, 2012](#)). Others claim that the orchestrator does not have to be the largest player in the ecosystem, but could be one that uses smart power, problem framing, or informal authority (e.g. [Brusoni and Prencipe, 2013](#); [Gulati et al., 2012](#); [Williamson and de Meyer, 2012](#)). Our findings differentiate these findings more clearly by elucidating that orchestrators with a smaller distance of knowledge are typically start-ups or firms exhibiting start-up like organisation. Thus, resources, power, or firm size are less relevant in these cases compared to typical features of start-ups, such as the pace of product development, neutrality, and flexibility. Only in ecosystems led by several co-orchestrators do the firms tend to be large and established in order to have the resources in place (monetary as well as work force) to develop the joint value proposition and survive the comparably long time until the value proposition is developed and brought to the market. These new findings open up a new pathway of research, which may explain how start-ups orchestrate ecosystems, even though they face limitations, such as resource constraints or lack of reputation and brand name, factors that, arguably, are not ideal when orchestrating several interlaced companies that are dependent upon the orchestrator.

[Proposition 4](#) also demonstrates another difference between ecosystems and networks/alliances. Start-ups typically enter alliances and networks for access to resources held by corporations, whilst start-ups bring innovativeness to the alliance that corporations often lack ([Fang, 2008](#); [Hu et al., 2017](#); [Rothaermel and Deeds, 2004](#); [Wuyts et al., 2004](#)). As our findings reveal, this is also true for ecosystems: Most of the start-ups possess innovative technologies that are important enablers of the innovation the ecosystem is striving to create. However, a key factor distinguishing ecosystems from alliances and networks is the strong focus on the creation of a joint value proposition ([Adner, 2017](#); [Jacobides et al., 2018](#)). This leads to a start-up taking on an additional role when it is the orchestrator: Organising the development of the joint value proposition and ensuring alignment. As our findings and [Proposition 4](#) demonstrate, the start-up's main advantage in this role, compared to corporations, is its higher flexibility, agility, and neutrality, which are important qualities of an orchestrator. Thus, and especially in cases such as Insured Factoring, where the start-up does not possess any technologies but is merely the orchestrator of the ecosystem, the start-up is a key player in the ecosystem simply because of its ability to orchestrate. This finding adds an important contribution to the literature on start-ups in inter-firm collaborations and opens up interesting pathways for future research, such as: How can start-ups be evaluated if their mere purpose is the orchestration of an ecosystem? What are the resulting investment strategies? And which factors influence whether a start-up becomes the orchestrator of an ecosystem or not? For instance, do such start-ups display effectuation or a causation approach to decision-making (e.g. [Palmié et al., 2019](#); [Saravathy, 2001](#))? What kind of investors would be interested in such start-ups? And does the risk of failure for start-ups decrease or increase if they are orchestrating ecosystems? There are also questions from the perspective of the complementors in a start-up-led ecosystem: How can partners secure the success of the start-up and avoid failure of the ecosystem as a whole? What are (financial) strategies to possibly integrate such start-ups in later stages? How can corporations use start-ups to drive innovation in ecosystems? These are just a few questions that emerge from our fourth proposition, which, we hope, opens up a new stream of research in the entrepreneurship literature and beyond.

Additionally, applying the attention-based view to ecosystems helps to gain a better understanding of this emerging phenomenon and might open up intriguing pathways for future research along these lines. In this vein, our propositions reveal two different types of ecosystems. First, in the case of a smaller effective distance of knowledge between the orchestrator and the field of business the ecosystem is focused on, the orchestrator focuses its attention on partners and potential value propositions closely related to the existing domain of experience and knowledge, which can be seen as local search ([Afuah and Tucci, 2012](#); [Cyert & March 1963](#); [March and Simon, 1958](#)). In such situations, the ecosystem is clearly focused on the realization of the joint value proposition and further actors are involved solely for this objective. Second, in the case of a larger effective distance of knowledge, the ecosystem involves some actors for the materialization of the value proposition, and involves others to serve as co-orchestrators, who mostly provide the knowledge and network to understand the ecosystem's field of business. Given the larger effective distance of knowledge, the orchestrator has to conduct distant search, since the field of business the ecosystem is focused on is not related to its prior experience and knowledge base ([Afuah and Tucci, 2012](#); [Cyert & March 1963](#); [March and Simon, 1958](#)). Extant research in the context of attention has argued that local search offers several advantages over distant search, since it allows firms to pay attention to and utilise novel knowledge and information faster and more accurately ([Ocasio, 1997](#); please, also see [Anand et al., 2016](#); [Denrell & March 2001](#);

Helfat, 1994; Knudsen and Levinthal, 2007). Even though our qualitative research design does not allow for a performance evaluation of the different types of ecosystems identified in this study, we argue that the orchestrator does achieve a higher financial return when the effective distance of knowledge is smaller. In such situations, ecosystem actors are brought in because they are specialised in the activities and contributions that help achieve the value proposition, which, arguably, increases the ecosystem performance compared to ecosystems where actors are not specialised in their specific activities. Also, if additional orchestrators are involved in the ecosystem, they will demand their share of the overall returns, which reduces the initial orchestrator's share. Thus, we argue that local search is advantageous in an ecosystem context (and not just in classical one-firm settings).

Local search is also associated with a lower degree of innovation (e.g. Fleming, 2001; Fleming and Sorenson, 2001; Katila and Ahuja, 2002) and a lower potential for substantial performance improvements in complex environments, since building novel solutions upon existing knowledge reduces the extent of knowledge recombination (Fleming, 2001). In addition, innovative solutions are less likely to be found in the vicinity of the existing experiences (Barnett, 2008; Levinthal, 1997). Yet our study shows that ecosystems are an exception to these findings. Even though the orchestrator conducts local search in situations with a smaller effective distance of knowledge, our cases clearly show that the ecosystem is able to create a highly innovative solution. In fact, creating a value proposition that is based on non-generic, thus very innovative, modules is a core aspect of the ecosystem concept (Jacobides et al., 2018). Therefore, ecosystems might be an alternative way for firms to step into novel fields of business and create substantial innovations without leaving the existing domain of knowledge and without being forced to conduct distant search.

Previous research has introduced various means of conducting distant search, since it is considered to be more difficult to perform than local search (Cohen and Levinthal, 1990; Cyert & March 1963). Research has shown that drawing on actors from outside of an organisation may facilitate broader search (Rosenkopf and Nerkar, 2001; Schildt et al., 2005) (please see Posen et al., 2018 for an overview). Our research introduces ecosystems as a further means of conducting distant search. This offers an intriguing pathway for future research to explore how the distinctive features of ecosystems, such as collaborations between actors from different backgrounds on a joint value proposition, mutual adjustments of unique or supermodular modules, or multilateral collaborations among actors (Adner, 2017; Jacobides et al., 2018), affect distant search. In general, if the single firm is no longer adequate as the primary level of analysis, and ecosystems are replacing traditional thinking in firms and single organisations, so too should the attention-based view of the firm develop into an attention-based view of ecosystems. We hope this study, as one of the first to apply this theory to ecosystems, will spark future research along these lines.

6. Practical implications

Given the growing significance of ecosystems both in research and also in industry practice, we would like to channel our findings into several implications for practitioners, especially for companies serving as ecosystem orchestrators.

Our first proposition emphasises the significance of the substantive uncertainty of the environment as a core influencing factor on the design of an ecosystem. The weaker the uncertainty, the larger the ecosystem (i.e. more actors and positions) and the greater the links among the actors. This leads to an ecosystem with greater, stronger complementarity effects among the modules provided by the actors involved and, thus, provides greater benefits to the ecosystem's customers. Therefore, ecosystems might be particularly beneficial in situations of weak substantive uncertainty (c.f. Proposition 1).

According to Propositions 2, 3, and 4, the effective distance of knowledge of the initial orchestrator driving the ecosystem is a key influencing factor on how the ecosystem will be designed and shaped. The smaller the effective distance of knowledge, the stronger of an alignment structure the orchestrator will design, and, thus, will govern the ecosystem by itself, resulting in a single orchestrator ecosystem. The orchestrator will also greatly pre-define the ecosystem structure and activities. Ideally, the orchestrator shows characteristics of a start-up, namely speed of product development, agility, and flexible forms of organisation. Thus, if the orchestrator of such an ecosystem appears to be a corporation, it might consider founding a spin-off or acquiring a start-up or a small firm as an orchestrator for the ecosystem. The larger the initial orchestrator's distance of knowledge, the more likely it will be to involve additional partners as orchestrators, and a multi-orchestrator ecosystem will emerge. The activities will be flexible and adjusted to the situation at hand, with the orchestrator ideally showing characteristics of a corporation – mostly solid funding and a reputation as a trustworthy partner, despite there being no clearly defined value proposition at the beginning.

CRedit authorship contribution statement

Bernhard Lingens: Conceptualization, Validation, Investigation, Data curation, Writing - original draft, Writing - review & editing. **Lucas Miehé:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing, Visualization, Project administration. **Oliver Gassmann:** Conceptualization, Data curation, Supervision.

Acknowledgements

We would like to thank the editor and the two anonymous reviewers for their suggestions, which greatly contributed to the quality and maturity of our article. Also, we received valuable feedback from Christoph Lechner, Maximilian Palmié, Vangelis Souitaris, Naomi Häfner, Pietro Beritelli, Marc van Essen, Marko Seppänen and the anonymous reviewers and the participants of the Top Scholar Seminar 2018 at University of St. Gallen. Appreciated feedback was received during ISPIM and EURAM conferences (both in 2018). We thank our interview partners for taking time for our research. Research assistance by Nicolas Staub and Manoj Kahdan is gratefully acknowledged.

Appendix 1. Initial interview questions for the orchestrator

Ecosystems

- What is the value proposition of the ecosystem for the end customer?
- Please sketch the ecosystem by drawing and explaining the partners, their roles, benefits, contributions, and relationships necessary for this value proposition to be delivered.
- How is the value creation generated and distributed within the ecosystem? What are the activities of the respective partners?
- How are the partners linked with each other? How rigid or flexible are the respective positions?
- How closely are the partners intertwined? How deep are the links among the respective partners?
- What are the features, strength, weaknesses, and contributions of the partners involved?
- How is the ecosystem governed?
- Which partner(s) is/are responsible for its governance?

External conditions

- In your opinion, how is your company perceived by its clients (e.g. as a quality leader, trusted partner/company)?
- What are the market conditions that are most relevant for your ecosystem? Why is that the case?
- Is your market competitive?
- How do you assess market and technology risks in your environment? Is the environment uncertain or hard to estimate?

Internal conditions

- How would you describe the structures, behaviour, and culture of your company?
- Why are you the orchestrator of your ecosystem?
- What are your strengths and weaknesses, especially regarding innovation?

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