

**Orchestration of Innovation in Ecosystems:
An Analysis of the Development and Management of Ecosystem Initiatives**

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Executive Summary (English)

The success factors for companies are changing fundamentally. Digitalization and globalization have caused a reordering of traditional industry boundaries, and firms can no longer meet customer expectations in isolation. In a more borderless economy, it is crucial to create a mindset more open to expanding the view of competitors and market possibilities. As boundaries between industries become blurred, companies need to consider partnering with other players, from corporations, to startups and public institutions. As a result, firms from various industries will develop or be part of ecosystems. Ecosystems – a novel way of cooperating – have the power to create a customer-centric, simplified joint value proposition that expands a product or service beyond what an end-user could previously obtain from a single firm. The combination of partners' complementary skills enables an ecosystem to meet customer demands and allows firms to stay competitive. Yet, understanding the complex nature of this underlying phenomenon is a challenge for both theory and management alike.

Despite significant interest in ecosystems, the following questions remain unexplored: (i) the development of ecosystems, (ii) the role of startups as orchestrators within ecosystems, and (iii) the impact of ecosystems on innovation as R&D intensity. As a result, this thesis will be guided by these three research gaps. In order to provide the information needed, this dissertation uses two methodological approaches. It is based on two qualitative case studies (Chapter 2 and Chapter 3) and one quantitative text mining analysis with R, over the years 2013–2018 (Chapter 4 C), to explore the underlying phenomenon. I was one of the first to study the establishment of an ecosystem in general. Besides identifying four archetypes of ecosystems, my findings highlight the importance of search in the development process. Secondly, and contrary to the existing literature on the role of a startup as an orchestrator, I am able to prove that an ecosystem can be successfully orchestrated by a startup. Lastly, my findings highlight the relevance of ecosystems for innovation and R&D. My insights reveal that most STOXX Europe 50 companies engage in ecosystems to innovate and show an increasing trend of R&D intensity.

The dissertation focuses on several contributions to the literature on ecosystems and provides hand-on guidance for practitioners.

Executive Summary (German)

Die Erfolgsfaktoren für Unternehmen verändern sich grundlegend. Digitalisierung, und Globalisierung führen zu einer Neuordnung der traditionellen Branchengrenzen. Unternehmen können die Kundenerwartungen an neuen Innovationen nicht mehr alleine bewältigen. In einer grenzenloseren Wirtschaft ist es entscheidend, eine breitere Denkweise zu schaffen, um den Blick auf Wettbewerber und Marktmöglichkeiten zu erweitern. Da die Grenzen zwischen den Branchen immer mehr verschwimmen, müssen Unternehmen eine Partnerschaft mit anderen Akteuren wie Konzernen, Startups und öffentlichen Institutionen in Betracht ziehen. Infolgedessen werden Unternehmen aus verschiedenen Branchen Ökosysteme entwickeln oder Teil von diesen werden. Ökosysteme – sind eine neue Art der Zusammenarbeit - haben die Macht, ein kundenorientiertes, vereinfachtes gemeinsames Wertversprechen zu schaffen, das ein Produkt oder eine Dienstleistung kreiert, die der Endnutzer in dieser Form zuvor nicht erhalten konnte. Die Kombination, der sich ergänzenden Fähigkeiten, der Partner ermöglicht es einem Ökosystem, die Kundenanforderungen zu erfüllen und die Unternehmen wettbewerbsfähig zu halten. Das Verständnis der komplexen Natur dieses zugrunde liegenden Phänomens ist sowohl für die Theorie als auch für das Management eine Herausforderung. Trotz des großen Interesses bleiben Fragen bezüglich (i) der Entwicklung des Ökosystems, (ii) der Rolle von Startups als Orchestrator und (iii) der Auswirkungen von Ökosystemen auf die Innovation als F&E-Intensität bislang unerforscht. Diese drei Forschungslücken bilden die Grundlage für diese Dissertation. Um die benötigten Informationen zu liefern, verwendet diese Dissertation zwei methodische Ansätze. Sie stützt sich auf zwei qualitative Mehrfach-Fallstudien (Kapitel 2 & 3) und eine quantitative Text-Mining-Analyse mit R über die Jahre 2013-2018 (Kapitel 4), um das zugrunde liegende Phänomen zu untersuchen. Ich war einer der Ersten, der die Errichtung eines Ökosystems im Allgemeinen untersucht hat. Neben der Identifizierung von vier Archetypen von Ökosystemen unterstreichen meine Ergebnisse die Bedeutung der Suche im Aufbauprozess. Zweitens, und im Gegensatz zur vorhandenen Literatur, kann ich beweisen, dass ein Ökosystem erfolgreich durch Startups orchestriert werden kann. Und schließlich unterstreichen meine Ergebnisse die Bedeutung von Ökosystemen für Innovation und F&E. Meine Erkenntnisse zeigen, dass die meisten Unternehmen von STOXX Europe 50 versuchen sich in Ökosystemen zu engagieren, um Innovationen zu fördern. Die Dissertation konzentriert sich auf mehrere Beiträge zur Literatur über Ökosysteme und bietet Anleitungen für Praktiker.

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List of Abbreviations

3D	Three-Dimensional
3G	Third Generation
5G	Fifth Generation
AI	Artificial Intelligence
App	Application
API	Application Programming Interface
B2B	Business-to-Business
B2B2C	Business-to-Business-to-Customer
B2C	Business-to-Customer
B2G	Business-to-Government
CAGR	Compounded Annual Growth Rate
CEO	Chief Executive Officer
C-level	Chief-level
cf.	confer (compare to)
CO ₂	Carbon Dioxide
COO	Chief Operating Officer
e.g.	exempli gratia (for example)
ERI	European Innovation
et al.	et alii (and others)
etc.	et cetera (and so forth)
FMCG	Fast Moving Consumer Goods
i.e.	id est (that is)
IT	Information Technology
IoT	Internet of Things
IP	Internet Protocol
M&A	Merger & Acquisition
M2M	Machine-to-Machine

Min.	Minute
MVP	Minimum Viable Product
n.a.	not available
p.	page
P&C	Property & Casualty
PDF	Portable Document Format
R&D	Research & Development
RGP	Redemption Grace Period
SME	Small and Medium Enterprise
TV	Television
VC	Venture Capital
vs.	Versus

1 Innovation through Ecosystems

1.1 Introduction to the Relevance and Overall Structure

1.1.1 *Ecosystems as a Business Model for Driving Innovation*

In recent years, *innovation* has been a hot topic in management studies, with recognition of the reshaping taking place in organizations of all kinds and sizes, as well as the resulting new customer value (Tidd & Bessant, 2018). One such example is *ShareNow* (former *Car2Go* and *DriveNow*), which was able to create superior customer value by successfully implementing the so-called ‘ecosystem business model’. This specific ecosystem, consisting of the key actor *Daimler AG* and a number of complementary actors offers the world’s first and largest ‘free-float’ carsharing service through an app that allows members to temporarily hire a car (Herrmann et al., 2014; Leminen et al., 2012; Rong et al., 2015a). A notable benefit of *ShareNow* is that cars can be picked up and dropped off wherever and whenever the customer wants (Herrmann et al., 2014). Moreover, unlike a regular car rental business where a fixed amount of rental time is offered to a client, the *ShareNow* model allows cars to be rented by the minute (Gassmann et al., 2014). *Daimler AG*, *BMW Group*, and their partners were able to create unique customer value by building a successful ecosystem in *ShareNow*. This example illustrates how building up an ecosystem can create unique customer value by offering an easy, flexible, and complete customer experience. It shows how actors seek cooperation with partners in an ecosystem in order to create an innovative business model that they would not be able to realize in isolation (Adner, 2006; Chesbrough, 2006; Fjeldstad et al., 2012; Moore, 1993, 2006). However, an important question remains: How do ecosystems, such as *ShareNow*, develop from a business model to a system that offers value?

A business model describes *who* the customers are, *what* goods or services should be offered, *how* that market offering is created, and *why* the business is profitable (Gassmann et al., 2014). Similar to other business models, the ecosystem, at its core, aims to create value for the customer (Kandiah & Gossain, 1998; cf. Zott & Amit, 2010; Zott et al., 2011). In practice, a business model is often seen as a description of how ‘a business is run’ (Zott et al., 2011). Specifically, a business model encompasses all activities that serve the fulfillment of an overall objective (Zott & Amit, 2010), which – in the case of an ecosystem business model – is the joint value proposition (Adner,

2017; Cusumano & A., 2014; Iansiti & Levien, 2004b; Moore, 1993, 1996). In that sense, an ecosystem business model describes the entirety of activities in a system of mutually interdependent actors, as well as the mechanisms connecting these activities (Jacobides et al., 2018; Zott & Amit, 2010, 2015b). The *magic-triangle*, developed by Gassmann et al. (2014), is a popular and comprehensive tool to describe the components of a business model. It addresses both internal and external perspectives of a business model: *who* and *what* refer to external aspects, whereas *how* and *why* address the internal dimensions. Figure 1 below shows how these four dimensions of a business model relate to each other:

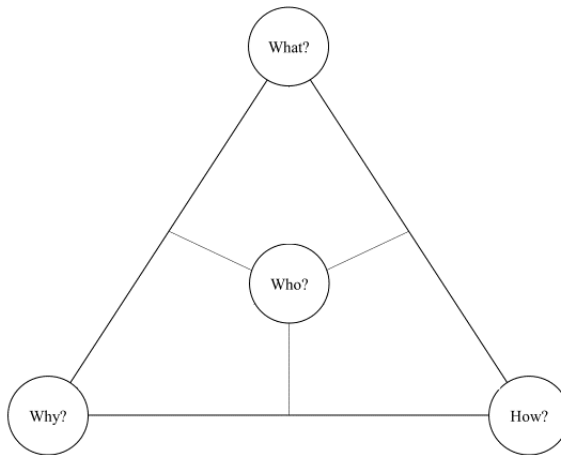


Figure 1: Business Model Triangle according to Gassmann et al. (2014)

In the context of the ecosystem topic, it is important to note the holistic characteristics of the business model concept: By bringing together internal and external factors that contribute to a market offering, a business model aims to illustrate the whole picture (cf. Leih et al., 2015; Martins et al., 2015; Teece, 2010, 2018a; Zott & Amit, 2015a; Zott et al., 2011). Therefore, the business model is seen as a concept spanning the boundaries of a single firm (Gassmann et al., 2014): A business model depicts how a focal actor interacts with and, thus, is embedded in its surrounding ecosystem (Shafer et al., 2005; Zott & Amit, 2010).

Who – the customer

Since every business model caters to a specific customer group, it is important to understand *who is* and *who is not* part of that customer segment (Gassmann et al., 2014). Only with that knowledge can companies create a market offering that generates targeted value (Chesbrough & Rosenbloom 2002; Hamel 2000; Gassmann et al., 2014). Customers are at the very core of every business model and should therefore always be the starting point of all business considerations (Gassmann et al., 2014).

What – the value proposition

This second dimension of a business model describes the offering brought to the market and is, thus, the manifestation of how the company intends to meet the customers' needs (Gassmann et al., 2014).

How – the value chain

The *how* of a business model describes the value chain that yields the final market offering, i.e. the processes and activities resulting in the value proposition in conjunction with the necessary resources and capabilities, as well as their coordination (Gassmann et al., 2014).

Why – the profit mechanism

The last dimension describes how a business model is financially attractive or, essentially, how the business aims to make money. As such, it includes various financial elements, such as the cost structure, as well as the revenue mechanisms (Gassmann et al., 2014).

When considering these business model components and their interdependencies, the complex nature of the business model concept becomes very apparent (Gassmann et al., 2014). Value is, therefore, not realized by one component in isolation. In line with that idea, ecosystems can be embedded in the business model concept. Ecosystems have the overall purpose of creating a joint value proposition, which ecosystem partners could not create by themselves and, thus, they enable actors to innovate beyond the boundaries of their own limited resources, capabilities, and markets (Adner, 2017; Cusumano & A., 2014; Iansiti & Levien, 2004b; Moore, 1993, 1996). Innovation in the context of such a complex system consequentially entails great potential, but can also turn out to be very challenging (Brusoni & Prencipe, 2013; Clarysse et al., 2014; Gassmann et al., 2014; Moore, 1993).

In turn, the following Chapters will primarily focus on illuminating the innovative potential of an ecosystem business model in addition to creating a general understanding of the ecosystem concept.

1.1.2 The Significance of Ecosystems for Innovation

With the rise of information technology, the business focus gradually shifted from the supply side to the demand side of the market. As such, this transition affected every aspect of market dynamics and signified a new business paradigm (Kandiah & Gossain, 1998). In recent years, customers have increasingly demanded integrated solutions rather than single products or service applications (Williamson & de Meyer, 2012). Consequentially, a profit-maximizing company has an inherent interest in meeting these needs.

One company alone can no longer meet these new customer expectations, which have been fostered by the potential of digitalization (Adner, 2006; Jacobides et al., 2018; Williamson & de Meyer, 2012). By focusing on the customer, companies in many industries have recognized the need for change: Companies must step away from a singular, vertically integrated approach to value creation and start drawing upon knowledge and capabilities that are dispersed globally (Williamson & de Meyer, 2012). Digitalization is not only changing customer expectations but is also fundamentally transforming whole industries and eroding their boundaries. New technologies allow companies to serve customers with a holistic value proposition by bringing together sectors and businesses that once appeared disconnected (Atluri et al., 2017). As a result, companies seek cooperation with partner firms in order to attain the innovation a single player would not be able to achieve alone (Adner, 2006; Chesbrough, 2006; Fjeldstad et al., 2012; Moore, 1993, 2006). A multitude of actors add complementary contributions, which together add up to a mutual value proposition (Adner, 2017; Jacobides et al., 2018). These contributors are significantly autonomous, yet interdependent, and are therefore characterized by modularity (Jacobides et al., 2018). As such, the interdependence of distinct modules differentiates ecosystems from other governance forms aimed at the co-creation of value (Adner, 2017). The interconnection between ecosystem partners enables the materialization of an ecosystem's focal value proposition, which is at the very core of the ecosystem's purpose. Importantly, for an ecosystem to matter, it must consist of a multiplicity of partners with relationships that cannot be broken down to a mere aggregation of bilateral partnerships. Partners must interact across industries and thus form multilateral relationships (Adner, 2017). This

particular form of relationship turns ecosystems into complex systems (Brusoni & Prencipe, 2013; Clarysse et al., 2014; Moore, 1993).

Having touched upon an ecosystem's general characteristics, the question arises of how they emerge. In essence, companies have to deliberately establish and groom ecosystems as they do not develop autonomously (Adner, 2017; Jacobides et al., 2018). In other words, it requires a conscious and intentional effort for an ecosystem to emerge (Jacobides et al., 2018). In order to establish an ecosystem, companies not only have to identify potential partners, but they also have to settle on a joint value proposition (Adner, 2017; Moore, 1993). This mechanism will be further explained in Chapter 1.2.2. Furthermore, the ecosystem's distinctive properties pose a number of challenges to its partners (Adner, 2017; Jacobides et al., 2018). Similar to the ecosystem as a whole, the value proposition is characterized by modularity. The value proposition, thus, consists of different modules, which are both non-generic and complementary. Hence, each partner's contribution to the value proposition has to be specifically developed and only the aggregated totality of all contributions results in the full customer value (Jacobides et al., 2018). As a result, there is a strong mutual dependency among the partners and a single firm's isolated contribution to the ecosystem is of relatively little value. This dynamic creates a *chicken-and-egg problem*: Companies often demonstrate hesitation when it comes to joining an ecosystem as their adapted individual contribution loses its generic value (Dattée et al., 2018; Jacobides et al., 2018). A solution to overcoming this problem is for the companies that are leading ecosystem initiatives to convince and assure potential partners, as well as promote mutual alignment (Adner, 2017; Altman & Tushman, 2017; Jacobides et al., 2018). This consideration leads the way to the specific measures a driving company – or orchestrator – has to take for the whole ecosystem to succeed. The study at hand accordingly aims to analyze the construction of an ecosystem. Looking at the type of company inclined to join an ecosystem, it can further be argued that ecosystems are especially attractive for start-ups as they allow for innovation and development a single firm would not be able to attain alone due to limited resources of all kinds (Adner, 2006; Chesbrough, 2006; Fjeldstad et al., 2012; Moore, 1993, 2006). Regarding a company's position in an ecosystem, the question arises of whether and how startups take up the orchestrator role (e.g. Jacobides et al., 2018).

As shown by many real-life examples and previous research (cf. Kiron et al., 2013; Lindgardt et al., 2009), competitive advantage and, thus, profits are often not dependent solely on unique ideas or products, but rather benefit most from an innovative business

model (Gassmann et al., 2014). As a result, this thesis will offer further analysis on these conditions and dynamics that are present in the ecosystem business model.

1.2 Attempt at a Definition

1.2.1 Terminology and Comparison to Natural Ecosystems

The concept of business ecosystems, first introduced by Moore (1996), was derived from the idea of a self-regulated ecological ecosystem. In his contribution to *The Antitrust Bulletin* (2006) on business ecosystems, Moore states:

“Like the idea of democracy galvanizing a society, the idea of a business ecosystem provides a vision and proof of concept that multiple contributors with differing interests can join in common cause.” (p. 55).

With this quote, Moore (2006) hints at what the different actors in an ecosystem have in common and what brings them together, despite differing interests – the joint value proposition. In that sense, an ecosystem is a network based on both competition and cooperation. Still, the question of what specific characteristics define a business ecosystem remains.

Ritala and Almanopoulou (2017) argue that in order to achieve a consistent definition of the term *ecosystem*, attention has to be given to both the *eco* and the *system* aspects of an ecosystem. The prefix *eco* implicitly suggests an analogy to ecology or natural ecosystems (cf. Moore, 1993; Oh et al., 2016; Ritala & Almanopoulou, 2017). While a number of authors argue in favor of such an analogy or simply make use of it (e.g. Geels, 2002; Huggett, 2011; Pickett & Cadenasso, 2002; Ritala & Almanopoulou, 2017; Zahra & Nambisan, 2012), others (partly) question its applicability or leave it behind altogether (e.g. Oh et al., 2016; Papaioannou et al., 2009). Introduced to management studies by Moore (1993), the ecosystem concept relates to the idea that every entity in an ecosystem exists in a network of interdependencies: Each actor affects and is affected by other actors and is, thus, part of a constant process of co-evolution within the ecosystem (Moore, 1993, 2006).

The second part of the term – *system* – refers to the totality of distinct components that exhibit interdependencies between each other, and therefore form the system as a whole, which is distinguished from other systems (Rogers, 2010; Von Bertalanffy, 1956). In management studies, ecosystem literature widely recognizes the applicability of a system science perspective (e.g. Hartvigsen et al., 1998; Peltoniemi, 2006). When taking the innovative capabilities of an ecosystem into consideration, existing research

depicts business ecosystems as a form of complex adaptive system (e.g. Anderson, 1999; Cilliers, 2005; Durst & Poutanen, 2013; Xiaoren et al., 2014). In the past 30 years of management research, a number of authors have compared business dynamics to natural ecosystems (e.g. Hannan & Freeman, 1989; Moore, 1993; Nelson & Winter, 1982; Schot, 1998). Notably, Huggett (2011) creates a link between emergent business models and biological observations. This comparison is especially interesting when considering the start-up focus of this thesis.

Mainly due to the accessibility it creates for readers who are not familiar with the ecosystem topic, the natural ecosystem metaphor attained a certain popularity in social sciences and economics, including the field of business ecosystem research (Corallo et al., 2007; Corallo & Protopapa, 2007; Pickett & Cadenasso, 2002). Accordingly, the mentioned analogy finds its place in state-of-the-art ecosystem research (see Chapter 1.3). First, it is important to highlight its limits while diving further into the ecosystem terminology. In today's time of globalization, a big limitation of the natural ecosystem analogy is its roots in territorial conditions. While natural ecosystems can be big in size, they are local (i.e. the Sahara Desert). Conversely, business ecosystems can be globally dispersed. Moreover, a comparison to natural ecosystems seems flawed in light of the designed and purposeful character of a business ecosystem. While natural ecosystems are the product of natural development and coincidence, business ecosystems must be designed and intentionally developed (Corallo & Protopapa, 2007; Dattée et al., 2018; Jacobides et al., 2018; Papaioannou et al., 2009). Business ecosystems change, adapt and evolve over time, which is both in contrast to and yet comparable with ecological or biological ecosystems (Zahra & Nambisan, 2012).

The terms 'business ecosystems' and 'innovation ecosystems' are often applied synonymously in existing ecosystem literature (e.g. Aarikka-Stenroos & Ritala, 2017; Adner, 2017; Gawer & Cusumano, 2014; Jacobides et al., 2018; Ozalp et al., 2018; Williamson & de Meyer, 2012). In a recent literature review, de Vasconcelos Gomes et al. (2018) were able, however, to identify a transition in literature 'from business ecosystem to innovation ecosystem' (p. 30). On that same note, the question of how different ecosystem concepts are distinguished arises. The next subchapter therefore aims to answer this question and equally differentiate ecosystems from other governance forms aimed at the co-creation of value.

1.2.2 Differentiation of Ecosystem Concepts and Comparison to Other Systems

With multilateralism as a differentiating characteristic (see Chapter 1.1.2), ecosystems can be distinguished from other configurations of activities and actors aimed at the materialization of a value proposition, such as platforms or networks (Adner, 2017). These constructs do, however, have some components in common with ecosystems, creating certain overlaps (Adner, 2017; Altman & Tushman, 2017; Gawer & Cusumano, 2014; Jacobides et al., 2018). It is therefore important to specifically differentiate ecosystems from other constructs of interdependence. New technologies reducing transaction costs made way for the rise of ecosystems (Adner, 2017; Baldwin & von Hippel, 2011), which was crucial given the ecosystem's necessity for collaboration (Adner & Kapoor, 2010; Jacobides et al., 2018; Moore, 1996; Teece, 2016). Ecosystems structurally resemble networks and can be viewed as a web of alliances (Jacobides et al., 2018). Nevertheless, alliances and ecosystems only overlap partly and alliances 'clearly represent a very specific subset of them' (Jacobides et al., 2018). The fact that partners within an ecosystem are indispensable for the materialization of a joint value creation (Adner, 2017) distinguishes ecosystems from platforms (e.g. Gawer & Cusumano, 2002; Parker et al., 2016a), networks (e.g. Gulati, 1998, 1999; Gulati et al., 2000; Powell et al., 1996), or multi-sided markets (Hagiu & Wright, 2015; Rochet & Tirole, 2003). Research examining network or alliance constructs focuses on the interactions between the individual firms (e.g. Gulati et al., 2012; Powell et al., 1996). Ecosystem research takes this one step further and focuses on the purpose behind the collaboration between ecosystem members (i.e. the joint value proposition). However, the findings from the related field of platform research should not be entirely ignored when looking at the topic of ecosystems. The mechanisms found in platforms, especially the interconnection of complementors via the platform, yield valuable insights for ecosystem research (e.g. Gawer & Cusumano, 2002; Parker et al., 2016a). Aspects such as applied technology, network effects, or the study of inter-partner transactions (cf. Eisenmann et al., 2011; Gawer, 2014) are equally important for the examination of ecosystems.

Moreover, a comparison of ecosystems and alliances shows that the literature streams for both ecosystem research and network and alliance literature indicate a specific overlap: In certain situations, ecosystems and alliances can serve the same purpose. Network and alliance literature predominantly focuses on information and knowledge exchange for the establishment of theoretical and conceptual constructs (Ahuja, 2000; McEvily & Zaheer, 1999; Muthusamy & White, 2005; Powell, 1998; Powell et al.,

1996; Uzzi, 1996). Similarly, the exchange of information and knowledge (see also *knowledge ecosystem*) can be actively promoted by the instalment of an ecosystem. These two constructs of interdependency can therefore, and in certain situations, have the same generic motive.

The specific differences between different ecosystem forms will be elaborated upon in the following paragraphs.

Differentiation of ecosystem concepts

In existing ecosystem research, the ecosystem metaphor has not yet been clearly defined and, thus, a number of different – but not clearly distinguished – ecosystem concepts can be found in literature (de Vasconcelos Gomes et al., 2018; Valkokari, 2015).

Valkokari (2015) states that it is beneficial to distinguish the different ecosystem concepts along the lines of the ecosystem outcomes, the logic of the action (i.e. the rules), the interactions, and the actor roles. In an attempt to fill this gap in research, she names and distinguishes three main ecosystem concepts: (1) business ecosystems, (2) innovation ecosystems, and (3) knowledge ecosystems. Additionally, it is useful to further define and distinguish (4) platform ecosystems (Ceccagnoli et al., 2011; Cennamo & Santalo, 2013; Gawer, 2014; Gawer & Cusumano, 2014), as well as (5) entrepreneurial ecosystems (Acs et al., 2017; Prahalad, 2009).

The following subchapters will give a brief overview of the concepts named above, which will be summarized in Table 1 by comparing the different types of ecosystems.

Ecosystem concept:	Business ecosystem/ Innovation ecosystem (1)	Platform ecosystem (2)	Knowledge ecosystem (3)	Entrepreneurial ecosystem (4)
Definition	Merger of independent partners who aim to create a joint value proposition (Thomas & Autio, 2020)	Independent partners focus on shared connectivity to create complements that enhance the value offering (Thomas & Autio, 2020)	Merger of independent partners who accelerate the translation from research knowledge into products or services (Thomas & Autio, 2020)	Merger of independent entrepreneurs who aim to develop new entrepreneurial ventures (Thomas & Autio, 2020)
Logic	Orchestrator manages and aligns ecosystem partners to create a joint value proposition	Facilitators create mutual exchange between heterogeneous consumer groups who would not interact otherwise	Actors around knowledge exchange for the benefit of all partners	Regional dynamic and self-regulating network to create innovation opportunities
Key actors	Orchestrator of ecosystem	Platform orchestrator	Universities & public research organizations	Entrepreneurs
Example	Swiss Post Logistics, 5G, Tailor Fits	App Store, Amazon Marketplace, Alibaba	Bayern Innovativ, Research Collaborations, Community Events	Silicon Valley, Hubs, Accelerators

Table 1: Overview of different ecosystem types

The first concept – **business ecosystems** – is defined in line with the definition provided by Moore (1996). As mentioned above, the interdependent relationship between distinct modules distinguishes business ecosystems from other governance forms aimed at the co-creation of value and other concepts within strategic management (Adner, 2017; Teece, 2007, 2016). The noteworthy definition in ecosystem literature comes from Moore (1996), who defines a business ecosystem as ‘an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world’ (p. 26). The majority of existing ecosystem research focuses on a business ecosystem’s role in creating competitive advantage or value for the ecosystem actors, as well as for the ecosystem as a whole (Adner, 2012; Adner & Kapoor, 2010; Iansiti & Levien, 2004a). In this stream of literature, business ecosystems are described as coordinative systems, which serves an economic purpose and rely on a multitude of interdependent actors that produce complementary and modular products and services (Adner & Kapoor, 2010; Iansiti & Levien, 2004a; Jacobides et al., 2018; Williamson & de Meyer, 2012). A business ecosystem is therefore aimed at resource exploitation for the creation of a joint value proposition (cf. Jacobides et al., 2018; Valkokari, 2015). Further, the business ecosystem can be seen as a global coalition of competitive and cooperative relationship ties, and operates around a focal firm with the goal of simultaneous value creation and capture through the combination of

complementary resources (Adner, 2017; Jacobides et al., 2018; Milinkovich, 2008; Valkokari, 2015)). The orchestrator's role in aligning the ecosystem is central (Adner, 2017). The business ecosystem is characterized by the driving capacities of the ecosystem orchestrator (cf. Dattée et al., 2018; Jacobides et al., 2018). In this context, the variety and increased number of ecosystem entities in a business ecosystem differentiates it from other governance forms aimed at the capture of value, such as networks (Heikkil & Kuivaniemi, 2012).

As suggested above, the *innovation ecosystem* is not clearly defined and, therefore, the concept and the term are used ambiguously (Oh et al., 2016; Ritala & Almpantopoulou, 2017). In a recent study, de Vasconcelos Gomes et al. (2018) found a shift from the use of the term *business ecosystem* to the term *innovation ecosystem*. The authors discovered that the terms are distinguished from one another since the term business ecosystem relates to value capture, while the term innovation ecosystem focuses on value creation (de Vasconcelos Gomes et al., 2018). Adner and Kapoor (2010) refer to the innovation ecosystem in relation to its effect on firm performance. Similarly, Adner (2006) defines innovation ecosystems as *'[...] the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution'* (p. 2). In both of these articles, a focus on value creation becomes apparent, which is in line with the idea suggested by de Vasconcelos Gomes et al. (2018). On a more general note, Jackson (2011) defines an innovation ecosystem as *'the complex relationships that are formed between actors or entities whose functional goal is to enable technology development and innovation'*. van der Borgh et al. (2012) locate ecosystem value in innovation on either the individual company level or a subordinate innovation community. From the statements above, it becomes clear how closely related the concepts of innovation ecosystems and business ecosystems are. When looking at the aspect of 'change' in an innovation ecosystem, its ultimate goal is the co-creation of value through the implementation of a clear innovation strategy (Adner, 2006). Lastly, and to summarize this differentiation, it should be noted that the innovation ecosystem integrates certain aspects of other forms of ecosystems as it needs both the exploration (knowledge) and exploitation (business) aspects of ecosystem dynamics in order to generate novelty (Valkokari, 2015). I therefore define business ecosystems and innovation ecosystems as similar concepts, but nevertheless want to highlight the focus on innovative capacities in the latter as this aspect distinguishes these two types of ecosystems from each other. The graphic below, Figure 2, visualizes the separation of the two definitions at a certain stage. However, according to the literature stream, the

two concepts eventually merge to form one definition. For this reason, the business ecosystem and the innovation ecosystem are also summarized in the same column in Table 1.

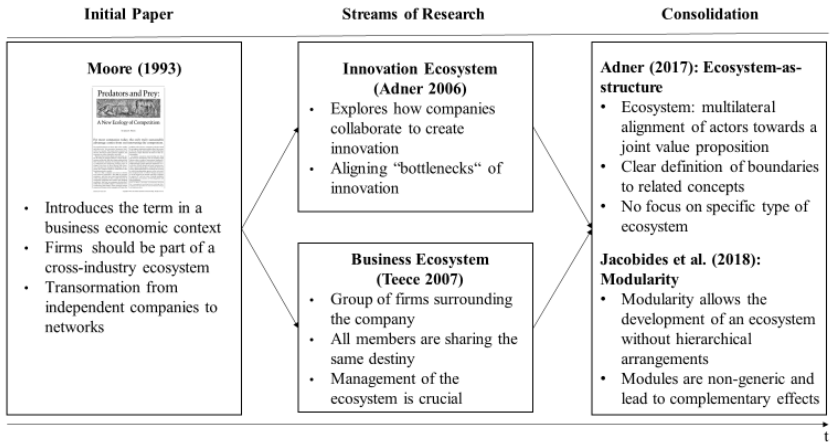


Figure 2: Visualization of the merger of business and innovation ecosystems

A related stream of ecosystem research focuses on ecosystems surrounding a platform. The primary scope of this literature stream is the relationship between different customer groups via a physical or virtual platform (Evans & Schmalensee, 2016; Parker & Van Alstyne, 2005; Rochet & Tirole, 2003). Importantly, and as described in the paragraph above, an ecosystem rarely has a platform at its core (Autio & Thomas, 2014; Thomas et al., 2014). Consequentially, a platform is not a defining characteristic of an ecosystem in general (Gawer, 2014). Rather, a *platform ecosystem* differs from other ecosystem forms. In a platform ecosystem, the supply side performs the role of complementor by co-creating complementary products (e.g. Alt et al., 2010; Lucas Jr & Goh, 2009). These complementors utilize boundary resources provided by the platform provider (Ghazawneh & Henfridsson, 2013) to co-create precisely defined products or services (Boudreau, 2012). On the other side, customers in a platform ecosystem can be defined as the beneficiaries and compensators as they provide compensation through payments or by providing data. These data can be analyzed by the platform provider to increase the product quality, to tap into new markets, and to further develop the platform (Eisenmann et al., 2011). From an economic perspective, platform ecosystems are specific markets, which act as facilitators in creating mutual

exchange between heterogenous consumer groups that would not otherwise interact (Gawer, 2014). The platform provider aims to meet the needs of these customer groups while exploiting the positive network externalities (Ceccagnoli et al., 2011; Linder et al., 2003; Rochet & Tirole, 2003). These network externalities can be defined as the value of the ecosystem as it relates to the number of interactions within a platform ecosystem. Thereby, the value creation can be described as the result of scaled growth from provider and customer interactions (Eisenmann et al., 2011). The more interactions the platform allocates, the more valuable it is due to a greater variety of products and services (Scholten & Scholten, 2012). In this context, experts also refer to network effects that can be achieved by a platform. Thereby, the direct network effect can be described as a simple network effect: the increasing utility of a product or service simultaneously increases the value for the user (Kapoor & Lee, 2013). In this regard, WhatsApp is a good example to demonstrate the occurrence of these network effects. However, it should be noted that WhatsApp is used as an example of network effects in a one-sided market and is not directly related to the ecosystem concept. The application (app) can be defined a one-sided market as it basically only adds value for the user and network effects increase with the increasing number of users. This means that when WhatsApp was initially only being used by a small number of users, each new user added a higher value to the platform. However, the greater the number of users using the app, the lower the added value was for each new user. At some stage, an optimum number of users (U^*) was achieved and WhatsApp's main responsibility started to focus on continuous improvement of the app in order to remain competitive. In this vein, WhatsApp may not provide the highest security, but it benefits from the number of users using the app compared to other communication apps (e.g. Signal). At this point, the platform is scaled more by its size and less by its innovation.

In addition to the one-sided market, there can also be a two-sided platform market (Thomas & Autio, 2020). In the context of the two-sided market, the provider faces the well-known chicken-and-egg problem. The problem occurs any time the value proposition for two different groups is dependent on penetration. This means that the platform provider needs to subsidize the separate actors in an early stage of the ecosystem development to exploit the optimum network externalities (N^*) later on. If the platform reaches N^* , the ecosystem scales almost by itself as the added value is beneficial to all actors. Apple's App Store can be used as an example in this context: In the beginning the company had to subsidize individual providers to ensure the competitiveness of the App Store. Nowadays, Apple first submits new developed apps

to a quality and security assessment before they are available in the App Store. In order to continuously benefit from external network effects, Apple must ensure the continued improvement of the iPhone and the provided apps, as the iPhone and the apps provide the platform for the interactions between provider and customer, and ensure that Apple receives the profits from its network effects.

In comparison to the other ecosystem types mentioned above, the **knowledge ecosystem** has more decentralized relationship ties, which are held together merely by knowledge exchange (Quinn et al., 1998). As its name suggests, this type of ecosystem's main purpose is exploring new knowledge (Valkokari, 2015) – this is the central activity and output of the ecosystem (Järvi et al., 2018; Thomas & Autio, 2020; van der Borgh et al., 2012). Participants in and users of a knowledge ecosystem are most commonly organized around a joint knowledge search (Järvi et al., 2018). Thereby, participants aim to be part of a joint creation of new, pre-commercial knowledge in a pre-competitive market to create a collective resource that no single actor could create independently (Järvi et al., 2018; Leten et al., 2013; van der Borgh et al., 2012). It is worth mentioning that knowledge creation in this context is based on the active participation of all the participants. According to Gulati et al. (2012), the level of participation can vary by the mindset of the individual actors. In this regard, public research institutions, universities, and bridging and brokering organizations can be defined as key actors in a knowledge ecosystem (Clarysse et al., 2014; Valkokari, 2015). However, for-profit organizations may also provide powerful inputs for knowledge exploration (van der Borgh et al., 2012). On this basis, actors in a knowledge ecosystem can be seen as extremely diverse participants (Clarysse et al., 2014; Powell et al., 2012), bound together *“by a joint search for valuable knowledge while having independent agency also beyond the knowledge ecosystem”* (Järvi et al., 2018). Importantly, this ecosystem is not structured around an orchestrator, but rather around the knowledge itself, which leads to a comparably flexible and highly adaptive entity with a multitude of diverse contributors (Baptista & Swann, 1998; Powell et al., 2012; Valkokari, 2015). This is especially important in comparison to business and innovation ecosystems where the customers and a focal actor – or orchestrator – are at the core of the ecosystem (cf. Adner, 2016; Adner, 2017; Adner & Kapoor, 2010). Besides, as the multi-actors are organized around knowledge creation and search, their focus is less on economic viability (cf. Adner & Kapoor, 2010; Clarysse et al., 2014; Iansiti & Levien, 2004a; Jacobides et al., 2018) but more on collaboration for knowledge creation.

The last concept – *entrepreneurial ecosystem* – introduces the ecosystem concept to entrepreneurship. This line of thought focuses on the specific ecosystem structure of the environment surrounding an entrepreneur or entrepreneurial activities (Acs et al., 2017). The entrepreneurial ecosystem has some similar characteristics to related concepts – such as industrial districts, clusters, and business ecosystems. These similarities include having as economic value creation as a purpose (Pitelis, 2012; Stam & Spigel, 2017), an association of independent actors (Stam, 2015), and knowledge as a key source (Stam & Spigel, 2017). However, another stream of entrepreneurial ecosystem research describes fundamental differences between these related concepts. In this stream of literature, Isenberg (2011) suggests that an entrepreneurial ecosystem consists of six general domains: a conducive culture, enabling policies & leadership, availability of appropriate financial resources, quality human capital, venture friendly markets, and institutional and infrastructural support. These domains indicate a shift towards an economic view that is more focused on people, networks, and institutions. To illustrate this economic shift more clearly, the following table, Table 2, offers a detailed description of the six domains:

Domain	Description
Policy & Leadership	Government and policies enhance commitment of entrepreneurs to a region as an attractive place for entrepreneurship (Feld, 2012). Thereby, policies should cover economic development, taxes, and investment vehicles (Isenberg, 2011).
Finance	Availability of strong and supportive communities of venture capital funds, investors, and other forms of financing across sectors (Feld, 2012; Isenberg, 2011).
Culture	Culture supports ambitious entrepreneurs and their appetite for growth. It enables creativity and experimentation, shows acceptance for failure, and celebrates innovation (Foster et al., 2013; Isenberg, 2011).
Supports	Infrastructural support is given by providing co-working clusters, transportation, and telecommunication. Institutional support is given through conferences, entrepreneur-friendly associations, or business plan contests (Isenberg, 2011)
Human Capital	Availability of a broad and deep pool of skilled talents in all fields and areas can be named as a key resource for enabling an entrepreneurial ecosystem (Stam, 2015). In this context, universities should be well connected with the entrepreneurial community. (Feld, 2012; Foster et al., 2013)
Markets	Access to entrepreneur's network and a connection to domestic markets; large/medium/small companies as customers to support entrepreneurial economic growth (Foster et al., 2013; Isenberg, 2011)

Table 2: Detailed description of six domains based on Isenberg (2011)

With regard to the interconnection of the domains described in the table above, it is relevant to mention that the six domains may not be considered as isolated from one another, but, on the contrary, are created through their interdependences (Stam & Spiegel, 2017). Additionally, and unlike previous definitions of the term ‘ecosystem’ introduced by Moore (1993), Iansiti and Levien (2004a), or Adner (2017), an

entrepreneurial ecosystem is built up within a region instead of emerging within the global markets (Stam & Spigel, 2017). Importantly, and as its name suggests, the entrepreneur, rather than the venture, is considered to be the centerpiece of an entrepreneurial ecosystem (Stam, 2015). In light of this, the entrepreneurial ecosystem also demonstrates a different understanding of knowledge. Within business ecosystems, knowledge can be defined as the recombining of know-how from multiple actors to increase competitiveness and to develop new products or services (e.g. Jacobides et al., 2018). In addition to this market and technical know-how, an entrepreneurial ecosystem highlights a new type of knowledge: entrepreneurship process knowledge. This knowledge is shared between entrepreneurs through informal social networks and entrepreneurship organizations or trainings (Stam & Spigel, 2017). Moreover, entrepreneurial ecosystems are also different than business ecosystems regarding their value creation. A business ecosystem's goal is the materialization of a joint value proposition (Adner, 2017) and this goal is managed by an orchestrator, who takes the most important role within the business ecosystem (Adner, 2017; Jacobides et al., 2018).

By contrast, an entrepreneurial ecosystem has no main driver and its output can be defined as the process by which opportunities for innovation are created at a regional level (Fritsch, 2013; Stam & Spigel, 2017; Tsvetkova, 2015). Isenberg (2010) defines the entrepreneurial ecosystem as a “*dynamic, self-regulating network of many different types of actors*”, in which success depends on the entrepreneur's ability to create a cohesive social and economic environment that supports economic growth and the creation of new ventures (Bruns et al., 2017; Kuratko et al., 2017). In this context, Silicon Valley is an example of what Isenberg (2010) describes as the *gold standard* entrepreneurship ecosystem. This entrepreneurial ecosystem is based on the six domains introduced above (Isenberg, 2010). Silicon Valley encourages a beneficial entrepreneurial environment and advances new venture creation (Kuratko et al., 2017), has developed a culture of failure and risk taking, offers top-level human capital (Kushida, 2015), and has the most competitive venture capital market in the world (Lee, 2000). Silicon Valley has created a business environment that has proven to be extremely promising for entrepreneurial success (Kushida, 2015).

1.3 State of the Art in the Literature about Ecosystems

Ecosystems have increasingly become a subject of interest among scholars and practitioners alike in recent years (Adner, 2017; Jacobides et al., 2018; Talmar et al., 2018). Using the biological ecosystem as a metaphor, Moore (1993) defined the term ‘business ecosystem’ around the co-evolving capabilities of ecosystem firms (see Chapter 1.2.1). As such, this new perspective questioned the previous understanding of competition, which was seen as the struggle for market power in a single industry (Moore, 1993; Porter, 1980; Teece, 2012). While it had already been understood that co-operation leads to strategic advantage (Richardson, 1972), this new idea further challenged the existing industry boundaries (Moore, 1993). Consequently, the established strategic tools were no longer suitable to analyze the new, cooperative forms of doing business across industries (Moore, 1993).

Historically, there were two streams of ecosystem research (cf. Adner, 2017; Thomas & Autio, 2012). Initial ecosystem research (Moore, 1993) was concerned with ‘business ecosystems’ (see Chapter 1.2.2 for a definition), which are aimed at the creation of a superior value proposition through their actors and their collaborations (see also Clarysse et al., 2014; Iansiti & Levien, 2004a; Moore, 1996, 2006; Nalebuff & Brandenburger, 1996; Rong & Shi, 2014). In contrast to this view, the second stream focused on ‘innovation ecosystems’ (see Chapter 1.2.2 for a definition). It saw the value proposition itself as the starting point, which in turn depended upon the interdependent activities of the ecosystem members (Adner, 2006; Adner & Kapoor, 2010, 2016a, 2016b; Adner et al., 2013). From a strategic perspective, the *activity-centric* as opposed to the *actor-centric* ecosystem-as-structure approach, developed by Adner (2017), expands the understanding of an ecosystem as it focuses on the multilateralism of partners. In that sense, the relationships between a multiplicity of ecosystem partners are viewed as a set of critical ties, which cannot be broken down into an aggregation of bilateral partnerships (Adner, 2017). In the recent past, the ecosystem-as-structure perspective became predominately accepted and the term ‘ecosystem’ became a synonym for both ‘business ecosystems’ and ‘innovation ecosystems’ (e.g. Aarikka-Stenroos & Ritala, 2017; Adner, 2017; Gawer & Cusumano, 2014; Jacobides et al., 2018; Ozalp et al., 2018; Williamson & de Meyer, 2012).

According to this conceptualization of ecosystems, the focal value proposition is characterized by a certain modularity (see Chapter 1.1.2), as the ecosystem partners contribute in an autonomous yet interdependent manner (Baldwin & Clark, 2000; Jacobides et al., 2018). Referring back to the metaphor of the natural ecosystem

mentioned above (Moore, 1996), modularity of the joint value proposition helps the ecosystem to grow, flourish, and evolve. The growth of an ecosystem is attained by a modular configuration of the activities and actors, which is aimed at alignment (Adner, 2017). According to Adner (2017), the structure of an ecosystem is defined by four elements: the *actors* (actors undertaking activities in an ecosystem) and their *activities* (action, input), which need to be aligned through their *positions* (location of the firm in the flow of activities) and *links* (transfer across actors).

Moreover, researching the type of companies joining ecosystems is as compelling as the mechanics of an ecosystem. Considering a company's resource level and capabilities, scholars have been questioning whether startups are suited as corporate firms to take up the orchestrator role (e.g. Jacobides et al., 2018). Two contradictory perspectives can be identified in existent literature. A substantial body of research posits that corporations possess a fundamental advantage regarding their orchestrating capabilities due to their size and resources – and are therefore prone to take the role of the orchestrator in an ecosystem (Adner, 2017; Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004b; Jacobides et al., 2018). However, a number of scholars (Brusoni & Prencipe, 2013; Gulati et al., 2012; Helfat & Raubitschek, 2018; Williamson & de Meyer, 2012) suggest that startups are suited to be orchestrators as they possess not only the necessary flexibility and an understanding of partners, but also credibility and influence due to specific knowledge or an important module.

Looking at the vast amount and totality of literature introduced above, certain gaps in understanding become apparent. The following paragraphs therefore aim to give an overview of the unclarified areas in ecosystem literature that have motivated my research.

Research gaps derived from existing literature

An ecosystem's joint value proposition can be materialized through a process of co-creation (Adner, 2017). From a strategic perspective, a way to achieve this is for a driving company to encourage alignment among the partners through orchestration (Adner, 2017; Altman & Tushman, 2017; Jacobides et al., 2018). Despite an increasing consensus among scholars that the mechanisms of value co-creation need to be revisited in the ecosystem context (e.g. Adner, 2017; Adner & Kapoor, 2010; Meynhardt et al., 2016), existing literature falls short of providing a comprehensive understanding while including the central aspect of orchestration. While related research provides theoretical frameworks on how value co-creation can be promoted by platform owners (e.g.

Eisenmann et al., 2009; Parker & Alstyne, 2008), ecosystem research lacks a similar inquiry of value co-creation.

The idea that an orchestrator drives the success of an ecosystem (e.g. Adner, 2017; Jacobides et al., 2018) implies that specific measures exist, which a driving company must undertake in order for the whole ecosystem to succeed. Consequently, a number of additional issues need to be considered: How can orchestrators define the focal value proposition? How should potential partner companies be localized and selected? In what order are partners added to the ecosystem? How can the orchestrator generate an understanding of the partners' individual agendas in order to facilitate alignment and commitment? The necessity and relevance of these questions has been expressed in previous research (Hannah & Eisenhardt, 2018; Jacobides et al., 2018). With the exception of Dattée et al. (2018), previous studies have, however, neglected to investigate these gaps while maintaining a focus on the orchestrator's role in the ecosystem. Previous ecosystem research has therefore been unable to give sufficient answers to the aforementioned issues.

Secondly, existing literature generally questions a startup's ability to fulfill the tasks of orchestration and therefore remains under-researched. While research provides theoretical frameworks on how corporations orchestrate ecosystems, streams of research have failed to examine startups in an ecosystem while maintaining a focus on orchestration. Both ecosystem and startup literature has therefore failed to specifically investigate cases in which startups take the role of the ecosystem orchestrator (Adner, 2017; Jacobides et al., 2018).

Finally, the emphasis shift towards an ecosystem as a new form of cooperation that can be measured through innovation input (research & development (R&D) costs) and innovation output (Gerybadze et al., 2010). In this regard, research has proven positive effects of R&D on a firm's performance (Gerybadze et al., 2010; Park et al., 2018), and conducted studies have additionally highlighted the importance of innovation and R&D. However, due to the lack of studies emphasizing the relationship between R&D investments, corporate success, and financial performance (Baumann & Kritikos, 2016; Gerybadze et al., 2010), the impact of ecosystems on R&D costs remain unexplored. More specifically, the relationship of innovation input as R&D intensity and ecosystems as a new way of cooperating remain under-researched. Figure 3 aims to give an overview of all the gaps found in the existing research that inspired this dissertation.

Summary of Research Gaps

Existing ecosystem literature has not yet been able to provide a sufficient understanding of...

- (1) ... the mechanisms of value co-creation in the ecosystem context, especially in regard to the orchestration of an ecosystem
 - (2) ... how the joint value proposition of an ecosystem initiative is defined (by the orchestrator).
... how orchestrators search for ecosystem partners and how the ecosystems are built.
... the order in which partners are added to an ecosystem.
 - (3) ... how startups orchestrate an ecosystem.
... what specific capabilities a startup needs to bring into an ecosystem.
 - (4) ...the impact of ecosystems on R&D costs
...the relationship between ecosystems and innovation as R&D intensity
-

Figure 3: Summary of research gaps in current literature

1.4 Research Questions and Outline of the Thesis

1.4.1 Research Questions to be Addressed by the Thesis

The dissertation aims to close the research gaps described above. The overall goal of this thesis is to provide an answer to the following research question:

Q: How can companies create innovation through ecosystems?

This research question is guided by three sub-questions, which will be addressed by three studies. Study 1 provides a better understanding of ecosystem development, and develops specific approaches and recommendations for value proposition search, partner search, and the order of adding partners to the ecosystem. This analysis is guided by the following research question:

Q1: How does a firm set up an ecosystem and the role of organizational search for finding and integrating potential ecosystem partners?

The research conducted for study 2 is based on study 1. The analysis in study 1 has proven, contrary to existing literature, that startups can overcome their disadvantages and fulfil the requirements to orchestrate an ecosystem. On the basis of this realization in study 1, the second sub-question arose. More precisely, the question to be answered is:

Q2: How do startups orchestrate ecosystems?

Based on the insights ascertained in study 2 showing that startups can orchestrate ecosystems successfully, despite their lack of resources (e.g. R&D expenditures), my third research question developed. Study 3 discusses the impact of ecosystems on innovation input as R&D intensity, as existing literature has not yet explored this relationship precisely. As a result, this third study addresses the following sub-question:

Q3: Does the fact that companies claim to innovate in ecosystems or with partners have an influence on their R&D budgets?

1.4.2 Thesis Outline

The aim of the dissertation is to create an overview of the orchestration of innovation in ecosystems. More precisely, it examines how ecosystems are developed, managed, and what potential they provide for companies of all sizes. For this reason, attention is paid to specific characteristics that affect the entire ecosystem (cf. Brusoni & Prencipe, 2013; Dattée et al., 2018; Jacobides et al., 2018). At present, it is rarely studied how firms build up ecosystems (Dattée et al., 2018). The noteworthy exception, Dattée et al. (2018), has focused on the question of how ecosystem orchestrators come up with a compelling vision for the ecosystem, even in situations of high uncertainty, in order to convince prospective partners to join. There is no empirical analysis that examines the development of ecosystems in general and their relevant characteristics of value proposition search, partner search, and the order of partners joining as inter-related functions. For this reason, the first study of the dissertation is nestled around the core challenges that evolved for the orchestrator when building up the ecosystem. To address these challenges, I first focus on the question of how the orchestrator searched for and identified suitable partners. In this regard, two types of orchestrators could be found: those with extensive networks and knowledge related to the field of business the ecosystem focuses on, and those without extensive networks or knowledge. Whilst the latter were searching for potential partners by themselves and were easily able to identify their agendas and pain-points, the first type of orchestrator relied entirely on partners, who functioned as scouts. Such scouts were, for example, accelerators, established companies with extensive networks, or consultants. Thus, orchestrators lacking the network and knowledge to find suitable partners were always delegating this task to scouting partners.

Second, the orchestrators were facing a chicken-and-egg problem: Since all partners are needed to form the joint value proposition in an ecosystem, and every partner must invest in the creation of its individual module for the joint value proposition (Jacobides et al., 2018), it is natural that no partner wants to be the first to commit. So how can an orchestrator convince a potential partner to be the first one to enter the ecosystem, invest in the respective module, and lay the foundation for all the subsequent partners to join? I found that the orchestrator needs to try to first integrate the partner contributing the most crucial module for the joint value proposition. If this firm is a founding member of the ecosystem, additional partners are more likely to join since they know that the most crucial partner has already committed. In one case, the orchestrator did not manage to convince a founding partner and was therefore unable to attract other partners; they were understandably reluctant to join an ecosystem knowing that their contributions would not be enough and that their success would be dependent upon the orchestrator's ability to convince a partner capable of providing the core module to join.

Third, I strived to understand how an orchestrator convinced partners to commit to an ecosystem. For the partners, this turned out to be a decision made based on a risk-benefit reasoning. If the risk was minor compared to the expected benefit, they were likely to step into the ecosystem if the orchestrator was able to evoke a compelling vision of the ecosystem. If the risk-benefit relation was not as favourable, the orchestrator needed to build up credibility first. In cases where a scouting partner was involved, this partner appeared to help achieve this goal: a well-known scouting partner can demonstrate the credibility of the orchestrator. Additionally, a strong technology, reputable managers, or a strong track record were valuable tools to help an orchestrator increase its credibility as a suitable ecosystem leader. In addition, I found that the choice of partners also affects the long-term development of the ecosystem: The first partner typically determines the future path of the ecosystem, since it is likely to set the focus on its own fields of business and implicitly (by providing a network and knowledge) or explicitly (by using power) steers the ecosystem in a specific direction.

Considering my second analysis – the situation of startups as orchestrators of ecosystems – two contradictory perspectives can be identified. A large number of scientists believe that established companies have a significant advantage due to their access to available resources as well as their size, and are therefore more suitable for the role of orchestrator (Adner, 2017; Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004b; Jacobides et al., 2018). On the other hand, there are researchers (Brunson & Prencipe, 2013; Gulati et al., 2012; Helfat & Raubitschek, 2018; Williamson & de

Meyer, 2012) who suggest startups for the role of orchestrator because they have, for example, an understanding of their partners or the necessary flexibility. To bring clarity to the discussion and close the research gap on how startups orchestrate ecosystems, my second study examines ecosystems that are successfully orchestrated by startups. The resulting framework will support founders, corporations, and investors.

Lastly, the shift towards an ecosystem value that includes customer value and value for all ecosystem partners (Parker et al., 2016a) considers innovation as one of the main possibilities for firms to adapt to these changing business environments (Gerybadze et al., 2010; Lome et al., 2016). However, for now, existing literature focuses on the impact of business model components on ecosystems (Madsen, 2020), on ecosystems as a new kind of partnership to meet customer expectations (Adner, 2017; Jacobides et al., 2018), and on the correlation between a company's expenditures on innovation and its overall financial performance (Jaruzelski et al., 2018). Although research points out the relationship between cost and innovation, the link to ecosystems has not yet been considered. R&D costs should decrease as an ecosystem is formed, as it allows companies to focus on their core value propositions to generate new innovation that results from the knowledge acquired by the whole merger. To determine whether this logic is valid, and to close the gap between ecosystem and R&D costs, my third analysis aims to discover the impact of ecosystems on innovation as R&D intensity. The findings highlight the relationship between innovation in terms of R&D intensity and ecosystems.

To successfully explore the above-mentioned research gaps, this dissertation uses two methodological approaches. It is based on two qualitative case studies and one quantitative text mining analysis. The former methodology will answer the open 'why' and 'how' questions (Eisenhardt, 1989; Yin, 2014). In order to be able to guarantee that the results are of a general nature, the individual studies are based on data from multi-case studies (Eisenhardt, 1991; Ozcan & Eisenhardt, 2009). The latter methodology allows a broad evaluation of the R&D intensity and enables the count of specific words related to ecosystems and R&D in a broad pool of data. The next subchapter summarizes the main features of this thesis to give an overview of the structure of my dissertation.

1.5 Overall Structure of the Thesis

Selection	Brief Summary
Chapter 1: Innovation through Ecosystems	
Relevance and Overall Structure of Thesis	<i>Chapter 1 introduces the relevance and structure of the dissertation and gives an overview of the state of the art in the literature. It positions the research question and overviews the outline of the dissertation.</i>
State of the Art in Literature	
Research Question and Outline	
Chapter 2: Development of Ecosystems	
Introduction	<i>Chapter 2 is the first empirical contribution, and is based on a study analyzing 10 qualitative multi-case studies. It looks at the full search process in the context of the establishment of ecosystems to explain in great detail how companies develop an innovative ecosystem from the very beginning.</i>
Literature Review	
Methods	
Findings	
Discussion and Implications	
Chapter 3: Ecosystems as an Opportunity for Startups	
Introduction	<i>Chapter 3 is the second empirical contribution, and is based on the study in Chapter 2. It sheds light on how startups successfully orchestrate ecosystems. To do this, my second study examines ecosystems that are successfully orchestrated by startups.</i>
Literature Review	
Methods	
Findings	
Implication	
Chapter 4: Consequences of Ecosystems on R&D Intensity	
Introduction	<i>Chapter 4 is my third and last empirical contribution. The study is based on a text mining analysis with R. To address the impact of ecosystems on R&D costs, this study focuses on ecosystems as a novel way of cooperating and innovation input as R&D intensity.</i>
Literature Review	
Methods	
Findings	
Implication	
Chapter 5: Conclusion	
Theoretical Contributions	<i>Chapter 5 integrates the empirical contributions of the dissertation to answer the dissertation's research question of the dissertation. It describes the theoretical contribution, as well as the managerial implications, which are illustrated in a case study. It also outlines the limitations and the potential for future research, as well as providing a conclusion.</i>
Managerial Implications	
Future Research	
Discussion	

Table 3: Overall structure of the thesis

This dissertation contains material from working papers that were presented in earlier stages at scientific conferences (ISPIM, 2018 & 2019; DRUID, 2019) and are currently under review in scientific journals. Specifically, Chapter two, three and four are built on working papers.

I hereby declare that I have written most of the content of the following chapters.

In Chapter two, I contributed 90% of the Introduction, 80% of the Literature Review, 80% of the Methods, 95% of Data Collection and Data Analysis, 90% of the Findings, 60% of the Implications.

In Chapter three, I contributed 70% of the Introduction, 70% of the Literature Review, 80% of the Methods, 100% of Data Collection and Data Analysis, 80% of the Findings, 80% of the Implications.

In Chapter four, I contributed 100% of the Introduction, 100% of the Literature Review, 70% of the Methods, 10% of Data Collection, 60% Data Analysis, 70% of the Findings, 70% of the Implications.

Of course, my co-authors contributed substantially to these manuscripts with their reviews, edits, changes and feedback. Accordingly, parts of this dissertation could bear striking resemblance or correspond literally to my own future publications.

2 No One can Whistle a Symphony – How Firms Search for Potential Value Propositions and Partners in Building-up an Ecosystem¹

2.1. Introduction

In order to make use of the tempting opportunities provided by ecosystems, firms driving ecosystem initiatives, the orchestrators, must build them up, since ecosystems do not emerge by themselves (Dattée et al., 2018; Jacobides et al., 2018). Following the definition of an ecosystem, such build-up is based on defining a promising value proposition for the ecosystem's customer(s) and identifying suitable partners for its implementation, especially as ecosystems partners intrinsically depend upon one another to create value for customers (Hannah & Eisenhardt, 2018). On top of this, one of the key characteristics of an ecosystem is the fact that the orchestrator cannot fully control the partners hierarchically. This implies a certain co-ordination among all parties in the ecosystem, and requires orchestrators to understand the interests of potential partners in order to convince them to commit to the ecosystem (Altman & Tushman, 2017; Dattée et al., 2018; Jacobides et al., 2018). Also, the aspect of co-ordination among ecosystem partners leads to an additional complication: Issues that arise in the context of ecosystem establishment have to be solved through co-ordination of the partners involved, which is why the establishment of ecosystems is not entirely driven by foresight but rather an iterative process with some element of trial-and-error involved (Jacobides et al., 2018). As a consequence, defining the ecosystem's value proposition and identifying suitable partners and understanding their interests is not a straight-forward process, but rather an iterative process, which makes it necessary to study these three steps comprehensively and not in isolation. Surprisingly, while research in other fields has dealt extensively with the question of how firms perform the iterative processes of defining the value proposition and partner search (Foss & Saebi, 2018; Teece, 2018b), previous research on ecosystems has mostly ignored this aspect, despite its central role in the establishment of ecosystems (Dattée et al., 2018; Jacobides et al., 2018). Even the more general question of how firms build ecosystems has not yet been sufficiently addressed, which has led to repeated calls for research (Dattée et al., 2018; Hannah & Eisenhardt, 2018; Jacobides et al., 2018). One of the few

¹This Chapter is based on the working paper "No One can Whistle a Symphony – How Firms Search for Potential Value Proposition and Partners in Building-up an Ecosystem" with co-authors Bernhard Lingsens and Oliver Gassmann

works in this area, Dattée et al. (2018), focuses on the specific question of how orchestrators with particularly strong market power and resources convince partners to commit to radically innovative ecosystems, but it does not cover the other elements of the abovementioned process.

This motivated us to conduct a qualitative multiple-case study with 10 cases. Since the underlying motivation of this work is to provide insights into how firms can build up ecosystems, we focus on the firm – more specifically, on the orchestrator – as the unit of analysis. In order to guide our research endeavor (Yin, 2014), we use the concept of organizational search (please, see Cyert & March, 1963; Nelson & Winter, 1982; Stuart & Podolny, 1996) as a theoretical lens for several reasons. First, search focuses on identifying new opportunities, capabilities, and partners (Cyert & March, 1963; March & Simon, 1958). This corresponds neatly with the underlying logic of ecosystems, which are a means of pursuing new opportunities by searching for and involving external partners in order to bring in new capabilities (Adner, 2017; Dattée et al., 2018; Jacobides et al., 2018). Second, organizational search is driven by and embedded in organizational structures and organizational decision making. However, organizations are not islands onto themselves; rather, they operate in populations with other organizations and institutional environments, which is why the concept of search follows an open-system perspective on organizational structures and decision making (Gavetti et al., 2007). Likewise, ecosystems are viewed as inter-firm structures (i.e., open systems), in which organizations jointly execute decision making and innovation activities (Jacobides et al., 2018). And, third, search is not considered to be a straightforward process, but rather an iterative process of identifying, learning, and adapting (Bedeian, 1990; Miles, 1980; Thompson, 1967). Our study applies the same logic by making the iterative search process for new value propositions, partners, and their interests the center of attention.

As a foundation for our study, the following literature review explains the ecosystem concept and its specifics, thus elaborating on what makes the above-mentioned iterative search process so special in this context. In section two of the literature review, we explain the fundamentals of organizational search as the theoretical lens of our study. Thus grounded, we aim to provide several key contributions to the research on ecosystems. First, to our knowledge, we are the first to describe the iterative process of how firms define the joint value proposition, identify partners, and understand their interests – a question that is essential to understanding the establishment of ecosystems (Jacobides et al., 2018). Second, by doing so, we show how firms conduct both local

and distant search in the context of the establishment of ecosystems. Third, we show in greater detail how orchestrators understand the interests of potential ecosystem partners as a foundation for their subsequent integration into the ecosystem.

2.2. Literature Review

2.2.1. Literature Background on the Ecosystem Concept

The ecosystem concept has been discussed by many scholars (e.g. Adner, 2017; Adner & Kapoor, 2010; Dattée et al., 2018; Davis, 2016; Davis & Eisenhardt, 2011; Jacobides et al., 2018; Kapoor & Agarwal, 2017; Moore, 1993). According to the structural view, the primary purpose of an ecosystem is the materialization of a joint value proposition that could not be achieved by one firm alone (Adner, 2017; Adner & Kapoor, 2010; Eisenhardt & Galunic, 2000; Jacobides et al., 2018; Li & Garnsey, 2014; Moore, 1993; Overholm, 2015). Thus, the multilateral set of partners needs to interact in order to materialize a joint value proposition (Adner, 2017; Autio & Thomas, 2019; Kapoor, 2018; Shipilov & Gawer, 2020). In the course of this manuscript, we will refer to ecosystems according to the structural view. In the context of development, Jacobides et al. (2018) name modularity as a main element of this concept as it creates the surroundings for an ecosystem to develop. Modularity describes the process of independent modules being manufactured separately but ultimately fitting together with other modules to create a new value proposition (Jacobides et al., 2018). As a result, an ecosystem's value proposition needs to be modular in order for several partners to contribute to it (Baldwin & Clark, 2000; Jacobides et al., 2018). Furthermore, these modules need to be complementary, i.e., they either mutually increase their respective values (so-called supermodularity) (Milgrom & Roberts, 1990; Topkis, 1978, 1998) or they are unable to function on their own. The modules must also be non-generic and especially created for the ecosystem, or at least adapted to modules from other companies in the ecosystem (Baldwin & Clark, 2000; Jacobides et al., 2018). These modules and firms can, therefore, not be easily replaced (Jacobides et al., 2018).

In this vein, Teece (1986) introduces the term of co-specialization which indicates that two or more modules require each other. As a consequence, partners need to more or less adapt their modules, which leads to higher or lower costs of adaption and, therefore, risk. This is likely to affect the establishment of ecosystems as well, since higher risks resulting from higher degree of co-specialization create higher barriers for partners to

enter an ecosystem (Jacobides et al., 2018). The degree of co-specialization is exogenous as it arises from the joint value proposition (Jacobides et al., 2018).

As a consequence of the modularity, there needs to be at least three ecosystem actors as the relationships within an ecosystem are inherently multilateral, i.e., the ties between actors cannot be divided into bilateral relationships (Adner, 2017; Jacobides et al., 2018).

Adner (2017) distinguishes between ecosystem partners and ecosystem actors. The former includes the firms necessary to help the orchestrator create the joint value proposition. The latter constitutes the sum of all partners, including the orchestrator. Hereby, the orchestrator represents a key actor within the ecosystem. Its main tasks include: developing the ecosystem, aligning all partners, providing the needed stability within the ecosystem, and managing the ecosystem as a whole (Hannah & Eisenhardt, 2018; Iansiti & Levien, 2004a; Jacobides et al., 2018). Consequently, to achieve a joint value proposition, and to specifically create new, or at least mutually complementary, modules that can be adapted to the ones provided by partners (Baldwin & Clark, 2000; Jacobides et al., 2018), all ecosystem partners must be aligned. The aspect of alignment constitutes another specific characteristic of ecosystems: They are networks of partners that are bound together by some level of hierarchy, without being fully hierarchically managed (Jacobides et al., 2018). On the one hand, some level of hierarchy is needed in order for the orchestrator to align the partners towards the joint value proposition (Brusoni & Prencipe, 2013; Leten et al., 2013). On the other hand, all partners are providing modules, which are connected by non-generic complementarities. The resulting dependency of the orchestrator from the partners makes it difficult to set unilateral standards (Jacobides et al., 2018).

Taken together, the process of search for the ecosystem's value proposition and partners may be influenced by different levels of co-specialization. Also, effects caused by varying levels of hierarchical control are likely to prevail. And both, in turn, will influence the orchestrator's ability to convince potential partners to commit to the ecosystem throughout the search process. Please see Table 4 for an overview of the ecosystem related terms used in the manuscript.

Terms	Description according to literature	Self-perception
Ecosystem Initiatives	A firm's ability to convince and assure partners, as well as to promote mutual alignment to eventually bring them together for a common purpose (Adner, 2017)	
Orchestrator	Firm driving the ecosystem initiatives and managing the whole ecosystem development process (Jacobides et al., 2018)	
Ecosystem	Pursues the primary purpose of a materialization of a joint value proposition that cannot be achieved by one firm in isolation (Adner, 2017; Jacobides et al., 2018; Moore, 1993)	
Modularity	How independent modules of a system are manufactured by different firms with little coordination effort (Jacobides et al., 2018, p. 8)	
Actors	Sum of partners and the orchestrator (Adner, 2017)	
Partner	Firms providing non-generic and complementary modules for the joint value proposition of the ecosystem (Hannah & Eisenhardt, 2018)	
Degree of co-specialization	Determines the degree of co-dependence among the partners in order to adapt the respective contributions to the value proposition. It further indicates that two or more modules require each other (Jacobides et al., 2018)	
Core elements of ecosystem	Namely actors, links, position, roles, and activities (Adner, 2017)	
Key partner		Provides the key module that is considered the most significant module for the joint value proposition supplied by the key partner
Module knowledge		Knowledge of the orchestrator of the different modules required for the creation of the ecosystem's value proposition
Key module		Most significant module for the joint value proposition supplied by the key partner
Committee partner		Ecosystem partner who has the closest relationship with the potential new partner or who could address the potential new partner's interests

Table 4: Overview of ecosystem terms

In the following section, we delve deeper into the mechanisms of this process from the perspective of organizational search.

2.2.2. *Organizational Search as the Theoretical Lens of our Study*

Search can be traced back to concepts introduced in seminal works on organizational behavior (e.g., Cyert & March, 1963; March & Simon, 1958; Nelson & Winter, 1982; Simon, 1955) and has played an essential role in the theoretical reasoning of related streams of research (e.g., Cohen & Levinthal, 1990; Cohen et al., 1972; Ocasio, 1997). Search can be defined as a “*controlled and proactive process of attending to, examining, and evaluating new knowledge and information*” (Li et al., 2013, p. 893). Search is most commonly considered to be ‘local’, i.e., organizations search for solutions in the vicinity of existing solutions, within the company’s field, and in areas where the organization’s individuals already have knowledge and experience (Cyert & March, 1963; Nelson & Winter, 1982; Stuart & Podolny, 1996). Thus, incremental solutions are likely to prevail unless more distal and complex solutions are actively pursued (Monteiro et al., 2008; Shimizu, 2007). In the latter case, firms perform ‘distant search’ to access new solutions and knowledge beyond their existing fields of expertise (Kogut & Zander, 1992; March, 1991; Miner et al., 2001). However, distant search is difficult to achieve (Argote & Greve, 2007) and, thus, often leads to poorer performance and a higher likelihood of failure (Cyert & March, 1963; Martin & Mitchell, 1998). Firms are more likely to successfully absorb new knowledge when there is an overlap between the novel information and the firm’s existing knowledge base (Cohen & Levinthal, 1990; Zahra & George, 2002). Thus, the development of knowledge is a rather time-consuming and difficult affair – particularly in fields that are far from the orchestrator’s core business (Birkinshaw et al., 2007; Meulman et al., 2018; Rosenkopf & Nerkar, 2001). Consequentially, the distance of knowledge is given as an exogenous condition for ecosystem development.

2.3. **Methods**

Given the novelty of the phenomenon in general and our research goal in particular, we view a multiple-case study as a suitable methodology (Eisenhardt, 1989; Ozcan & Eisenhardt, 2009). This method is specifically suitable for answering process-centric questions, such as the process of defining the value proposition, suitable partners, and understanding their interests (Eisenhardt et al., 2016).

A qualitative study was perceived as more suitable than a quantitative study due to the ability of a qualitative study to capture patterns, trajectories, and mechanisms with increased complexity. As opposed to a single-case study, a multiple-case study has the potential to produce a theoretical framework on a higher level of abstraction and

provides a better generalizability of the findings. (Eisenhardt, 1991; Eisenhardt & Graebner, 2007; Ozcan & Eisenhardt, 2009).

2.3.1. Data Sampling

The sample in our multiple-case study consists of ten cases, with the firm, more specifically the orchestrator, being the unit of analysis. The cases were selected according to several criteria. First, and obviously, the cases needed to fulfill the criteria of an ecosystem (cf. Adner, 2017; Adner & Kapoor, 2010; Eisenhardt & Galunic, 2000; Jacobides et al., 2018; Li & Garnsey, 2014; Moore, 1993; Overholm, 2015). Second, the cases varied in the orchestrators' characteristics (e.g., size, resources, power). In this vein, we examined cases with orchestrators from both established companies and spin-offs/ joint ventures/ start-ups. The selection and representation of ecosystems consisting of different types of companies acknowledge the real-life representation of companies in ecosystems. By following a similar approach to preceding ecosystem research, we further assured comparability (e.g., Mäkinen & Dedehayir, 2013; Rong et al., 2015b). The cases stem from different industry backgrounds (Eisenhardt, 1989; Ozcan & Eisenhardt, 2009), which is a frequently used means of increasing the generalizability of a multiple-case study (e.g., Chatman & Jehn, 1994; De Wulf et al., 2001; Frankenberger & Sauer, 2018; Schoenecker & Cooper, 1998), especially in the context of ecosystems (e.g., Davis, 2016; Mäkinen & Dedehayir, 2013; Rong et al., 2015b). In addition to the aspect of theoretical sampling, the decision to use cases from different industries was also due to the fact that it would have been challenging to find a sufficient number of cases that could provide the rich data needed to explore such a novel phenomenon, while relying exclusively on a single industry. Accordingly, our sample includes cases from areas such as mobility, public transport, logistics, finance, insurance, and housing. On the other hand, we are confident that our findings are not being distorted by differences across the sectors studied: since ecosystems are usually cross-sector collaborations, all of our cases involve partners from various sectors.

In general, our case sampling was based on an iterative process with continuous adjustments between case selection, data collection, and data analysis (Eisenhardt, 1989). Our initial set included about 20 brief cases, of which we chose five as primary samples based on our sampling criteria. After completing the first interviews and data analysis, we researched additional cases to expand and enrich our sample and gain a better understanding of the emerging theory (Eisenhardt, 1989). Accordingly, we excluded from our sample those cases that were shown to not meet our criteria

optimally, and we added further cases until we reached a state where additional cases did not significantly enhance our understanding of the context (Eisenhardt, 1989).

As a result of our sampling, ten cases have been selected. The ecosystem actors come from a variety of industries and are either established firms or spin-offs/ joint ventures/ start-ups. The value propositions identified in our cases address several customer demands in the contexts of Business-to-Business (B2B) (e.g., Factoring case), Business-to-Customer (B2C) (e.g., Sports case), and Business-to-Government (B2G) (e.g., Analytics case). The firms' value propositions, however, all have in common that they offer a digital service of some sort.

The ecosystems found in our cases further varied in size, ranging from at least three actors (e.g., InsurTech case) to 16 actors (e.g., Smart Building case). The establishment of the ecosystems took between one year and five years. The orchestrators were both corporates as well as start-ups, spin-offs, and joint ventures. For a detailed overview and case-by-case descriptions, including the contribution of each actor in the ten ecosystems, please see Table 5.

<i>Case</i>	<i>Foundation of Orchestrator</i>	<i>Foundation of Ecosystem</i>	<i>Orchestrator origin</i>	<i>Number of actors</i>	<i>Partner Origin</i>	<i>Case Description</i>
Access	2006	2011	Germany	5	Germany, United Kingdom, United States of America	The Access case focuses on keyless access to rental cars. The development of an app for the end customers and the technological equipment of the rental cars enables these cars to be opened using a smartphone. The ecosystem partners have adapted their software, hardware, and service components, and have also implemented new modules in the fleet.
Logistics	1849	2017	Switzerland	7	Switzerland, Germany, United States of America	The value proposition of the Logistics case is the delivery of goods by an autonomous drone. To make this service promise a reality, a logistics company cooperated with an airline (which later left the ecosystem) and a drone technology provider. A hospital provided the use case and, in addition to the test site, also offered knowledge and experience in logistics. Finally, the government authorities also became partners in the ecosystem to develop a legal basis for autonomous flying drones. A multitude of service promises are possible. Currently, the focus is on the transport of sensitive and high-quality medical objects (e.g., organs, blood, etc.) from one hospital to another.
Mobility	1906	2017	Switzerland	9	Switzerland, Germany, France,	The Mobility case refers to an ecosystem consisting of five core partner who promise an autonomous bus in pedestrian zones. To deliver on this promise, a university is providing expertise on the use of Big Data and a public transport company is bringing knowledge and experience, particularly in public transport processes. In addition, some start-ups specialized in autonomous driving are part of the ecosystem. A city was provided as a test site, which means that the public sector also plays an important role in the ecosystem. Another university contributed market knowledge and provided a network as well as market research. All these contributions were crucial for the realization of the performance promise of autonomous buses.
Move	2014	2015	Switzerland	7	Switzerland	The value proposition of the Move case focuses on a personally tailored relocation process. The primary aim is to relieve the customer of the burden of communicating individually with each company involved in the relocation process. The all-round service ranges from the organization of cleaning and the sale and transport of furniture, to a customized insurance service for the household. The service is offered in cooperation with an insurance partner. In this case, the function of the orchestrator has changed over time. In the initial phase, when the company was still a start-up, most of the process steps were executed manually and there was a lack of technical support regarding partner communication (later referred to as Move Phase 1). By establishing the company and implementing a platform, communication with the partners was largely automated (later referred to as Move Phase 2). The integration of the platform created more time for the orchestrator staff to shift their attention to new subject areas.
Smart Building	2015	2016	Italy	16	France, Italy, Netherlands, United Kingdom, United States of America, Switzerland	The Smart Building case has developed a smart air conditioning and heating solution to achieve an optimal and sustainable indoor climate (e.g., in offices or in the metro). The temperature is measured by a sensor and the existing ventilation is switched on and off by a device developed by the orchestrator. This ecosystem consists of a large number of partners, with relations both bilateral and multilateral. This case is referred to as an ecosystem because there are multilateral relationships. The enterprise has a large number of partners that have developed the hardware for the enterprise, as well as partners that supply the corresponding software.
InsurTech	2017	2017	Austria	3	Austria, Germany	The InsurTech case represents an ecosystem that merges a physical product with a customized insurance solution. An example application combines a smart toothbrush with a dental insurance policy. Specifically, the company acts as an insurance intermediary between B2C companies that manufacture physical products and insurers. The aim is to offer a customized and comprehensible insurance solution. The insurance is thus fully implemented in the sales process of the physical product.
Sport	2014	2014	Switzerland	6	Canada, Germany, Switzerland	The Sports case focuses on a solution for the creation of 3D soles, especially for ski boots. The soles are made using the technology of a 3D printer, which promises a unique experience. Customers typically receive a standard boot sole when buying ski boots. The problem is that a boot that doesn't fit properly will cause pain. An important player in this ecosystem is the partner who provides the 3D printer technology. In addition, the ecosystem has an e-commerce partner to successfully market its products.
Factoring	2016	2016	Switzerland	6	Switzerland, United States of America	The orchestrator of the Factoring case offers Swiss SMEs operating in developing countries a factoring solution for doing business with developing countries. Long payment periods (up to half a year) pose numerous challenges that can trigger liquidity problems for SMEs. The Fintech Ecosystem offers a customized solution for eliminating liquidity bottlenecks in order to enable business activities in developing countries. In addition to the orchestrator, the ecosystem includes funding partners, an insurance company, a reinsurer, a bank and a software company that uses an algorithm to assess the risk of SME claims.
Analytics	2016	2017	Turkey	13	Great Britain, Netherlands, United States of America, Switzerland	The ecosystem of the Analytics case has developed software that analyses potholes, rocks, bumps, and other types of data about damage to public roads. The software then evaluates this data with a unique algorithm. In order to achieve this value proposition, the company collaborates with many different players: the public sector is crucial for providing information about the roads, and private companies also provide the ecosystem with essential geo data. City managers also play an important role, as the software solution promises to reduce maintenance costs.
Data	1876	2017	Switzerland	11	Switzerland, Germany, United States of America	The Data case refers to an ecosystem consisting of five core partner who promise an autonomous bus in pedestrian zones. To deliver on this promise, a university is providing expertise on the use of Big Data and a public transport company is bringing knowledge and experience, particularly in public transport processes. In addition, some start-ups specialized in autonomous driving are part of the ecosystem. A city was provided as a test site, which means that the public sector also plays an important role in the ecosystem. Another university contributed market knowledge and provided a network as well as market research. All these contributions were crucial for the realization of the performance promise of autonomous buses.

Table 5: Case overview

2.3.2. Data Collection

Our data collection process was divided into five main phases. In the *first phase*, the researchers conducted initial interviews of 15 to 60 minutes to determine whether the ecosystem structure met the case selection criteria. Moreover, we wanted to gain an initial understanding of these cases. The interviews were conducted with the primary contact person from the ecosystem orchestrator.

In the *second phase*, we conducted semi-structured interviews based on the interview protocols included in the appendix. We interviewed managers from the orchestrator under the assumption that they would have an optimal overview of the ecosystem. The duration of the interviews varied from 30 and 90 minutes. The interviews were structured around the core elements of ecosystem development (cf. Adner, 2017; Adner & Kapoor, 2010; Eisenhardt & Galunic, 2000; Jacobides et al., 2018; Li & Garnsey, 2014; Moore, 1993; Overholm, 2015) – for further details, please see Interview Protocol in the appendix. We sought to learn more about the following aspects:

- (1) Company history, number of employees, contextual embedding
- (2) Timeline of the ecosystem development
- (3) Company's role within the ecosystem
- (4) Key elements of the ecosystem according to, namely, actors, links, positions, roles, and activities (Adner, 2017)
- (5) Initial situation at the beginning of the ecosystem initiative
- (6) Orchestrator's knowledge related to the joint values proposition, the ecosystem modules, and (potential) ecosystem partners
- (7) Orchestrator's understanding of partner interests
- (8) External conditions of the ecosystem, i.e., environmental uncertainty, industry characteristics, or competitive situation.

In the *third phase*, we conducted interviews with partners of the ecosystems or other third parties with strong insights into the ecosystem, such as investors or customers. We conducted these interviews in order to triangulate and enrich our findings.

In the *fourth phase*, we collected extensive additional data, such as internal presentations and reports, annual reports, press releases, homepages, and media reports. We deemed this a suitable approach since several of the cases in our study received extensive media attention due to their novelty or impact. As a result, we collected data from a wide range of data sources, including both external and (orchestrator) internal documents, as well as those from third parties within the ecosystem and other aspects

addressed in the first interview protocol (see Interview Protocol I in the appendix). This enabled us to augment, validate, and triangulate the findings of the first interviews (Jick, 1979). Also, it improved our ability to identify possible inconsistencies between the statements made in the initial interviews and the internal and external documents.

As a *last step*, we subsequently conducted additional interviews with the orchestrator, to deepen our existing knowledge and resolve any inconsistencies or ambiguities. In some cases, we organized workshops with some of the companies to gather further insights and check the correspondence between emerging theoretical constructs and the perception of practitioners. If required, we also approached the interview partners by e-mail and held brief follow-up interviews.

During all interviews, we took detailed notes, recorded them on tapes, and transcribed them within a short time period after the interviews (cf. Yin, 1981, 2014). Additionally, we worked with our respondents to create graphical representations of the ecosystems studied (Dattée et al., 2018). Afterwards, all three authors analyzed the information (Mayring, 2007) and elaborated the findings together.

In most of our cases, information about the core elements of the ecosystem was publicly accessible. In all of our cases, we were able to validate the key messages of our interviewees and thus strengthen their credibility. Also, we consciously observed time delays of several weeks to several months between interviews and follow-ups and withheld transcripts or information from previous interviews from the interviewees. By doing so, we were able to ask questions from previous interviews during follow-ups to check the consistency of the responses. No significant differences were found between the information provided from one interview to the next, which also affirmed the credibility of our interviewees. Finally, to further verify consistency, we conducted interviews with other companies in the ecosystems. An overview of our data sources is shown in Table 6.

Case	Field of business	# of Interviews	Interviewee position O = Orchestrator company P = Partner company	Interview code	Interview duration (min)	Total pages transcripts	Additional data	Source (additional data)
Access	Security	7	Chief Executive Officer (O)	1A	67+20+63	33+9+39	Company documents Blog posts & online articles	internal external
			Chief Sales Officer (O)	1B	81+67	40+40		
			Head Ecosystems & Venturing (P)	1C	60	34		
			Venture Fund Manager (P)	1D	21	12		
Logistics	Logistics	5	Head of Autonomous Delivery (O)	2A	36	17	Company documents Blog posts & online articles Radio & TV reports	internal external external
			Head of Open Innovation (O)	2B	53	25		
			Program Manager (O)	2C	55	26		
			Project Manager (O)	2D	36	21		
			Chief Executive Officer (P)	2E	39	14		
Mobility	Public transportation	6	Head of Open Innovation (O)	3A	52	27	Company documents Blog posts, Newspaper & online articles Radio & TV reports	internal external external
			Head Project Lab (O)	3B	75+48+58	38+30+33		
			Coordinator Project Lab (O)	3C	45+13	24+8		
Move	Home	8	Key Account Manager (O)	4A	9+60	6+23	Company documents Online & magazine articles Newspaper articles	internal external external
			Business Development Manager (O)	4B	86	36		
			Founder & CEO (O)	4C	66	40		
			Head of Business Development (O)	4D	25+24	15+15		
			Innovation Manager (P)	4E	40+60	17+23		
Smart Building	Energy	4	Chief Product Officer (O)	5A	53+55+40	18+21+27	Company documents Online & magazine articles	internal external
			Chief Executive Officer (O)	5B	22	10		
InsurTech	Insurance	5	Chief Executive Officer (O)	6A	38+31	20+19	Company documents Newspaper articles	internal external
			Chief Operating Officer (O)	6B	40+29+43	21+18+25		
Sports	Sports equipment	3	Chief Executive Officer (O)	7A	104+26+16	26+13+8	Blog posts & online articles	external
Factoring	Finance	8	Co-founder & Head of Sales & Marketing (O)	8A	137+23+80+27+22+6	29+10+38+12+15+26	Online & magazine articles	external
			Product Officer (O)	8B	81	42		
			Innovation Consultant (P)	8C	36	15		
Analytics	Analytics	2	Head of Sales (O)	9A	23+39	9+20	E-Mail Interview	internal
Data	IT	6	Managing Director of New Businesses (O)	10A	18+65	9+39	Internal Company presentation Online & magazine articles	internal external
			Chief Marketing Officer & Board Member (O)	10B	11+36	6+20		
			Director of Global and Local Partner Integration (P)	10C	60+23	40+13		
Total		54			2443	1214		

Table 6: Case and data overview Chapter 2

2.3.3. *Data Analysis*

We initiated our analysis by summarizing the data available to date into a comprehensive case narrative for each company. This case narrative was extended in later phases of data collection, as described above. For each case, the case narrative was first created based on our interview records and then supplemented with other data sources and follow-up questions (Yin, 2014). When conflicts arose, we reviewed our data to resolve them.

We then identified emerging patterns by analyzing each case through the lens of our research question and the aspects of co-specialization, type of search, and potential influences of varying levels of hierarchy. Also, with the help of tables, drawings, and other types of visualization, we were able to provide an overview of our content and more clearly identify patterns in our data (Miles, 1994; Yin, 2014). Due to the novelty of the ecosystem phenomenon, as well as the inductive nature of our inquiry, the authors independently segmented the data into meaningful clusters (Strauss & Corbin, 1998). The identification of codes continued until additional information from the interviews did not yield additional, meaningful codes (Guest et al., 2006, p. 65; Locke, 2001). For further details on the coding, please see the exemplary coding scheme in the figures 4 to 6.

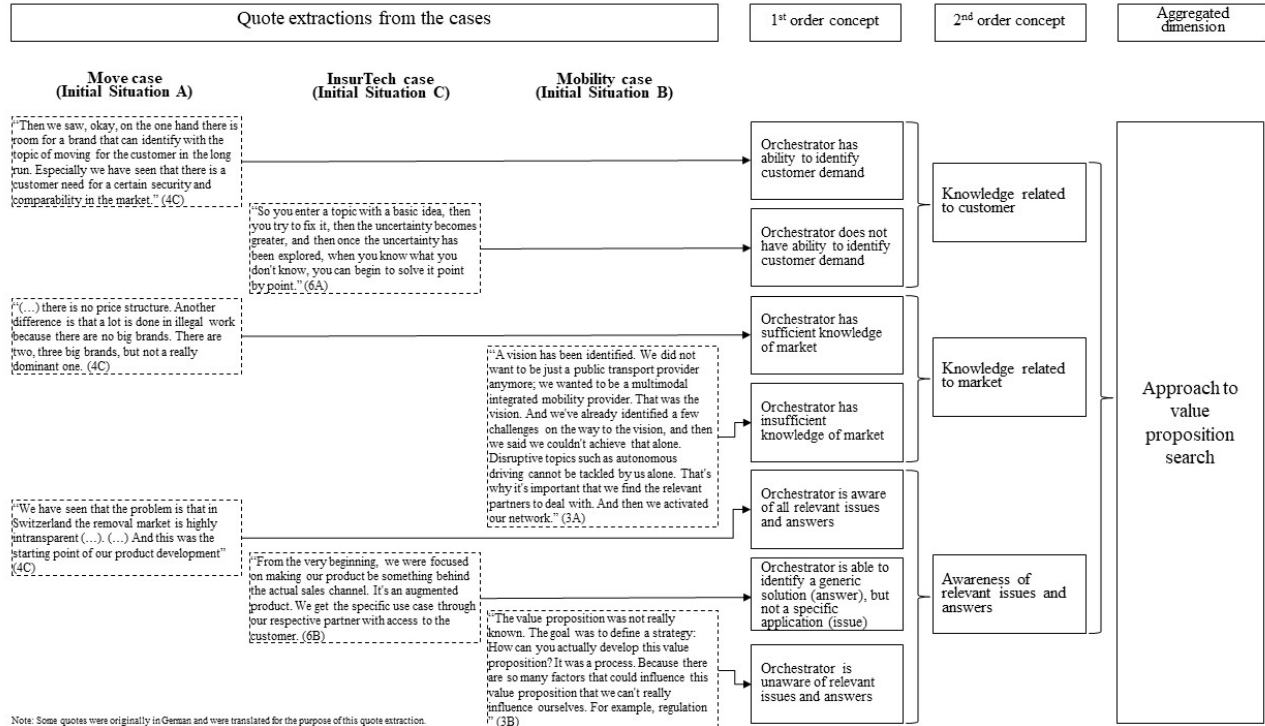


Figure 4: Exemplary coding scheme A

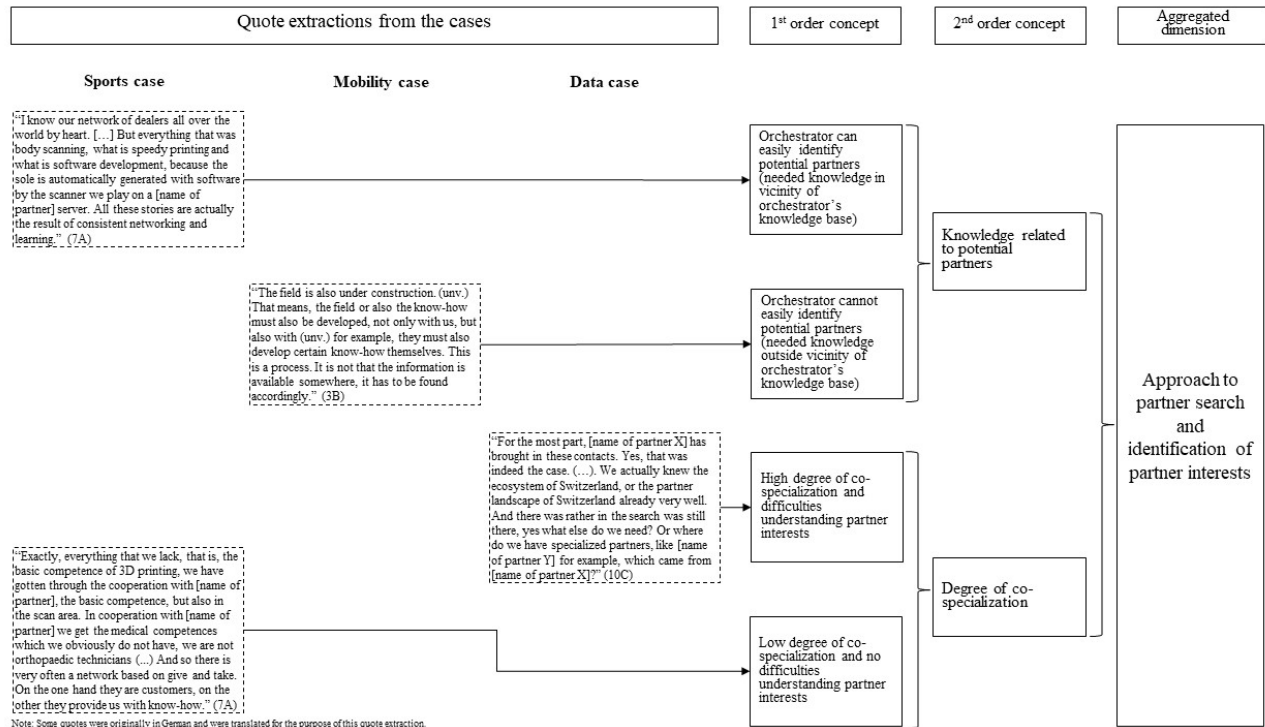


Figure 5: Exemplary coding scheme B

After completing the in-case analysis, we performed a cross-case analysis. We looked at all ten cases together to understand parallels and differences between them (Ozcan & Eisenhardt, 2009). With a replication logic in mind, we were able to develop first recursive constructs and, thus, identify emergent patterns across cases (Eisenhardt & Graebner, 2007). We then switched between emergent theory and data to clarify constructs, adjust abstraction, and confirm the underlying logical arguments.

When our theoretical knowledge was refined, we referred to previous literature to compare previous research with our research. By doing so, we followed an iterative process of refining knowledge, strengthening underlying logical arguments, and linking them to existing theory (Eisenhardt, 1989).

Our findings are guided by two main concepts, namely local search (Cyert & March, 1963; Nelson & Winter, 1982; Stuart & Podolny, 1996) and distant search (Kogut & Zander, 1992; March, 1991; Miner et al., 2001), as well as the degree of co-specialization (Jacobides et al., 2018). Additionally, throughout the data analysis, we kept the key defining aspects of ecosystems, especially varying levels of hierarchy, in mind. Search is performed in order to define both the value proposition for the ecosystem as well to identify and select potential partners. In our framework, the endpoint of the first search process is a clearly defined value proposition. The endpoint of the second search process is a defined set of partners. Both search processes are described below and illustrated in Figure 7.

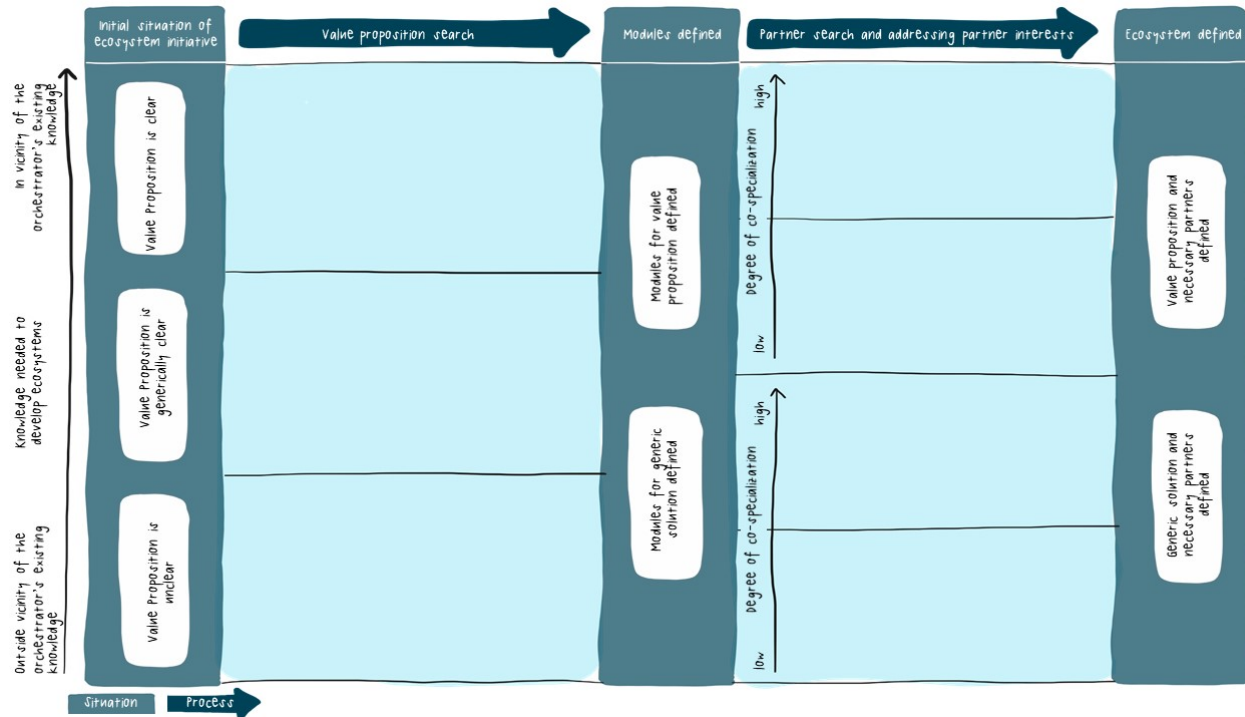


Figure 7: Overall structure of findings

2.3.4. The Search for an Ecosystem's Value Proposition

As far as the search for the value proposition is concerned, we identified three different initial situations, which lead to different approaches for the development of the value proposition.

Initial situation (A): The orchestrator has sufficient knowledge of the market and customers to independently define a value proposition for the future ecosystem.

Initial situation (B): The orchestrator has a vision for the ecosystem's future value proposition but is unable to specify it.

Initial situation (C): The orchestrator can define a solution (e.g., a technology) that can be used to address a multitude of customer demands. However, it is not able to find a specific customer demand that can be addressed by using this solution. Thus, the orchestrator is aware of a generic solution but not a corresponding problem that can be solved with this solution.

Before the ecosystem modules can be defined, the orchestrator has to attain clarity over the value proposition or generic solution. Once the value proposition and the generic solution, as well as necessary modules, are defined, the search for the ecosystem partners can begin.

2.3.5. The Search for Ecosystem Partners

The difficulty with which orchestrators identify and find the necessary ecosystem partners depends upon their knowledge of the potential partners. Two different starting points for the search for ecosystem partners can be inductively derived from our cases:

(A) The required partners are easily identified by the orchestrator and can be found using simple methods, such as desk research.

(B) The required partners are not easily identified by the orchestrator and cannot be easily found.

These two starting points result in two approach categories (A and B). When the ecosystem partners' levels of co-specialization are taken into consideration, four approaches to partner search can be identified. As shown in Figure 7, the approaches are structured along the dimensions of knowledge related to potential partners and the partners' levels of co-specialization, which could be either high or low. The approaches (A1, A2, B1, and B2) all indicate different configurations of the dimensions mentioned above:

(A1): The knowledge needed to identify partners is in the vicinity of the orchestrator's existing knowledge base and the degree of co-specialization is low

(A2): The knowledge needed to identify partners is in the vicinity of the orchestrator's existing knowledge base and the degree of co-specialization is high

(B1): The knowledge needed to identify partners is outside the vicinity of the orchestrator's existing knowledge base and the degree of co-specialization is low

(B2): The knowledge needed to identify partners is outside the vicinity of the orchestrator's existing knowledge base and the degree of co-specialization is high

As a result of the configuration of partner knowledge and the degree of co-specialization, the orchestrator either does (A1 and A2) or does not (B1 and B2) have the ability to search for partners independently. Therefore, the approach to partner search has to be chosen accordingly.

Throughout the whole process of partner search, our cases further revealed another core aspect of ecosystem establishment: The order in which partners are searched for and involved in the ecosystem by the orchestrator. This will be explained in detail following the overall case-by-case description of the findings.

2.4. Findings

2.4.1. Case-by-case Findings

In the following, the cases will be explained in detail to demonstrate how the approaches to value proposition search and partner search were derived from the case data. The presentation of all ten cases will be structured along the three initial situations outlined in section 4.1 (A, B, and C) to facilitate practical applicability.

Initial situation (A)

As an illustrative example of the first initial situation, the founders of the orchestrator of the **Access case** participated in a university competition on the topic 'What are the biggest problems in the car sharing sector?'. After an in-depth analysis and examination of current issues, the founders realized that the major problem for the customer was opening a rental car without a key. In highly frequented places, such as large airports or train stations, handing over the keys at any time, day or night, is not a problem. In suburban areas, however, the situation changes because keys can only be handed over during business hours. In remote regions, the customer is unable to find a rental car

offer because the operation of a branch office in a remote region would not be profitable. Although the founders had a clear idea of the value proposition that they aspired to bring to market, there were technical specifications that they had to address before finalizing this value proposition. Limitations to what was technically possible, thus, impacted the envisioned value proposition. The founders eventually submitted their proposal to the contest and subsequently developed a technology for opening cars with a smartphone. Through their research, the founders came to know the market and the modules required to solve the problem. They were able to independently establish the value proposition, define the necessary modules, and look for ecosystem partners to implement the value proposition, thus purposefully driving the ecosystem. The managing director described this as follows:

“Yes. The value proposition was very clear. The invention of this software concept made it clear what advantages it offered. What was added afterward is that it is not only useful in the automotive sector, but also for many other electronic applications.”
(1B)

Since the founding team was confronted with a rather high market uncertainty, they struggled to know which companies would prove to be the right key partners. Therefore, partners were identified and integrated one at a time in an iterative process, as the orchestrator had to learn to understand the market as well as future partners, which meant that the iterations were unplanned. Within the Access case, the orchestrator chose as its first partner the hardware manufacturer, which provided the connection module. This was because the development of this module was expected to take the most time. The Chief Executive Officer (CEO) explains this reasoning:

“I first added the hardware supplier, because he has to undertake the most significant developments of all partners. The software components, on the other hand, can be easily adapted and developed.” (1A)

An important event, which had great impact on the set-up of the ecosystem modules, was changing the key partner, who provided the key module, due to the module fit. The key module is considered the most significant module for the value proposition supplied by the key partner. It turned out that the initial key partner's module was not in total congruency with the necessary ecosystem modules, as the solution specificities of the key module and the orchestrator did not align. After replacing the initial key partner with a new key partner, the team was able to develop the ecosystem and integrate its additional partners with relatively little friction, with the exception of some contractual

disagreements, which lead to another partner shift. Finally, the modules and necessary partners were set and defined, allowing the ecosystem to develop. For an illustration of the ecosystem development see Figure 8.

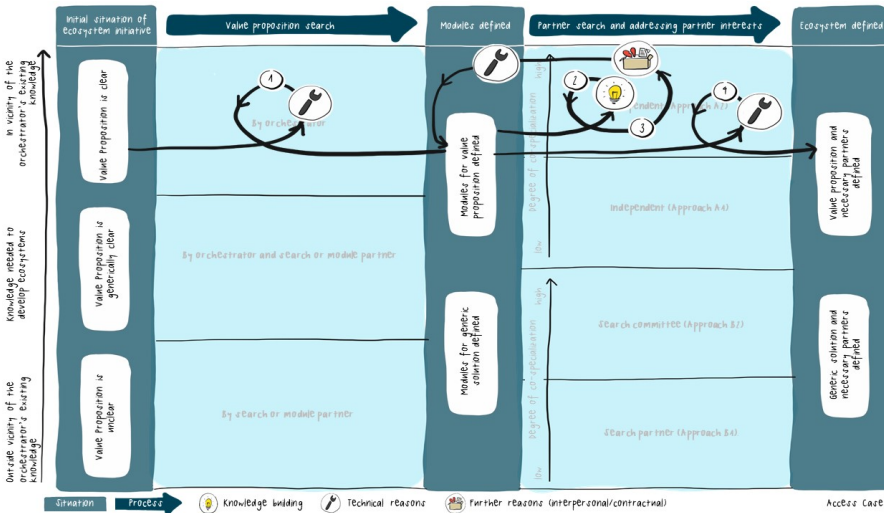


Figure 8: Ecosystem development Access case

In the **Factoring case**, the orchestrator’s management team developed the value proposition based on the deep domain knowledge it had acquired during previous working engagements in the banking sector. During that time, constant customer inquiries made the managers aware of a problem: Their company did not offer a factoring solution for Small and Medium Enterprises (SMEs) doing business in developing countries. In these regions, payment terms are typically very long-term, which can be a serious problem for the liquidity of these companies. Regular factoring can deal with this problem, but it is usually only granted to SMEs that have sufficient liquidity to begin with. As a result, SMEs with low ratings from doing business in these markets are excluded. The orchestrator’s co-founder and Head of Sales and Marketing describes the process of identifying customer needs as follows:

“From the very beginning, we knew what our customers were doing and what they were missing. From there, we developed our value proposition. (...) In this respect, you can clearly say that we developed the value proposition entirely by ourselves.”

(8A)

The founders initially presented a solution to serve this niche market, but it was rejected by their employer company's top management. Afterwards, they decided to start their own company and implement and further develop the value proposition themselves. During this independent process of value proposition search, the founders came to understand that a part of their value proposition was actually unnecessary as there was no substantial customer need for it. The orchestrator summarizes the situation as follows:

“We have a nice solution and for every nice solution it is very difficult to find customers.” (8A)

After getting rid of this element that had no actual customer demand and, thus, adjusting and correcting the value proposition, it was possible for the founders to define and set-up the necessary ecosystem modules. From there, they were able to search for partners catering to these modules through an independent search process due to the founders' strong network of relationships, as well as their superior knowledge of the industry. They, therefore, created the ecosystem purposefully. Figure 9 further shows the detailed development of the ecosystem.

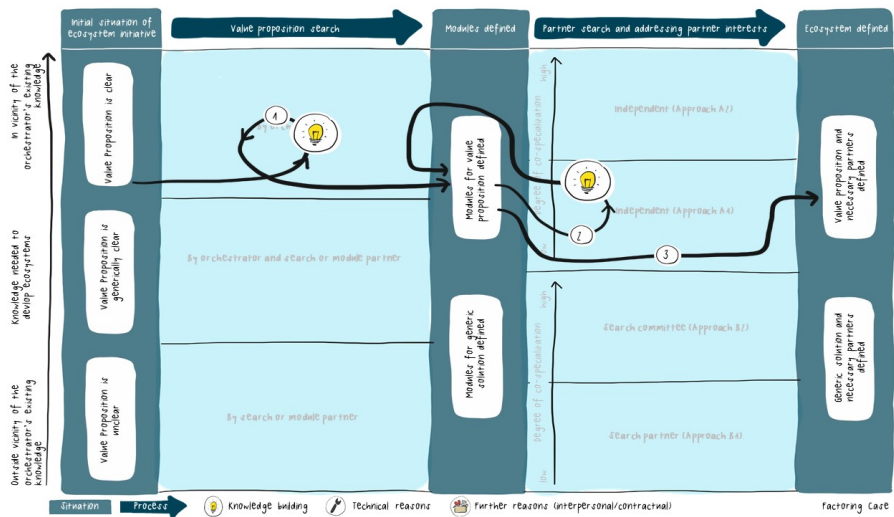


Figure 9: Ecosystem development Factoring case

Noticeably, the fundamental value proposition was defined at the beginning. Later on, only slight adjustments were made to the value proposition and its specific modules to adapt it to different geographical markets, since the conditions for loan payments, as well as market specificities, differ slightly from country to country. Further, the following quote from the orchestrator illustrates this development:

“The value proposition, per se, remained unchanged. The specific characteristics of our value proposition have been slightly adjusted over time. I would say that it is changing in the lower single-digit percentage range. But the fundamental value proposition remains stable.” (8A)

Similar to the first two cases, at the beginning of the **Smart Building case**, the orchestrator was fairly certain of the value proposition of the service. The individual modules and the market itself could easily be defined and understood, and they were therefore able to purposefully build up the ecosystems. As the Chief Product Officer nicely puts it, there was a clear understanding of customer need and the potential of the value proposition:

“We saw the potential; we discovered that we could save money on energy bills because every building consumes energy and therefore every owner of a building is a potential client, so that's when we started.” (5A)

The orchestrator was joined by a key partner early on, and additional ecosystem partners were identified and integrated alongside this initial search partner. The orchestrator benefited particularly from these partners' established networks and reputations. In the early days of the partner search process, it was necessary to change partners due to the misjudgment of partners' abilities, as the orchestrator states:

“And this people knowledge brought us to the right suppliers. But we did [make] mistakes, we changed suppliers over time.”(5A)

Trust and the ability of partners to actually deliver the necessary individual modules were important factors during this change of partners. Later on, to specifically cater to new clients with differing technical predispositions, the modules had to be slightly adapted to assure the technical implementability of the solution:

“We needed a market opener, and technical partners, so that we can work with the local teams and [...] target specific tradeshow, specific touchpoints for new clients and install the first pilots [...].” (5A)

The orchestrators eventually developed sufficient market knowledge to independently search for additional partners for these specific use cases. Figure 10 shows how the ecosystem emerged.

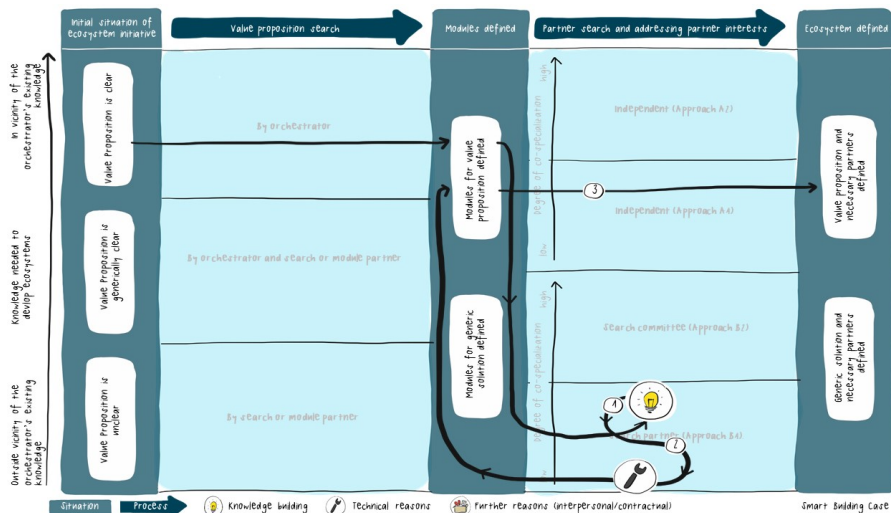


Figure 10: Ecosystem development Smart Building case

The founders in the **Move case** were very informed about the moving market from the get-go. Hence, they had a clear understanding of what the value proposition should be. The orchestrator had sufficient market knowledge to form a value proposition for a specific use case, thereby purposefully building the ecosystem. As explained by the CEO, they identified a clear customer need, which served as the starting point for developing the value proposition:

“We have seen that the problem is that in Switzerland the removal market is highly untransparent [...]. [...] a lot is done in illegal work because there are no big brands. [...] Especially we have seen that there is a customer need for a certain security and comparability in the market. And this was the starting point of our product development.” (4C)

Due to their high level of market knowledge and the clear value proposition, the orchestrator was able to independently define the necessary modules. The orchestrator could easily understand potential ecosystem partners due to the low degree of co-specialization. Hence, the founders independently identified and integrated four partners. During this process, some small but impactful adjustments were made. For instance, there was a change in the insurance partner due to contractual disagreements and some interpersonal challenges. Additionally, the founders eventually decided to

increasingly focus on their core competencies and consequentially adapted the value proposition as well as the necessary modules:

“And this, I think, is becoming more and more our strength, these user-insights, the data, the knowledge regarding the behavior of our users.” (4C)

The orchestrator, for instance, introduced furniture stores to the ecosystem, as the moving process and new furniture frequently go hand in hand. With the adapted value proposition and modules as a starting point, the orchestrator independently added new partners and, by doing so, finalized the ecosystem. Please see Figure 11 for an overview of the ecosystem development.

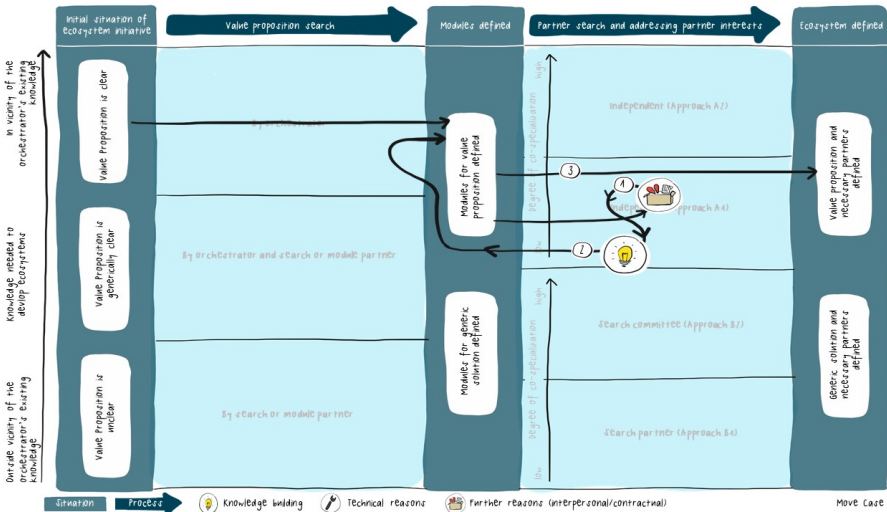


Figure 11: Ecosystem development Move case

In the **Sports case**, the orchestrator initially had a clear understanding of the value proposition as they wanted to use 3D printing technology to provide customers in the sports sector with tailormade shoe soles and eventually whole shoes. There was little uncertainty regarding the market as the founders had a high level of market, product, and sales knowledge from many years of experience in sports retail. The CEO pointed out:

“We understand foremost the functionality which is needed within sports. We know the market. [...] the main goal of our project was the printed ski boot. The sole helps us to have an earlier go to market and to earn money.” (7A)

There was, however, a fair amount of uncertainty regarding the specific technologies (like the software, scanning solutions, and 3D printing), as the product had to be developed from scratch and the founders had to find a way to integrate the technology into their business model to create the value proposition. Due to their high level of customer knowledge and experience of interacting with customers, the orchestrator was, nevertheless, able to independently develop the value proposition and define the ecosystem modules. Figure 12 shows the development of the ecosystem.

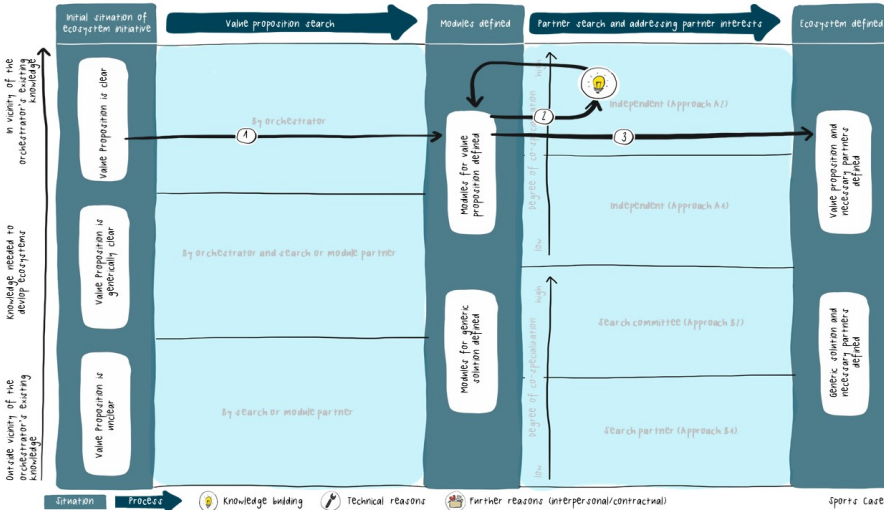


Figure 12: Ecosystem development Sports case

The ecosystem was built purposefully since the orchestrator used a targeted process to search for and gather ecosystem partners around the value proposition. For instance, the search for potential partners was quite easy as the orchestrator was able to find partners through simple desk research. This is underlined by the following statement from the CEO:

“It’s just that you start googling.” (74)

The orchestrator’s lack of experience in the technical domains related to the value proposition, which implied that the potential partners had to be more intensively convinced of the merits of being part of the ecosystem. Due to a higher degree of co-specialization, the complexity of the partner system was increased. This complexity, in turn, increased the uncertainty about the success of the initiative. For this reason, the

orchestrator had to build up knowledge in order to understand and address partner interests. A major adaption and change in modules came with the switch from a B2C to a Business-to-Business-to-Customer (B2B2C) business model, as the latter model was able to effectively provide access to a viable customer base. The orchestrator came to understand that it was much easier to reach end customers with an intermediary sports retailer in between. Through intensive collaboration and continuous learning, the orchestrator was able to align all necessary partners and bring an innovative product to market. The CEO described the situation as follows:

“I know our network of dealers all over the world by heart. [...] But everything that is body scanning, that is speedy printing and that is software development [...] is actually the result of consistent networking and learning.” (7A)

Initial situation (B)

In the **Mobility case**, there was no clear value proposition at the start of the initiative. The head of Project Labs said:

“The value proposition was not really known. The goal was to define a strategy [...]. It was a process. Because there are so many factors that could influence this value proposition [...].” (3B)

As the Head of Open Innovation explained, only a superficial vision as a multimodal integrated mobility provider was defined:

“A vision had been identified. We did not want to be just a public transport provider anymore; we wanted to be a multimodal integrated mobility provider. [...] and then we said we couldn't achieve that alone. Disruptive topics such as autonomous driving cannot be tackled by us alone. [...] And then we activated our network.” (3A)

The orchestrator was dependent on a partner to specify possible problems and associated solutions and to assist in the development of a value proposition. The orchestrators were purposefully driving the ecosystem, and therefore selected a university as a partner because it is a well-known institution in the field of new mobility solutions. Also, the orchestrator had a personal connection to the public institution. The university was able to provide knowledge regarding the market and potential technologies. With regard to the value proposition development, the university significantly shaped and changed the orchestrator's understanding by identifying and foregrounding what was technically possible in alternative mobility solutions. This

enabled the consortium to develop the idea of an autonomous bus in pedestrian zones. Please see figure 13 for an overview of the ecosystem development.

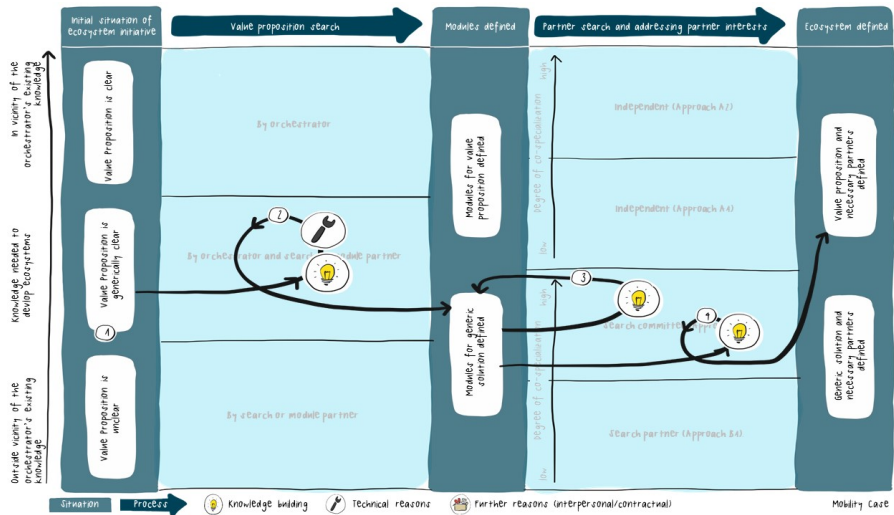


Figure 13: Ecosystem development Mobility case

For the Mobility case, as explained above, the definition of the value proposition, as well as the necessary ecosystem modules, would not have been possible without what we call a 'search and module partner'.

Due to the high degree of co-specialization of the modules, it was difficult for the orchestrator to understand and address partner interests. For this reason, the orchestrator jointly searched together with its existing partners in what we call a 'search committee'. Due to common ground among the partners and the broad joint network of all partners involved, it was possible for the search committee to locate suitable partners. The search committee held meetings in person or digitally. During the meetings, the requirements and capabilities of potential partners were discussed, defined, and analyzed, and a shortlist of all potential partners was drawn up. Thereupon potential ecosystem partners were contacted by the committee partner who has the closest relationship to the potential new partner or by the committee partner who could address the potential new partner's interests in the most conceivable way. If a new partner joined the ecosystem, this partner was integrated into the search committee if they had relevant and complementary skills.

It must be noted that the ecosystem initiative discussed here, the Mobility case, was part of a group of ecosystem projects initiated by the same orchestrator, a consortium. These projects were, therefore, not entirely independent from one another – especially not in the early stages of development. In the early phase of ecosystem development, the lab, which controlled these projects, initiated an adaption to modules to allow for the projects to fit together optimally as a whole. Consequentially, the module components of each ecosystem project – including the one analyzed in this Mobility case – were developed and adapted to maximize synergies and knowledge transfer. The development of these projects is summarized in the following quote:

“There was a lot of uncertainty. When the consortium started, they didn't know exactly which direction to take - there were other projects as well. [...] For each project, we should sign new [specific] contracts. Depending on the funding of the project, new agreements are concluded. The outline contract is just very rough.” (3B)

It was the consortium's goal to have the value propositions materialize jointly in synergy. In the Mobility case, the process of partner search as part of the ecosystem development was further characterized by early customer interactions and feedback loops. This, in turn, led to a certain shift and the addition of ecosystem partners before the ecosystem was eventually realized. Specifically, the orchestrator worked together with the authority responsible for public transportation in a rather rural, but touristic canton of Switzerland. In doing so, they were able to identify additional partner needs.

In the **Data case**, the orchestrator was able to define around 80% of the value proposition based on its own knowledge. The orchestrator gained this ability through a previously developed project. After this project failed after several months, the orchestrator moved on from simple IT storage to a multi-cloud solution. This was followed by the hiring of employees with in-depth domain knowledge, who helped elaborate the concept. In order to define the ultimate stage of the value proposition, a partner was needed, similar to the Mobility case. The following quotes from the Managing Director of New Businesses explain the process perfectly:

“So the innovation, the idea, [...] came [...] from us out of the failed customer project. [...] The tasks of the partners and the value proposition were largely clear. Let me now say that was 80 percent. The remaining 20 percent were then created [...] in cooperation with the technology partner.” (10A)

The contact to this technology partner, one of the largest global technology leaders, came from the personal network of a leading employee, and shows that the orchestrator

in this case was also driving the ecosystem with a purpose. This employee personally reached out and convinced the partner of the value of the initiative. The orchestrator chose the partner first that contributed the most important module to the ecosystem, as explained by the orchestrator of the Data case:

“Together with the search partner, a committee scouted the most important technology partner. It could be convinced by the commitment of the search partner [to the ecosystem].”

(10C)

The Data case also resembles the Mobility case in terms of the partner search approach. A search committee was used to identify potential partners, who were then contacted by the existing partner with the most common connection in order to convince the potential partner of the initiative’s merit. This was specifically relevant when it came to the local adaption of the ecosystem. To ensure technical feasibility with regard to differing technological points of departure, the modules were adapted with the help of partners. This cooperative process is described as follows:

“[...] the partners refined that and then they came to us with it or we did it together. It was a bit of a flowing process, it wasn't something that was done exactly according to a certain methodology.” (10A)

From there, and with the adapted modules in mind, the orchestrator finalized the partner search with the help of a search committee. Figure 14 shows how the ecosystem was built.

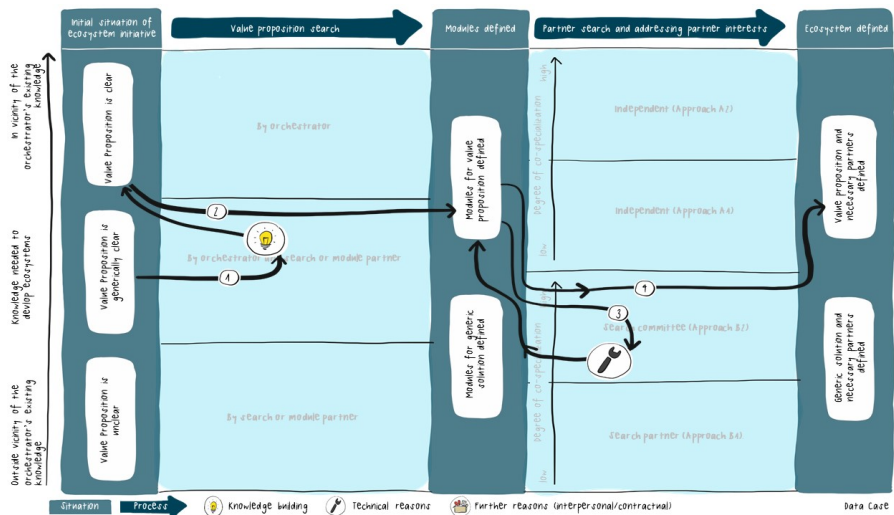


Figure 14: Ecosystem development Data case

Initial situation (C)

The orchestrator in the **InsurTech** case recognized a market in the InsurTech area. The founders noticed that almost all insurance contracts are too complicated, too long, and too unspecific to be useful in individual use cases. This represents a barrier to the digital sale of supplementary insurances for physical products. Based on the orchestrator's personal experience, it was known that insurance companies were too slow to provide such a service, so the idea emerged to solve this issue by being a sort of 'spider in the middle'. The orchestrator was purposefully building an ecosystem since he knew that it would offer a better solution than existing alternatives. A minimum viable product (MVP) was built to prove that the solution worked. After a hypothesis test, following the lean startup concept, the orchestrator quickly came to find that there was market potential for its generic solution. In line with the lean startup approach, this first process of defining a solution was characterized by iteration. In partnership with the partner who would eventually provide the key module, the orchestrator started developing its technical solution. With constant feedback, the orchestrator was able to technically specify its idea within the InsurTech field as there was initial uncertainty about which specific technology should be used to realize the vision. Further, they changed the generic business model from a B2C model to a B2B2C model due to improved customer accessibility. The modules for this generic solution therefore changed slightly, but were

eventually set. Subsequently, and with help from the same partner, more partners were added to the ecosystem. Eventually, the generic solution was adapted to specific use cases and the development of the ecosystem can be seen below (see Figure 15).

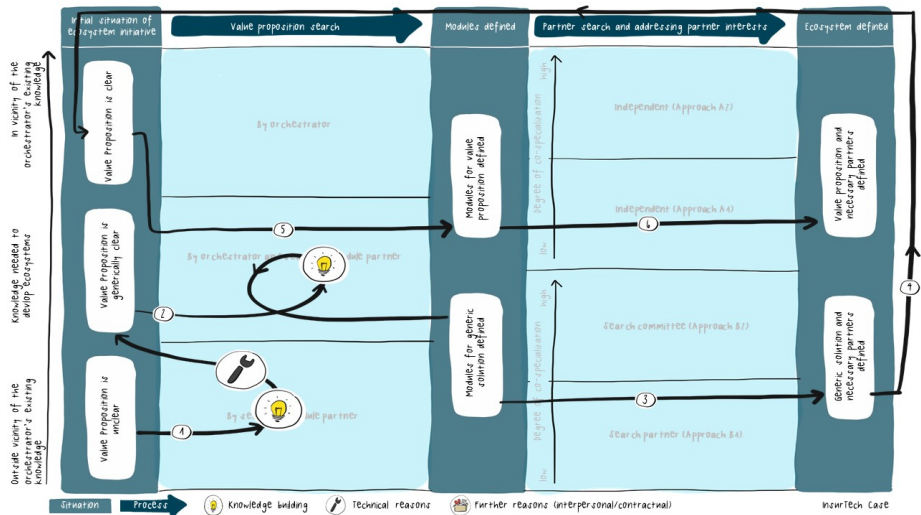


Figure 15: Ecosystem development InsurTech case

In collaboration with partners, the specific value propositions were then defined and the orchestrator independently added the last ecosystem partners with the use case in mind. This adaption per use case is described by the orchestrator as follows:

‘From the very beginning, we were focused on making our product be something behind the actual sales channel. It's an augmented product. We get the specific use case through our respective partner with access to the customer.’ (6B)

To a certain degree, the **Logistics case** behaved similarly to the InsurTech case, as the orchestrator was also driving the ecosystem’s goal orientation and followed a similar approach to value proposition and partner search. The orchestrator is one of the largest logistics providers in Switzerland. One day, during a meeting, the idea of using an autonomously flying drone for logistics was born. The idea can be summarized by the following statement:

“When we started the case, of course, we had some knowledge about drone technology. We had to know this to understand what was possible. We also had an initial understanding of the case, but of course, the idea about the case grew out of dozens of conversations with various customers. Our strength in Switzerland was our market knowledge. We know the local conditions, and we have the contacts to potential customers.” (2D)

At first, the value proposition was generically defined but could not be specified for one use case. The orchestrator started with the development of a generic drone-centered solution. During this process, the necessary expertise of which modules are needed for the specific value proposition was elevated with a partner, who helped to define the generic value proposition. Hence, there was a change in outlook related to feasibility and potential customer needs quite early in the process. Given the innovation potential of a drone solution, it became apparent that a promising use case existed. Thus, there was a relatively low risk of implementing the value proposition and not being able to monetarize it later.

As the orchestrator lacked specific domain knowledge, ecosystem partners could not be identified and integrated independently. Therefore, the orchestrator required the help of a committee of partners. During the joint process of ecosystem development, an early change of modules happened as the application of the drone solution within the logistics sector was narrowed down to transporting smaller goods. Later, a change of partners followed a subsequent specification regarding the scope of the transportation of smaller goods. As soon as the modules and partners for the generic solution were set, the solution was developed to a specific use case. For this concretization, the existing ecosystem partners helped define the use case specific modules as also illustrated in Figure 16.

solution, as well as the association with the key partner, helped convince a search partner to join the ecosystem. The search partner helped to scout new partners and established contact with these potential partners. The Head of Sales pointed out:

“They [the search partner] were introducing us to some of the partners, and with some others, we met in events on smart cities and startups. Just the telecom partner could be identified based on my personal network.” (9A)

These new relationships led to an adaption of the vision as the focus shifted to more pressing customer needs and, consequentially, induced a change of modules. After this last change, the orchestrator and partners adjusted the vision to a specific value proposition in close contact with specific customers. The value proposition of the initiative was ultimately based on software that analyses potholes, rocks, bumps, and other types of damage on public roads and evaluates them with a unique algorithm. The IoT solution provides a report about the condition of a road, and uses live map data to calculate the importance of possible road rehabilitation. Please see figure 17 for an overview of the ecosystem development.

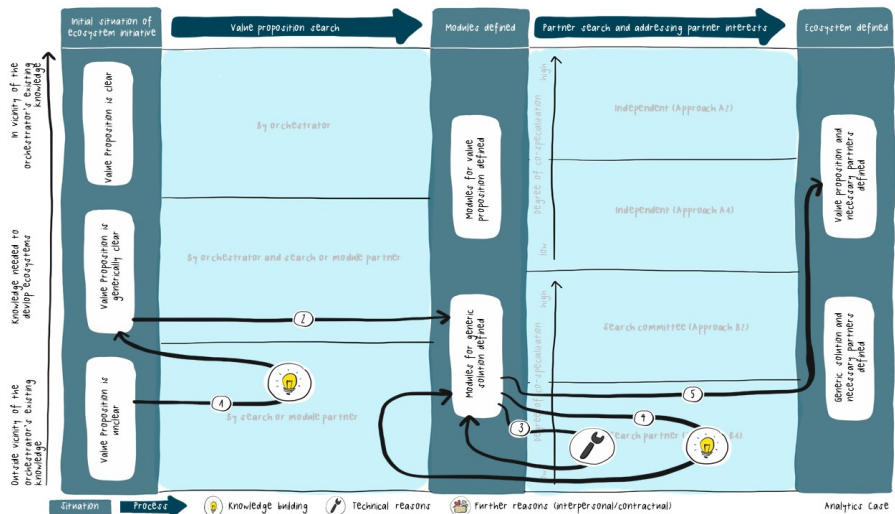


Figure 17: Ecosystem development Analytics case

2.4.2. Cross-case Findings

The cross-case findings are summarized in the illustration below (Figure 18).

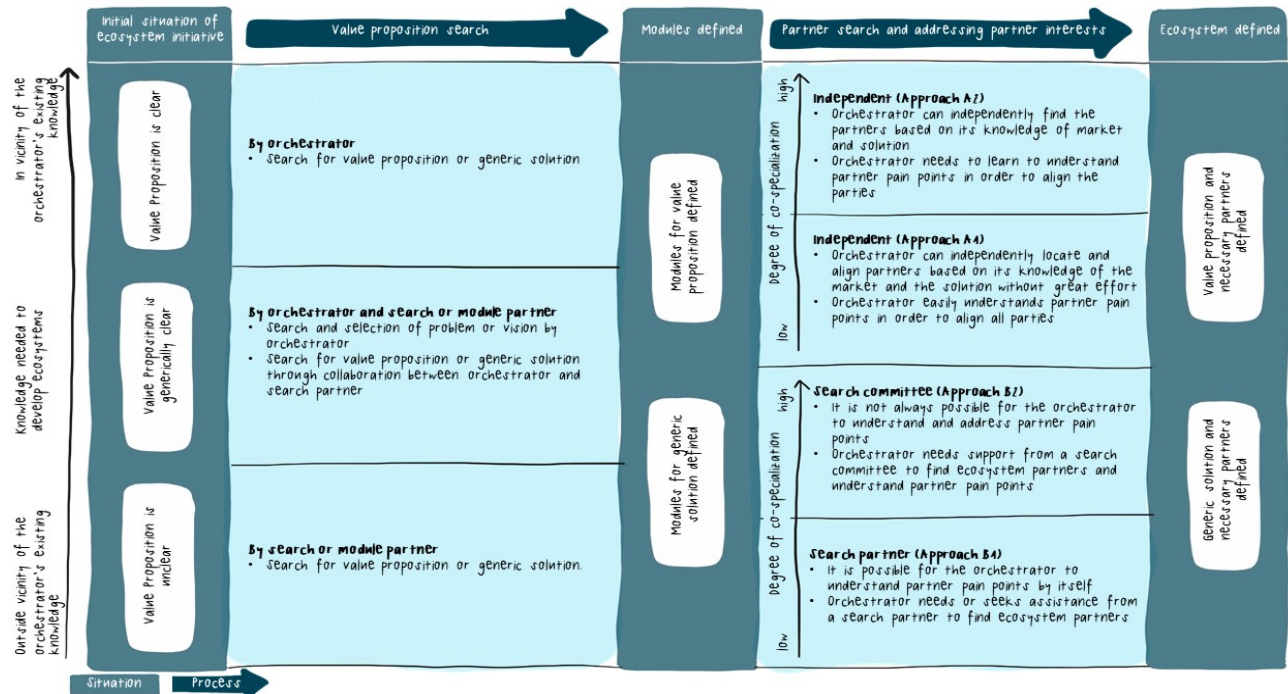


Figure 18: Framework of ecosystem search and development

As shown by Figure 18, different initial situations require different actions to define the value proposition. If the information needed to define the value proposition is in the vicinity of the orchestrator's knowledge and experience (local search), then the orchestrator is able to define the value proposition itself (for instance in the Factoring case). If the orchestrator lacks the related knowledge and experience (distant search), and starts with only a vision of the future value proposition, a search partner can help to further develop the value proposition prior to the start of the partner search, as demonstrated in the Data case. The search partner offers support during the search for the value proposition, the search for partners, and the process of understanding, and also helps addressing partner pain points. The search partner can be either a permanent (e.g., in the Mobility case) or a temporary member (e.g., in the Logistics case) of the ecosystem. Additionally, this partner can either provide a module for the value proposition (e.g., in the Smart Building case) or not (e.g., in the Sports case). Finally, the InsurTech and Analytics cases also show situations in which the orchestrator defines a solution as a value proposition, which can potentially then be applied across a variety of markets and situations. In these cases, specific applications are chosen later in the search process, even after the partners have been integrated.

This initial step, of defining the value proposition, is followed by the search for partners. In addition to the type of search, it is important to consider the degree of co-specialization, which leads to four different approaches to how the orchestrator can acquire partners. If the orchestrator has sufficient knowledge of and a network in the field the ecosystem is focusing on (local search), it can search, select, and find potential partners independently, as shown in the Access and Sports cases. Otherwise (in situations of distant search, e.g., in the Data and Mobility cases), it is essential to have a partner who has this network and knowledge – the search partner, as we call it. In either scenario, the degree of co-specialization determines the necessary degree of mutual learning among the partners in order to adapt their respective contributions to the value proposition. If a search partner is required, it is essential that the orchestrator learns from this partner as well as from future partners involved in the ecosystem.

These different starting points also affect the occurrence and intensity of iterations throughout the search process. This, in turn, has a significant influence on the time it takes to implement the ecosystem – *ceteris paribus*, the fewer iterations, the shorter the development time. In summary, if the value proposition is clear, the iteration level during the value proposition search is lower since the orchestrator is able to use its available resources to determine the modules needed. During the partner search,

however, the iteration level is high because the orchestrator first needs to identify the partners with the necessary modules. Then again, if the value proposition is unclear, the level of iterations is high in the first half of the search process and is lower during the partner search because the identified search partner has already contributed its knowledge to the value proposition search. These results are summarized in Table 7.

Finally, all cases clearly show that the partner providing the key module was integrated into the ecosystem first. This key module is the most significant module, and either requires the greatest number of adjustments or development efforts (e.g., as in the Access or the Smart Building cases), or is the core module of the joint value proposition (e.g., in the Data or InsurTech cases). The participation of the partner with the key module also influences potential additional partners, as they can be convinced more easily to commit to the ecosystem when the provider of the most significant module is already a part of the ecosystem. The following statement by the search partner in the Data case nicely illustrates this aspect:

“First, we added the most important partner, then the second [...] and so on. This means that as one company after the other was [...] added, this search group changed accordingly. [...] Once the most important partner had been convinced, it was much easier to convince all further partners.” (10C)

Initial situation of ecosystem initiative	Iterations during the Value Proposition Search Level of iterations caused by		Iterations during the Partner Search Level of iterations caused by		Development Time
Value Proposition is clear	Low	results and learnings from prototypes or market tests	Medium to high	module partners that are integrated into the ecosystem and contribute their knowledge	9 to 12 Months
Value Proposition is generically clear	Medium	knowledge exchange between orchestrator and search or module partner	Low to medium	module partners have already contributed knowledge to the value proposition search	12 to 24 Months
Value Proposition is unclear	High	knowledge building between search or module partner and orchestrator, and technical reasons during tests of prototypes	High	advancing into uncertain fields of innovation. The modules are adapted more frequently in relation to the other forms.	24+ Months

Table 7: Iterations of ecosystem search

2.5. Implications

2.5.1. *Contributions to Research*

Our findings allow us to contribute to literature on three levels. First, we contribute to the core of our study, the mechanisms that firms use to conduct the search for the ecosystem's value proposition as well as for the partners needed for its instantiation. In the same vein, we show how these mechanisms, as well as the type of search (local vs. distant) and the level of co-specialization, influence the intensity and occurrence of iterations throughout the search process. Second, based on these findings, we contribute to the broader topic of ecosystem establishment. And third, we contribute to the literature on ecosystems in general.

Regarding the first contribution, Figure 18 summarizes the findings of our cross-case analysis. We show that, based on the question of whether the knowledge needed to define the value proposition is in the vicinity of the orchestrator's knowledge or not (i.e., the type of search, local vs. distant), there are three different possible starting points for the value proposition search. Depending on which of these is used, the orchestrator either conducts the value proposition search by itself or jointly with a partner. The latter is either a module partner or, as introduced in this study, a search partner. The same logic applies for the subsequent search for the ecosystem partners. If the situation allows orchestrators to search for partners in the vicinity of their existing knowledge and experience, i.e., in situations of local search, such a search is conducted by the orchestrator in isolation. Conversely, in situations of distant search, the orchestrator either involves a search partner (in a case with a lower degree of co-specialization) or a search committee (in a case with a higher degree of co-specialization). For a more detailed view of these key findings, please refer to the cross-case Chapter, as well as Figure 18.

The mechanisms used throughout the search process also have a direct influence on the occurrence and intensity of iterations during this process. Table 7 clearly shows that if both the occurrence and the intensity of iterations increase, then the orchestrator has to conduct a greater distant search for both the value proposition and the partners.

The summary of our findings in Figure 18 and Table 7 reveals several further implications, which are of relevance for both researchers and practitioners alike. Situations of local search for both value proposition and partners, and lower degrees of co-specialization, might be ideal settings for startups, new ventures or, more generally, innovation initiatives in situations where resources are limited. They allow for

comparably fast ecosystem establishment, quick market testing of ideas, and faster implementation of the value proposition. The more the orchestrator has to conduct distant search and is confronted with higher degrees of co-specialization, the longer the time needed for the establishment of the ecosystem, and the greater the resources and manpower required. This is due to the increased occurrence and intensity of iterations and the necessary involvement of search partners or search committees. However, orchestrators conducting local search should not allow themselves to be caught by surprise: As Table 7 shows, even though the search for the value proposition might be a straightforward process in situations of local search, iterations during the partner search seem almost inevitable, and will consume both resources and time in the later stages of ecosystem establishment.

With these findings, we are among the first to describe the iterative process involved in the search for value propositions and partners in the context of ecosystems. Beyond this contribution to literature, per se, these insights provide a second level of contributions, namely to the wider field of ecosystem establishment.

In this regard, we show that it is beneficial to integrate the partner with the key module into the ecosystem first. As defined in the findings section, we use the term ‘key module’ to refer to (one of) the most significant module(s) for the value proposition – either because it is particularly crucial for the functioning of the value proposition or because it is particularly difficult to implement. If the orchestrator succeeds in doing so, this is one way of overcoming the chicken-and-egg problem of ecosystem establishment (Dattée et al., 2018). Considering the integration of the key module, it is possible to estimate at an early stage how quickly and successfully an ecosystem can be established, since it becomes obvious whether the orchestrator has managed to integrate the key partner, thus setting a strong foundation for the further development of the ecosystem – or not.

With this finding, we extend the statements of Dattée et al. (2018), who suggest that the ecosystem blueprint (also see Adner, 2012; Baldwin & Clark, 2000; Iansiti & Levien, 2004b) is of great importance for convincing partners to join the ecosystem. The blueprint can be seen as a clear vision for the future ecosystem, including a definition of the desired value proposition, as well as governance, interactions, and structures (e.g., which value is created by which partner, who does what, how do members benefit, who controls what) (Adner, 2006, 2012; Iansiti & Levien, 2004b; Williamson & de Meyer, 2012). We additionally extend the statements of Dattée et al., as the orchestrator does not necessarily need a blueprint for a situation of distant search. In that case, the

orchestrator only needs a vision or an opportunity to convince a search partner of the business opportunity provided by the ecosystems. With the help of the search partner, a blueprint for the initiative can be elaborated, and necessary additional partners can be convinced to join the ecosystem. Moreover, it is not enough to just have such a blueprint; the initiative also needs the key module to convince other partners to commit to the ecosystem. Furthermore, based on our findings, we argue that the importance of the blueprint decreases with the development of an ecosystem. While the blueprint is most relevant to convince key partners to join at the beginning of the initiative, at a later stage, its relevance decreases when persuading the partners who provide less significant modules to come on board.

These findings also imply that ecosystems develop in a path-dependent way. Based on our findings, we postulate that the degree of co-specialization has a strong influence on this dependence. A higher degree of co-specialization increases the need for overlapping knowledge between ecosystem partners and, thus, increases the path dependency: By remaining on common ground with mutual understanding, the specialization of modules limits the spectrum of their future adaptations. On the other hand, a low degree of co-specialization leads to less path dependency. In contrast to the high degree of co-specialization, it is possible to deviate from the previous path via new search partners, as perfectly demonstrated by the Data case.

On a third level, our findings provide contributions to the literature on ecosystems in general. In this regard, previous studies have differentiated between ecosystem partners as being, for instance, orchestrators, ecosystem leaders or hub firms, or complementors (Adner, 2016, 2017; Adner & Kapoor, 2010; Jacobides et al., 2018; Moore, 1996; Nambisan & Baron, 2013; Teece, 2016), or have distinguished between strategic bottlenecks and technical bottlenecks (Baldwin, 2018; Hannah & Eisenhardt, 2018). With our results, we introduce another type of actor in addition to the ones mentioned above: The search partner. We discover that either the orchestrator, the search partner, or the partners within the search committee define and search for the value proposition or relevant ecosystem partners by conducting local search, i.e., all further partners stem from the search field of this partner. As shown by our findings, specifically the ones illustrated in Figure 18, the search partner has a strong influence on the value proposition, as well as on the partners involved in situations of distant search. Based on this strong influence, we can further show the influence of search partners on the governance of ecosystems. This aspect is at the core of the ecosystem concept. Accordingly, Jacobides et al. (2018) call for a better understanding of how ecosystems

are governed and how the orchestrator fills the role of ecosystem administrator. Our results shed light on this very topic: If the initial orchestrator possesses the knowledge to search for and define the value proposition, as well as find the necessary partners by itself (i.e., to conduct local search), it is the ‘captain’ of the ecosystem initiative. In the case of distant search, however, the orchestrator’s significance in shaping and building the ecosystem is diminished. Instead, the orchestrator merely assigns either a search partner or a search committee to these tasks. It is important to note that, upon fulfilling this role, the search partners typically leave the ecosystem. In situations where there is a low degree of co-specialization, the orchestrator will govern the ecosystem after this happens. In cases where there is a high degree of co-specialization, the partners will be organized into a search committee, which will continue to significantly influence the ecosystem. Thus, the degree of co-specialization has a major influence on the governance of ecosystems in situations of distant search.

Beyond the contributions to the ecosystem concept, our study offers interesting insights into the intersection of organizational search and ecosystems. We found that ecosystems are driven by a process of local search – either because the orchestrator builds up the ecosystem in the vicinity of the existing knowledge base or because it involves search partners/ committees to conduct that task. Thus, the ecosystem member that searches for the value proposition and partners, and helps to understand their interests, conducts local search. Contrary to the established notion in the literature on search (e.g., Cyert & March, 1963; Monteiro et al., 2008; Moore et al., 2007; Shimizu, 2007), solutions resulting from such local searches are not necessarily ‘simple-minded’ or less innovative in an ecosystem context. Rather, the recombination of modules within the ecosystem invokes major innovation potential, as effectively demonstrated by the Access, Smart Building, and Sports cases, in which highly innovative solutions emerged from local search.

We also found an interesting mechanism for avoiding distant search in situations in which the orchestrator intends to build up an ecosystem in a field that is not in the vicinity of their existing knowledge: Instead of searching alone, the orchestrator makes itself visible and waits to be found by potential partners. For instance, in the Logistics case, the orchestrator developed a prototype of the solution – in this case the autonomous drone – used extensive media coverage to draw attention to this innovative solution, and then waited for potential partners to approach their firm. The underlying logic of this approach strongly resembles that of Afuah and Tucci (2012) conceptional work on crowdsourcing as a means of conducting distant search: Instead of performing

distant search, firms might present a problem on a crowdsourcing platform and wait until a member of the platform shows off by being able to solve it. For such an approach to be valuable, the ‘crowd’ needs to represent distant fields of knowledge to be able to propose very innovative solutions. An additional, necessary precondition is that the interdependencies between the modules provided by the initiator of the crowdsourcing initiative and the solution providers must be low, otherwise efficient collaboration between them would be complicated. Our cases provide empirical evidence of these thoughts and extend them to the ecosystem context: A low degree of co-specialization among existing ecosystem partners, such as in the Logistics case, is necessary to apply this approach in the ecosystem context.

2.5.2. Limitations and Future Research

Beyond the usual limitations that come with any qualitative research endeavour (Eisenhardt, 1989, 1991; Eisenhardt & Graebner, 2007), our findings might be prone to several, more specific, limitations. First, we show the influence of the type of search (local vs. distant) and the degree of co-specialization on the occurrence and intensity of iterations during the search processes. However, given our qualitative research method, we were not able to quantify this effect. Yet, such an understanding might be particularly relevant for practitioners, since it would enable them to more precisely assess the time and resources needed to establish ecosystems. For the same purpose, it would be beneficial to conduct a more fine-grained analysis of the influence different factors and conditions have on the time and resources needed to establish an ecosystem. Second, our findings show that ecosystems develop in a path-dependent way, depending on the type of search and the degree of co-specialization. However, we focus on the early phases of an ecosystem’s lifecycle (Moore, 1993). It would be exciting to conduct further investigations to determine whether this path-dependent development occurs over the entire life cycle of an initiative. Through this research, it would be possible to make a more precise statement about how far the selection of partners in the early stages determines the future of ecosystems, and what criteria should be considered in the selection of partners given these long-term effects.

Additionally, we analyzed the different mechanisms that firms were using to successfully conduct their searches for the value proposition and partners. However, we did not delve deeper into the question of whether these mechanisms were the result of a perfectly planned and executed approach, entirely driven by foresight, or whether they were, to some degree, unplanned and happened by chance. The literature on organizational search suggests that the focus of attention on certain information can be

the result of an intentional search process or it could happen due to spontaneous reactions to environmental stimuli. The first possibility increases the speed and accuracy of perception and action, but might lead to potentially neglecting opportunities, while, for the second possibility, the opposite is true (Barnett, 2008; Ocasio, 1997). Further investigations along these lines would be intriguing, since the literature on ecosystems is still divided on the question of the planned vs. unplanned emergence of ecosystems (Jacobides et al., 2018).

Previous research (e.g. Granstrand & Holgersson, 2020; Hannah & Eisenhardt, 2018; Jacobides et al., 2018; Rohrbeck et al., 2009) has called for a better understanding of the interplay between competition and cooperation in ecosystems. While this aspect is beyond the scope of our research, we do believe that mechanisms such as the search committee or even the cooperation between orchestrator and search partners might be affected by competition. This might open up several intriguing questions for future research.

Finally, and more generally, since this work is among the first to study the iterative search processes for the value proposition and partners in the context of ecosystem establishment, we hope to motivate future research along these lines.

3 A Single Conductor can Lead a Large Orchestra: How Startups Orchestrate Ecosystems²

3.1 Introduction

As mentioned before an ecosystem is usually managed by an orchestrator, who plays a key role within an ecosystem (Adner, 2006, 2017; Jacobides et al., 2018). Given this pivotal role, existing research has largely agreed on big and powerful corporates being the logical orchestrators (Fuller et al., 2019; Iansiti & Levien, 2004b; Moore, 1993). However, some studies are questioning this established believe and mention startups as ecosystem orchestrators, without explaining how such a small and vulnerable firm can orchestrate an ecosystem of several and potentially much larger and more powerful companies (Clarysse et al., 2014; Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004b; Jacobides et al., 2018; Zahra & Nambisan, 2012). Jacobides et al. (2018), setting the foundations of the structural stream on ecosystems, take up this open question and call for research that answers whether small firms are equally suitable for orchestrating ecosystems and, in case they are, how they manage to do so. This question is particularly important since startups have a major influence on today's economy (Criscuolo et al., 2014; Haltiwanger et al., 2013; Holcombe, 2003). On top of this, startups as ecosystem orchestrators might be an intriguing new phenomenon, combining the speed and innovativeness of startups with the power of an ecosystem of several and large firms. This might not just change the dynamics of competition and question existing believes on the role and impact of startups. It also opens-up new questions for startup investors or corporates being members of startup-led ecosystems.

We were able to identify several startups that have built up and are managing ecosystems, and we used these empirical insights to conduct a qualitative multi-case study (Eisenhardt, 1989; Yin, 2014) with nine cases. This allowed us to understand how a startup can successfully orchestrate an ecosystem, despite the inherent challenges that come, among others, from its lack of resources, power, or credibility (Clarysse et al., 2014; Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004b; Jacobides et al., 2018; Nambisan & Baron, 2013; Zahra & Nambisan, 2012).

²This Chapter is based on the working paper "A Single Conductor can Lead a Large Orchestra: How Startups Orchestrate Ecosystems" with co-authors Bernhard Lingens and Oliver Gassmann

In the course of our qualitative study, we identified two key dimensions, which we subsequently used to build the central framework. This framework determines four types of startup-led ecosystems. Based on our findings, we demonstrate the approaches that startups are using to orchestrate these different types of ecosystems. In doing so, we contribute to research on the ecosystem concept in several ways. First, our findings show that startups can be successful orchestrators as well as how they achieve this despite their inherent disadvantages. In this regard, our framework summarizing our findings (presented in the implications section of this study) could serve as an aid in making decisions about which strategies to use for the orchestration of a specific type of ecosystem. Second, we discuss the resulting implications of these findings for the orchestrating start-up, its ecosystem partners, accelerators, and investors, as well as for other types of resource-constrained firms striving to orchestrate an ecosystem. And third, by presenting the startup in a new role as an orchestrator of an ecosystem, we strive to open up a new stream of research along these lines.

In the next Chapter, the literature review, we elucidate further about ecosystems and orchestration. Then we introduce four tasks that startups must perform in order to successfully orchestrate an ecosystem; these tasks provide the underlying structure for our empirical exploration.

3.2 Literature Review

3.2.1 Key Characteristics of an Ecosystem and Ecosystem orchestration

According to the structural view³, the ultimate goal of an ecosystem is the materialization of a joint value proposition by the firms involved, which provide modules for this joint value proposition (Adner, 2017; Jacobides et al., 2018). However, not all of the firms involved are ecosystem members: only firms whose modules fulfill two critical criteria are considered to be part of the ecosystem (Jacobides et al., 2018). The first criterion is that the modules need to be complementary, i.e. they increase each other's value (the so-called supermodularity) (Milgrom & Roberts, 1990; Topkis, 1978, 1998) or cannot function without each other (Teece, 1986). This implies that actors need to explicitly create new modules – or at least mutually adapt existing modules – to

³ The so-called “structural view”, introduced by (Adner, 2017) emerged recently and has quickly established itself as an independent stream of research (already cited 10 times in A+ journals, 14 times in A journals and 28 times in B journals in just two years) within the broader area of ecosystems. Thus, in line with the notion within the ecosystem community, I consider the ecosystem-as-structure view to be a suitable foundation for my work.

achieve complementarity with the modules provided by the other partners (Baldwin & Clark, 2000). The second criterion is that the modules are ‘unique’, i.e. the partner providing them cannot easily be replaced. As a result, ecosystem partners are mutually dependent on each other: if one of them is failing or leaving the ecosystem, then the ecosystem as a whole will fail. This interdependence has two crucial implications for the subsequent discussions. First, it defines the boundaries of an ecosystem since firms providing modules that are relevant for the joint value proposition but are not characterized by complementarity and uniqueness, must be regarded as suppliers but not as ecosystem members. Second, it highlights the importance of the orchestrator, whose main task is to align this interdependent set of partners towards the joint value proposition.

Beyond the ecosystem concept, streams of literature on related concepts, such as alliances and networks, also discuss the role of startups (Doz, 2019) or firms with similar resource constraints, such as SMEs (Radziwon & Bogers, 2019). However, since these concepts lack the aspect of orchestration, which is central to ecosystems, they do not explain how startups can take over the particular tasks related to such orchestration (Adner, 2006, 2017; Jacobides et al., 2018). Additionally, ecosystems are different than platforms (Gawer & Cusumano, 2014). For instance, a platform offers heterogeneous groups that would not otherwise interact the possibility for exchange (Gawer, 2014). Hereby, the value proposition of a platform can be defined as the result of the increasing interaction between customer and provider (Eisenmann et al., 2011). For differentiation of ecosystems from related concepts, please see Table 8.

Construct	Ecosystem^a	Supply Chains^b	Network and Alliances^c	Transaction Platforms^d	Open Innovation^e
Description	The alignment of a multilateral set of partners that must interact in order for a focal value proposition to materialize.	Partners operate autonomously and create their own value propositions. Precise hierarchical structure and bilateral agreements.	The focus on a joint value proposition is missed. No interaction in order to materialize a new value proposition. Precise hierarchical structure.	No joint value proposition is pursued at the core. Rather, there is an exchange opportunity between supply and demand sides with bilateral agreements.	The focus on a joint value proposition is missed. No hierarchical structure and no set of multilateral partners.
Logic	Materialization of a joint value proposition by firms that provide complementary modules.	End product is the sum of partial value propositions.	Partners follow own strategic goals but benefit from network effects.	Two-sided market, which connects buyers and sellers.	Firms profit from unilateral exchange of expertise.
Key difference to ecosystem	n.a.	Independent and replaceable partners. Existence of bilateral agreements.	Alliance partners operate autonomously. No creation of a joint value proposition.	No unique and complementary partners who jointly create a value proposition.	No focal value proposition for a multilateral set of partners.

Table 8: Overview of ecosystem related concepts

^a (Adner, 2006; Jacobides et al., 2018), ^b (Porter, 1985; Simchi-Levi, 2008), ^c (Gulati, 1999; Powell et al., 1996), ^d (Gawer, 2002; Parker et al., 2016b), ^e (Chesbrough, 2006; von Hippel, 2005)

In the following Chapter, we delve deeper in the actual tasks of orchestration. According to the structural view, an ecosystem is defined as the alignment of partners, by an orchestrator, towards a joint value proposition. This definition allows us to define the key tasks an orchestrator has to fulfill. First, the materialization of a joint value proposition is at the very heart of the ecosystem concept, and the orchestrator's key task is to make sure this value proposition comes true (Adner, 2017; Jacobides et al., 2018). In this study, we refer to this task as *product development*, which includes activities related to the materialization of the joint value proposition. As a second cornerstone, alignment refers “*not only to compatible incentives and motives but also raises the question of actors' consistent construal of the configuration of activities*” (Adner, 2017). The first part of this task, the provision of incentives for partners to join the ecosystem and stay with it, will be referred to as *persuasion*. The second part, which is based on the exchange of information among partners (Adner, 2017), will be called *coordination*. However, ecosystems are usually not static – rather, as with most economic activities, the usual aim is to grow the ecosystem and to scale the value proposition. This growth is particularly relevant in an ecosystem context, since an increasing number of partners might shift incentive systems as well as dynamics within the partner structure, and, thus, might also shift the alignment of partners. Therefore, studies on ecosystems should not view orchestration as a static task but must consider its growth as well (Adner, 2017; Jacobides et al., 2018; Moore, 1993). In this study, we refer to the task of growing the ecosystem as *scaling*. Beyond these four key tasks, which are directly derived from the definition of an ecosystem according to the structural view, namely *product development*, *persuasion*, *coordination*, and *scaling*, there might be a multitude of other tasks relevant to the orchestration of ecosystems. However, in this study, we only focus on these four tasks, since they are at the very heart of the ecosystem concept.

3.2.2 Key Challenges Startups Face when Orchestrating an Ecosystem

The abovementioned tasks lead to significant challenges for startups, which is why scholars have repeatedly claimed that large firms are better suited to orchestrate ecosystems.

The tasks of persuasion and scaling, in particular, require an ecosystem orchestrator to display compliance and conformity in order to secure ecosystem membership, and also to be the provider of stability within the ecosystem (Dhanaraj & Parkhe, 2006; Hannah

& Eisenhardt, 2018; Iansiti & Levien, 2004b). These aspects are arguably associated with corporates, not startups. In this regard, the advantages that come from size and bargaining power are helpful when it comes to persuasion and scaling (Adner, 2017). On top of this, the tasks of product development and coordination generate significant coordination efforts, development costs, and transaction costs for the orchestrator (Jacobides et al., 2018). This might be particularly challenging for startups, given their limited resources (Skala, 2019).

This raises the question of how startups can orchestrate ecosystems, despite these challenges. Some authors have claimed that the orchestrator does not have to be the most resource-rich actor in the ecosystem, but rather the one that uses particular skills or power to steer the ecosystem, i.e. intellectual capital to stimulate and shape the business ecosystem (Williamson & de Meyer, 2012), ‘informal authority’ based on knowledge and status, control over crucial resources and technologies (Gulati et al., 2012), or the capability for ‘problem-framing’ to understand and solve problems to stimulate innovation and capture its value (Brusoni & Prencipe, 2013). Others have argued that the firm’s capability to innovate, to scan and sense the environment, and the capability to integrate are all crucial for successful ecosystem orchestration (Helfat & Raubitschek, 2018). Startups might display some critical advantages in this regard in terms of learning, sharing their knowledge, and adaption (Zahra & Nambisan, 2012). However, even though these scholars propose that startups might use these specific strengths to overcome the challenges of orchestration, they have not sufficiently explained how they are doing so. Thus, in the following methods section, we explain how we have used our qualitative multi-case study to explore this crucial question.

3.3 Methods

We believe a case study is a suitable methodological approach to address the abovementioned questions (Eisenhardt, 1989). This is because the ecosystem concept is still under-researched and lacks empirical foundations (Jacobides et al., 2018). Moreover, we view this as a suitable approach since we intend to open up a new stream of research on startup-led ecosystems. In this vein, we follow established notions in case study research (Eisenhardt, 1989), and intend to observe different patterns of ‘how’ startups orchestrate ecosystems and describe the boundary conditions driving the differences among them – the ‘why question’.

Based on the four tasks of orchestration defined in the literature review, we used several criteria to sample our nine cases. First, we selected the cases due to our definition of an ecosystem, introduced above. This definition of an ecosystem also defined its boundaries, i.e. which firms are part of the ecosystem and which are not. In this sense, we only considered partners who offer a unique and complementary contribution to the joint value proposition. Mere suppliers, who provide generic modules, are not within this studies scope. Second, all of the ecosystems studied needed to be orchestrated by startups. For this, we applied the following criteria to distinguish startups from established firms: First, startups are innovation-driven firms and aim to create products or services that do not yet exist (Gërguri-Rashiti et al., 2017). Second, they have a short operating history (Szarek & Piecuch, 2018) and are, on average, less than 10 years old (Gërguri-Rashiti et al., 2017). However, they are massively growth-oriented despite having limited resources, such as knowledge, talent, and capital (Skala, 2019), as well as high uncertainty (Katila et al., 2012), and being at an early stage of operation (Davila et al., 2003; Gurel & Sari, 2015; Schlaegel & Koenig, 2014; Veselovsky et al., 2017). In addition, we verified that all startups were orchestrators and were performing orchestration tasks. Lastly, in order to ensure generalizability, we chose cases with high diversity in terms of value proposition (Eisenhardt, 1991; Ozcan & Eisenhardt, 2009). This kind of approach has also been used by previous studies on ecosystems (Chatman & Jehn, 1994; De Wulf et al., 2001; Schoenecker & Cooper, 1998). However, we do not believe that our findings are in danger of being distorted by industry specifics. This is because ecosystems usually involve different types of partners from different industries. Furthermore, previous ecosystem research has also used such sampling techniques to provide a more comprehensive overview, while ensuring that results are not distorted by cross-industry differences (Davis, 2016; Mäkinen & Dedehayir, 2013; Rong et al., 2015b). Finally, we follow the recommendation to use polar cases in order to derive clear and extreme patterns (Eisenhardt, 1989).

The focus of our data collection was on interviews with startup managers responsible for orchestration, C-level staff, and/or co-founders, since these people are mainly responsible for performing the tasks of orchestration. (Given the nature of startups, these roles may overlap in some cases.) To triangulate and deepen our results, we conducted additional interviews with other ecosystem participants, investors, accelerator staff, and even customers. Typically, interviews lasted between 30–90 minutes and were recorded and transcribed verbatim immediately after the interviews. Furthermore, we consulted external data for the evaluation of the funding and costs. For

instance, we used investor reports and startup news and included standard key ratios to understand what funding has usually been obtained. Additionally, we interviewed experts regarding main cost drivers, and checked the type of investor and the associated investment (e.g. an early-stage venture capital firm might only provide small amounts, a later stage venture capital firm, or even a corporate venture capital firm, might provide large amounts). Lastly, we conducted a consistency check on all these sources. It is to be noted that in the Sports Case, we were only able to interview one person, the company's CEO, and, furthermore, we have triangulated even more intensively in this case. This was possible because the case is excellently documented in public records (newspapers, blog entries, etc.). Nonetheless, we were able to gather information from a similar case (Factoring Case) with a more extensive database showing similar findings to the Sports Case. For this reason, we can be confident that the given information from the Sports Case is correct. For triangulation, the interviews were willingly conducted with temporal distance, and questions from previous interviews were repeated to ensure the validity of the information received. In the Maintenance Analytics Case, one interviewee requested not to be recorded, which is why there is no transcript of this interview. This triangulation interview was held with a person external to the ecosystem, lasted for approximately 20 minutes, and aimed to verify the information we received from our case company. In all cases, we collected secondary data, such as media reports, internal documents, or presentations, to triangulate our findings (Jick, 1979). Our data sources and case descriptions are shown in Tables 9 and 10.

<i>Case</i>	<i>Field of business</i>	<i># Interviews</i>	<i>Interviewee positions</i> O = Orchestrator company C = Complementor company	<i>Interviewee</i>	<i>Interview duration</i> (min)	<i>Total pages transcripts</i>	<i>Additional data</i>	<i>Source</i> (additional data)
Factoring	Finance	8	Head of Sales & Marketing (O) Innovation Consultant (C)	A1 A2	137+23+80+27+22+69+81 36	29+10+38+12+15+26+39 15	Online & magazine articles Internal Company presentation	external internal
Sports ¹	Sports equipment	3	Chief Executive Officer (O)	B1	104+26+16	26+13+8	Blog post & online articles Company website documents	external internal
InsurTech	Insurance	5	Chief Executive Officer (O) Chief Operating Officer (O)	C1 C2	38+31 40+29+43	20+19 21+18+25	Company website documents Newspaper articles	internal external
Move	Home	8	Key Account Manager (O) Business Development Manager (O) Founder & CEO (O) Head of Business Development (O) Innovation Manager (C)	D1 D2 D3 D4 D5	9+60 86 66 25+24 40+60	6+23 36 40 15+15 17+23	Company website documents Online & magazine articles Newspaper articles	internal external external
Share	Mobility	6	Chief Executive Officer (O) Head of Ecosystems (C) Car Tenant (C) Car Tenant (C) Car Tenant (C)	D1 D2 D3 D4 D5	39 + 41 25 22 18 24	26+30 13 11 9 12	Company website documents Internal company presentation Radio & TV reports	internal internal external
Maintenance Analytics	Analytics	3	Head of Sales (O) Program Manager Accelerator	E1 E2	23+39 19	9+20	Company website documents E-Mail Interview	internal internal
Smart Building	Energy	5	Chief Product Officer (O) Chief Executive Officer (O) Program Manager Accelerator	F1 F2 F3	53+55+40 22 16	18+21+27 10 7	Company website documents Online & magazine articles	internal external
Visualization	IT	5	Chief Executive Officer (O) Project Manager (O)	G1 G2	60+94+59+34 25	27+46+15+18 11	Company website documents Blog post & online articles	internal external
Access	Security	7	Chief Executive Officer (O) Chief Sales Officer (O) Head of Ecosystems & Venturing (C) Venture Fund Manager (C)	H1 H2 H3 H4	67+20+63 81+67 60 21	33+9+39 40+40 28 12	Company website documents Blog post & online articles	internal external
<i>Total</i>		50			2259	1040		

Table 9: Case and data overview Chapter 3

<i>Case (Orchestrator origin)</i>	<i>Foundation of Orchestrator</i>	<i>Number of partners</i>	<i>Number of Orchestrator employees at the start of the ecosystem initiative (and today)</i>	<i>Partner origin</i>	<i>Case Description⁴</i>
Factoring (Switzerland)	2016	6	2-10 (today: 11-50)	Switzerland, United States of America	The Orchestrator of the Factoring case offers Swiss SMEs operating in developing countries a factoring solution for doing business with developing countries. Long payment periods (up to half a year) pose numerous challenges that can trigger liquidity problems for SMEs. The Fintech ecosystem offers a customized solution for eliminating liquidity bottlenecks in order to enable business activities in developing countries. In addition to the orchestrator, the ecosystem includes funding partners, an insurance company, a reinsurer, a bank, and a software company that uses an algorithm to assess the risk of SME claims. For a detailed outline of this ecosystem, see Figure 26.
Sports (Switzerland)	2014	6	1 (today: 2-10)	Canada, Germany, Switzerland	The Sports case focuses on a solution for the production of 3D soles specifically for sports shoes. The soles are manufactured using the technology of a 3D printer and knowledge of biomechanics, and they promise unique wearing comfort as well as performance. The customer (private individuals) usually receives a standard shoe sole when purchasing sports shoes. The problem is that when a sole doesn't fit, it can cause pain. Important players in this ecosystem are the partners who offer the 3D printing technology and the software solution. In addition, the ecosystem has an e-commerce partner to successfully commercialize its products. For a detailed overview of this ecosystem, see Figure 27.
InsurTech (Austria)	2017	3	1 (today: 2-10)	Austria, Germany	The InsurTech case represents an ecosystem that merges a physical product with a customized insurance solution. An example application combines a smart toothbrush with a dental insurance policy. Specifically, the company acts as an insurance intermediary between B2C companies that manufacture physical products and insurers. The aim is to offer a customized and comprehensible insurance solution for private customers. The insurance is thus fully implemented into the sales process for the physical product. For a detailed overview of this ecosystem, see Figure 28.
Move (Switzerland)	2014	7	2-10 (today: 11-50)	Switzerland	The orchestrator of the Move case developed a personalized relocation solution. Generally, the person moving must address all companies involved in the move (e.g. cleaning service, furniture transport, etc.) individually and deal with them. The Orchestrator fulfills this task and coordinates all ecosystem partners involved in order to provide a personalized relocation solution from a single source. For a detailed overview of this ecosystem, see Figure 29.
Share (Switzerland)	2013	7	2-10 (today: 11-50)	Switzerland	The value proposition of the Share Case is a peer-to-peer car sharing opportunity. With the use of a technical solution, private car owners and renters are interactive, although employees of the rental partner are usually there to assist them personally during the entire process. Furthermore, an independent insurer offers an insurance solution for the rented cars. In addition to these core partners, there are a number of other players, such as garages, petrol stations, credit partners, or supermarkets, that offer additional services or benefits to tenants or private lessors. For a detailed overview of this ecosystem, see Figure 30.
Maintenance Analytics (Turkey)	2016	13	2-10 (today: 2-10)	Great Britain, Netherlands, United States of America, Turkey	The ecosystem of the Maintenance Analytics case developed a software that analyzes potholes, rocks, bumps, and other types of damage on public roads, using a unique algorithm. To achieve this performance promise, the company works with many different stakeholders. Firstly, the public sector is crucial for road information, and secondly, the ecosystem obtains geodata from private companies. The software solution promises cities and countries a reduction in maintenance costs and helps to detect the damage mentioned above at an early stage and initiate prophylactic actions. For a detailed overview of this ecosystem, see Figure 31.
Smart Building (Italy)	2015	16	2-10 (today: 11-50)	France, Italy, Netherlands, United Kingdom, United States of America, Switzerland	The Smart Building case has developed an intelligent climate and heating solution to achieve an optimal and sustainable indoor climate (e.g. in office buildings or shopping malls). The (temperature) monitored by a sensor and the existing ventilation is turned on and off by a device developed by the orchestrator. This ecosystem consists of a multitude of actors with multilateral and bilateral relations. The company has a large number of partners who have developed the hardware for the company, as well as partners who have developed the appropriate software and other technologies (e.g. data transfer). For a detailed overview of this ecosystem, see Figure 32.
Visualization (Switzerland)	2015	4	2-10 (today: 11-50)	United States of America, Switzerland	The orchestrator of the Visualization case develops 3D model maps of cities with two resulting value propositions for different customers. First, the 3D model allows cities to evaluate whether their infrastructure is ready for autonomous driving of cars (e.g. if the curbs are high enough to be recognized by these vehicles). Secondly, car manufacturers have the possibility to use the simulation model for digital test cycles of autonomous vehicles. The creation of such maps requires an ecosystem approach, as an intensive co-specialization of software and hardware providers is required, and the authorities must facilitate the creation of 3D models of the respective metropolitan areas. For a detailed overview of this ecosystem, see Figure 33.
Access (Germany)	2006 ⁵	5	2-10 (today: 11-50)	Germany, United Kingdom, United States of America	The promise of the Digital Access case lies in a digital solution that allows the customer to open doors of cars, rooms, buildings, etc. with a temporary smartphone code. This eliminates the need to exchange keys, which is particularly advantageous in connection with shared goods. Therefore, one of the most significant applications (among others for which the Orchestrator has different employees and partners) offers keyless digital access to rental cars. To unlock cars via smartphone, the car rental company has technically converted its cars to the new system and has developed a mobile app for customers. Other hardware and software solutions had to be implemented by the other ecosystem partners. To this end, the actors adapted their modules to synchronize the software, hardware, and service components. For a detailed overview of this ecosystem, see Figure 34.

Table 10: Case descriptions and further information

⁴For a visual illustration of the different cases please see figures 26 to 34 in the appendix.

⁵The Orchestrator of the Access case has carried out research and development activities for a long time and has only begun to build its own ecosystem in recent years. For this reason, the founding year differs from that of the other startups.

Our case sampling includes a diverse set of value propositions: Business-to-Customer and Business-to-Business (e.g. Factoring case), and physical goods (e.g. Sports case), as well as services (e.g. Move case). In addition, Maintenance Analytics provides infrastructure support and the Smart Building Case focuses on process optimizations.

We analyzed our data by inductively searching for patterns and emerging themes across the cases (Eisenhardt, 1989), both by using methods such as case pairings, drawings, and tables to detect patterns more easily, as well as by word codings for deep-dive and validation. Our coding scheme is shown in Figures 19 and 20. The analysis of the case studies was guided by the four tasks of orchestration, as described in the literature review. However, one additional task emerged in the course of our analysis, namely *funding*. Startups are usually not profitable during their early stage of operating, which requires them to collect funds from investors in order to cover their expenses (Picken, 2017). It is to be noted that by ‘funding’ we do not mean the funding of the ecosystem per se, but merely of the startup. As shown by our empirical data, funding was tightly linked to the four tasks of orchestration as derived from theory: Depending on the *product development*, the startups had to collect more or less funding. The differing *coordination* efforts led to significant differences in costs and therefore funding needs. The same accounts for scaling and persuasion. Given its significance, we added *funding* as a fifth task of orchestration in the context of startup-led ecosystems. This is consistent to the literature on startups since funding is widely considered as one of the key aspects of the startup world (Cassar, 2004; Garg & Shivam, 2017; Manigart & Struyf, 1997; Mustapha & Tlaty, 2018). Thus, we believe it is justifiable to add this startup specific task to the other tasks of orchestration derived from the ecosystem stream, especially given our intention to open up a new stream of literature on the intersection of ecosystems and startups as orchestrators.

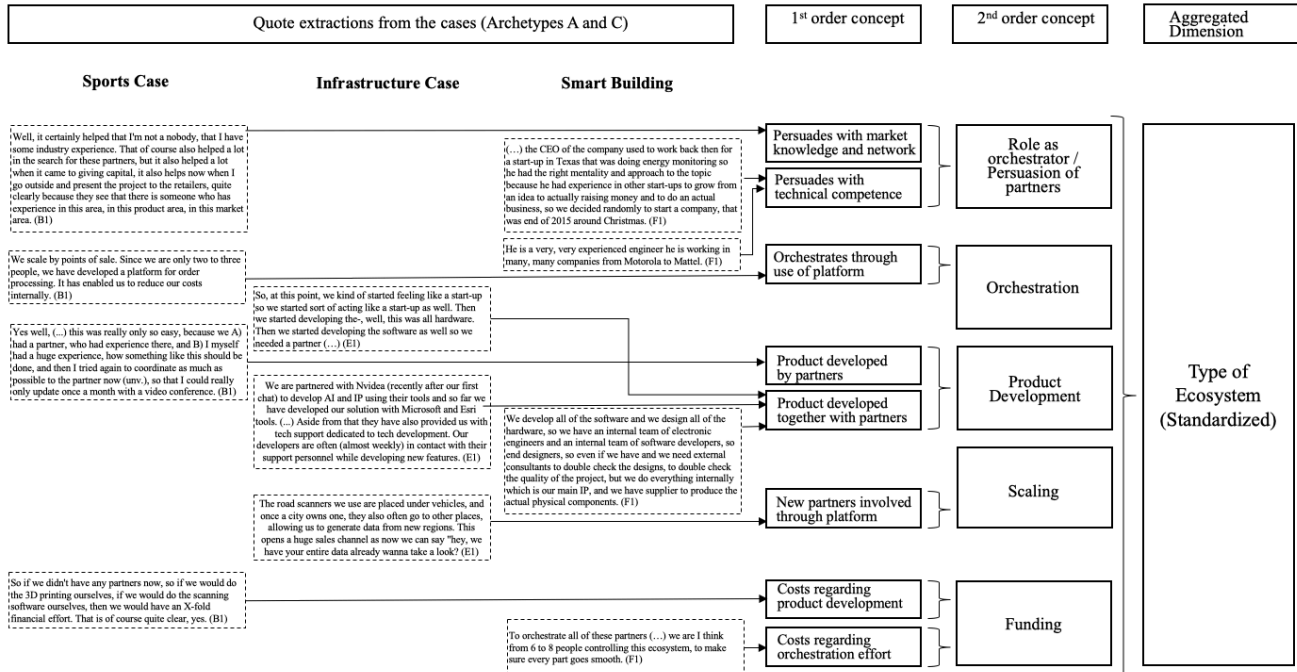


Figure 19: Exemplary quote extractions from archetype A and C

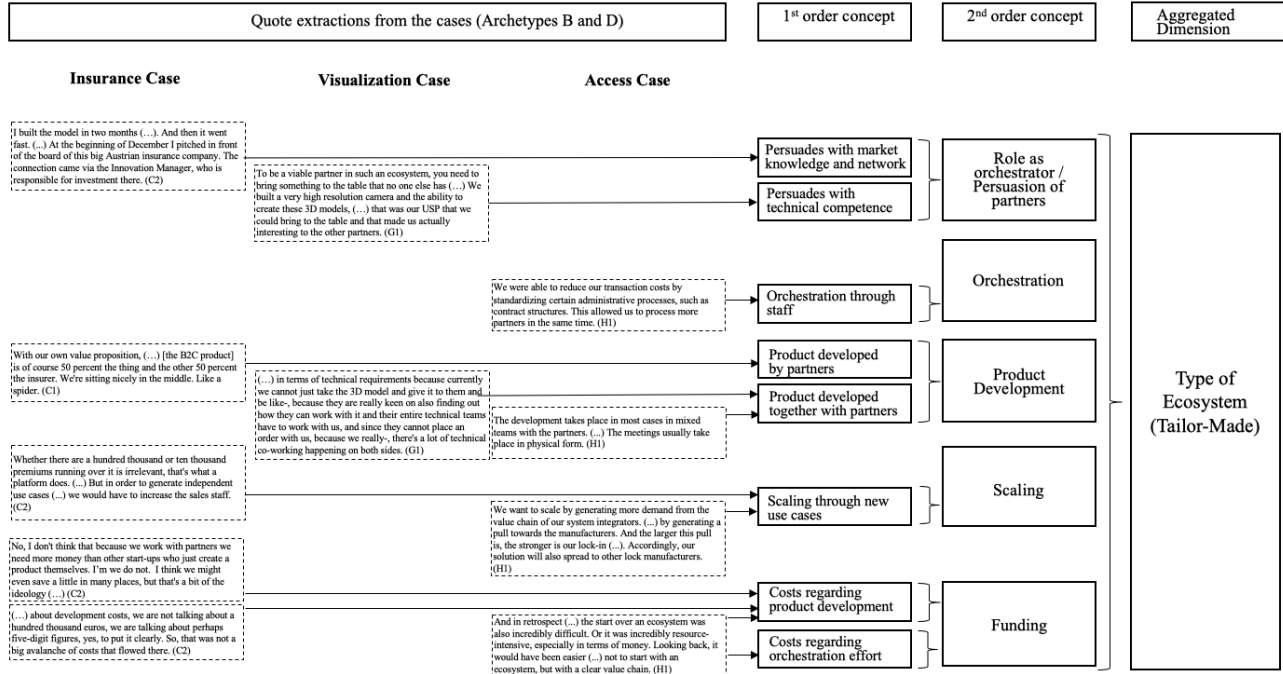


Figure 20: Exemplary quote extraction from archetype B and D

In the course of both data analysis but also data collection, it was essential to ensure that the four tasks of orchestration were actually performed by the startup. Given its significance, we explain for each task how we ensured this critical matter: Product development (i.e. activities related to the materialization of the value proposition) was both checked based on data and external validity checks. Since the ecosystems studied aimed to sell their value propositions, external data (such as sales brochures, homepages etc.) very available and allowed for consistency checks with the descriptions given by the interview partners (both from the orchestrator as well as from the partners). Thus grounded, we were able to double-check (both based on the interviews with actors involved in the ecosystem and externals) what was needed for this value proposition to come true and who was the main driver behind that. We see a strong validity of this finding since all interviews with both orchestrators and partners, external data, and external estimations were consistent throughout all the cases. This is all the more true since in all cases, the orchestrator was the only player being in interaction with all partners involved in the product development. Thus, it is very unlikely that another player within the ecosystem performed the task of product development even though this player did not deal with all relevant partners being involved in that task. The same is true for the tasks of coordination and persuasion. Given the multilateral nature of ecosystem interactions, coordination needs to embrace all partners involved in the ecosystem and can, thus, only be performed by the firm being connected with all partners (Adner, 2017; Jacobides et al., 2018). On top of this, coordination was done either by a platform or by people. In case of the first, it was easy to track who was in charge of implementing that platform and, in case of the latter, whose employees were coordinating the other players, i.e. setting up and managing meetings, gatherings etc. Scaling involved activities such as the integration of sales and additional module partners. We were able to trace back these activities to the orchestrator for the same reasons as mentioned above: Based on interviews with the orchestrator but also with the partners involved for the purpose of scaling we were able to double check who actually involved these partners, i.e. set-up meetings and contracts. Finally, funding could only be performed by the orchestrating startup because this firm being the one selling its shares and receiving funding in return. Obviously, selling shares can only be performed by the company owning these.

As a result of our analysis, we observed that some of our cases show similar patterns, while others are considerably different from each other. We found that these patterns can be traced back to two surrounding conditions, which we call *value creation* and *type*

of ecosystem. The first dimension, *value creation*, indicates whether the orchestrator participated in the value creation for the joint value proposition (i.e. providing a module) or if the modules are provided solely by the partners, with the orchestrator merely focusing on the task of orchestration. The findings section shows whether the orchestrator provides a complementary and non-generic module for the joint value proposition or if that firm merely acts as an orchestrator. The second dimension, *type of value proposition*, indicates whether the ecosystem is ‘standardized’ or ‘customized’. A standardized value proposition is one that delivers the same value proposition to every client, by always involving the same partners in the same way. On the contrary, a customized ecosystem provides a unique value proposition to each customer.

This implies that the value proposition changes for each customer. Consequently, different modules, and thus different partners, are required. Based on these two dimensions, we were able to define four different archetypes of startup-led ecosystem orchestrators (Miles, 1994). Although these archetypes emerged from our inductive analysis, they correlate nicely with the ‘types’ of ecosystems identified by Iansiti and Levien (2004b), which increases their validity and generalizability as well as the link to further studies on ecosystems. Figures 19 and 20 illustrate how quote extractions from the cases are used to determine the startup’s role in the value creation, which allows us to classify it as one of the four archetypes. Also, the figures illustrate the classification of the cases based on the type of value proposition (standardized vs. customized). We further used a matrix that addresses each of the four archetypes and the four core tasks of orchestration executed by a startup. The principal differences between the four archetypes are, on the one hand, which actors provide the necessary modules for value creation and, on the other hand, whether the value creation is standardized or customized. For instance, archetypes A and C both offer a standardized value creation. In archetype C, the startup itself contributes a module to the value proposition, thus going beyond the mere role of orchestrator of the ecosystem. In contrast, the startup in archetype A is only responsible for the orchestration of the ecosystem and does not contribute a generic module towards the value creation. Please see Figure 21 for an overview of the archetypes and associated cases. This framework allowed us to structure our findings and connect the patterns (i.e. approaches of ‘how’ startups orchestrate ecosystems) with the underlying boundary conditions (i.e. ‘why’ they are doing so (Eisenhardt, 1989). In the following Chapter we present these findings by describing each archetype one by one in great detail, structured along the four core tasks.

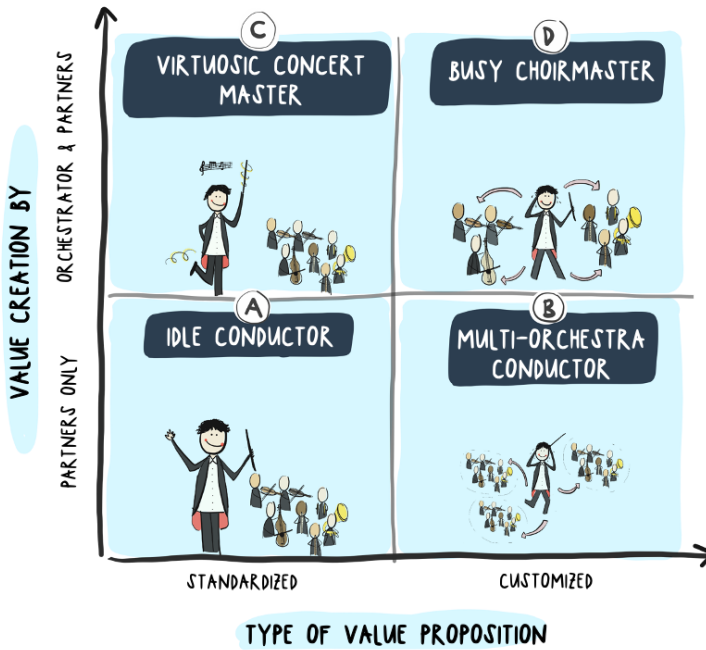


Figure 21: Different types of orchestrators

3.4 Findings

3.4.1 Archetype A: Idle Conductor

The first archetype is represented by the Sports and the Factoring cases. The Sports company provides a solution to create customized soles for running shoes. The soles are made using 3D printer technology, and they promise a unique and pain-free sports experience. In this ecosystem, there are different, important players that provide the modules needed for the value creation. For example, the partner who provides the 3D printer technology and the partner who provides the scanning solution. The Factoring case operates in a different context, as it offers a factoring solution for SMEs doing business in developing countries. SMEs in this field of business are usually confronted with long payment periods and increased risks. The Factoring company offers a solution to overcome these liquidity bottlenecks, while the ecosystem involves investors, an

insurance company, banks, and a software company that assesses the risk of the SMEs' claims.

Arguably, when considering joining an ecosystem, firms evaluate the tradeoff between the opportunity and the potential risks incurred. Therefore, the orchestrator needs to provide evidence that the ecosystem is likely to succeed, which relates to the challenge of persuasion. To persuade new partners to join their ecosystems, the orchestrators in the Factoring and Sports cases showed their potential partners that they had an excellent network and knowledge of the market. In both cases, the startup fulfilled the tasks of product development and cooperation that define an orchestrator by actively searching for partners to implement their ideas for a new joint value proposition, which they were not able to realize in isolation. The CEO from the Sports case sums it up nicely:

“I have found the partners through my many years of experience in the industry. (...) It certainly helped that I am not a nobody in the industry.” (B1)

Indeed, in this first archetype, in which the orchestrator does not contribute a module to the joint value proposition, and where the value proposition is standardized, the founders of the analyzed firms had worked in the industry concerned before, and were well regarded. They then used their knowledge of the industry and their networks to engage with potential partners and convince them to join the ecosystem. Therefore, their roles as startups were solely to build and orchestrate the ecosystems, and their networks and their knowledge gave them the ability and legitimacy to do so.

As the startup does not contribute a content-related module to the value proposition, its minor role is to coordinate. We observed in both the Factoring and Sports cases that the standardization of the ecosystem enabled the use of a platform. (In this Chapter, the term ‘platform’ can be understood as a coordination possibility.) In this context, using a platform affects the running costs of the ecosystem since the platform allows for a reduction in costs, for example, by coordinating with partners about new inquiries, which previously had to be carried out by the employees of the orchestrator. Furthermore, the platform facilitates scaling of the ecosystem. The Head of Sales & Marketing in the Factoring case described it as follows:

“That’s when a software provider came into play [...] with whom we developed a platform. It allows us to automatically manage the interplay among funding partner, the insurance company, and our customers.” (A1)

In the Sports case, the partner provided the scanning software, which was installed at the electronic point-of-sale devices. The devices scan the client’s feet and send the data

to the orchestrator, who forwards it to the manufacturer. Hence, rather than providing a complementary module for the value creation, the Sports startup's primary role was to make sure the partners are aligned.

Additionally, the orchestrator in the Sports case tried to keep transaction costs low by optimizing communication behaviour, as illustrated in the following quote:

"Yeah, how can you be an orchestrator? [...] By trying to communicate as efficiently as possible. Do not travel to Italy, but make a FaceTime call, because one hour later you will be able to talk to Canada and the hour after that to Belgium." (B1)

As already mentioned, in this archetype the orchestrator does not contribute a module to the value proposition. In both of our cases, we saw that the orchestrator developed the value proposition based on insider knowledge, and subsequently gathered the different partners together to set up the ecosystem. Because the orchestrator had experience in the industry and could trust the partners, the orchestrator was able to focus on controlling and developing the ecosystem rather than product development.

Further down the line, scaling happened through involving additional sales partners, who brought new customers to the ecosystem. This growing pool of partners and customers was first managed by the orchestrator's team until an internal platform for order processing was launched. From that moment, the business grew more rapidly, while simultaneously enabling the startup to reduce its coordination efforts, as described by the Sports company's CEO:

"We scale by points of sale. Since we are only two to three people, we have developed a platform for order processing. It has enabled us to reduce our internal costs." (B1)

In terms of funding, both of our cases have shown that coordinating the first partners to ensure alignment and, later, building the platform, were the main costs drivers. However, once the platform was running, the business rapidly became profitable since the platform enabled quick scaling while keeping transaction costs low. More importantly, the startup did not develop a key component or technology for the ecosystem's value proposition, which kept the expenses low. For these reasons, the need for funding was relatively low, which is highlighted by the following quote from the Factoring case:

"If we had built the solution on our own, our financing requirements would have been much, much, much higher. So if that had been possible at all, the funding would have been [...] ten, twenty, fifty times higher." (A1)

Regarding the type of funding, it is to be noted that in both case companies received capital in the form of smart money. This is money provided by an investor who has knowledge, a background, and a network in the field the startup is in.

3.4.2 Archetype B: Multi-orchestra Conductor

Since the Move company displays two distinct value propositions, we split the Move case into two sub-cases for the purpose of our investigation. Move 1 describes Move's main value proposition, which consists of a platform for a personally tailored relocation process. This aims to relieve the customer of the burden of communicating individually with each company involved in a relocation process. The all-around solution ranges from organizing cleaning and transport of furniture to an included insurance solution for the household. However, beneath its main value proposition, which is the relocation platform (Move 1), we define a second case, Move 2. Indeed, for aspects that are not intrinsic to the relocation process, such as a client requesting the pick-up of newly purchased furniture, Move hands the client over to an ecosystem partner. The partner will then coordinate the ecosystem to perform the task rather than using the initial orchestrator's platform. Move 2 fits in the current archetype, Multi-orchestra Conductor, because of its ecosystem structure and the provenance of its value proposition, while Move 1 will be described through the next archetype, Virtuoso Concert Master. In the context of the Move case, the challenge of the task coordination can be shown by the fact that the startup coordinates and tailors the ecosystem partners for each client, leading to significant coordination effort. In the InsurTech case, the ecosystem combines a physical product with a tailored insurance solution. As an example, an intelligent toothbrush is combined with dental insurance. In concrete terms, the company interacts as an insurance intermediary between B2C companies producing physical products and insurance companies.

Similar to archetype A, the orchestrator in this second archetype does not contribute to the value proposition. However, the startup fulfills the role as an orchestrator by actively searching for ecosystem partners. Accordingly, the InsurTech case shows similar persuasion patterns as the first archetype, since the founder used his existing personal network as a serial entrepreneur to convince the ecosystem's first and most important partner, the insurance company, to work with them. This evidence is demonstrated by the following statement from InsurTech's Chief Operating Officer (COO):

“I was building the model within two months [...] And then it went fast [...] At the beginning of December, I pitched in front of the board of this big Austrian insurance company. The connection came via the Innovation Manager, who is responsible for investment there.” (C2)

This pattern was predictable since the value proposition happened through the partners only, meaning that the orchestrator had no key component to offer. The role of the startup was solely to build and coordinate the ecosystem, and the founder's network and knowledge gave it legitimacy and helped convince partners to join the ecosystem. These insights show that the startup actively sought ecosystem partners as it had to align a large number of different partners. And they demonstrate how the startup successfully overcame the challenge of coordination.

In our cases, the InsurTech company built a platform as an overarching solution that it then adapted to every new use case. Similar to the previous approach, building an ecosystem for communicating with the core partners can help to reduce the coordination effort. In Move 2, the orchestrator assigned each orchestration task that was not essentially related to the core relocation process to one of its partners, who then coordinated *its* ecosystem partners to perform the task. Hence, for this particular value proposition, Move 2 can be described as a strategic orchestrator of the ecosystem, while the assigned partner became the operative orchestrator. Hence, the value proposition happens only through the partners within the operational orchestrator's ecosystem. However, the value proposition can only be created through the assigned partners because of Move as a strategic orchestrator. Also, the value proposition is adapted to every particular client request, leading to a customized value proposition process.

As in the last archetype, the orchestrator does not contribute a complementary module to the ecosystem. Here again, its sole role is the coordination of the partners in the ecosystem, who, in turn, contribute to the value proposition. However, we observed that as the value proposition becomes customized, product development becomes more complicated. Indeed, the InsurTech startup's first function was to understand all of the partners' pain points and to conciliate them during the implementation process. Since the value proposition had to be adapted for each customer, the contribution of each partner changed, which required an even more considerable coordination effort.

Since the InsurTech's value proposition was customized, scaling was only possible in new use cases that involved additional partners who brought new customers to the ecosystem. The InsurTech Startup needed these partners because it does not own any

end customer products. Indeed, the InsurTech startup was continually looking for new companies that might be interested in insurance solutions to augment their core product (InsurTech's solution is B2B2C). Developing these use cases and convincing new partners took a great deal of time, effort, and resources, which was the reason the orchestrator chose to be funded through corporate venture capital from one of its core partners. Indeed, this quickly available amount of money enabled the startup to scale more rapidly. Also, building the previously described platform helped to reduce operating expenditures, such as coordination efforts, and also contributed to speeding up growth, as demonstrated by the following quote from InsurTech's co-founder:

“Whether there are a hundred thousand or ten thousand premiums running over it is irrelevant, that is what a platform does. [...] But in order to generate independent use cases [...], we would have to increase the sales staff.” (C2)

Both InsurTech and Move 2 did not face high product development costs since their partners were responsible for this activity. However, due to the customized structure of its value proposition, the coordinating startup faced higher costs – in terms of persuasion and coordination – than in the previous archetype, and profits emerged at a later stage. This led to high capital needs, which were covered, in the second funding round, through corporate venture capital that came from the core partner. Capital needs are different for every archetype and case study; that is why they cannot be described as absolute needs. When talking about capital needs, we always refer to relative capital needs regarding the industry and the size of the startup. In the following quote, the InsurTech Case's co-founder explains what was essential to convince the core partner to invest:

“The proof of concept was essential in the seed round in order to prove that it works and that we already have a decent income.” (C2)

The orchestrator described this source of funding as a strategic maneuver that strengthened the bond between the orchestrator and the partner. This was particularly important because in the InsurTech case value proposition only happened via the partners of the ecosystem, making the orchestrator more vulnerable in case one of the partners withdrew.

3.4.3 Archetype C: Virtuoso Concert Master

The third archetype is described by the following cases: Move 1, Share, and Smart Building. As described in the previous archetype, Move's main value proposition is a platform that functions as a coordination possibility for a personally tailored relocation

process. The platform aims to relieve the customer of the burden of communicating individually with each company involved in the relocation process. This ecosystem, named Move 1, is classified in the Virtuoso Concert Master archetype because of its ecosystem structure and the provenance of its value proposition. The value proposition of the Share case is a platform that exchanges peer-to-peer carsharing opportunities. In addition to this core offering, an independent insurer provides insurance solutions for rental cars and several other players, such as garages, petrol stations, and supermarkets, providing additional services or benefits to the users. The Maintenance Analytics company has developed software that analyses data about potholes, rocks, bumps, and other types of damage/potential threats on public roads and evaluates the data with a unique algorithm. The company collaborates with many different players in the ecosystem, mainly with the public sector, which provides crucial information about the roads, but also with private companies that supply geodata. Finally, the Smart Building case company has developed smart air conditioning and heating solutions to achieve an optimal and sustainable indoor climate. Sensors measure different parameters, such as temperature and Carbon Dioxide (CO₂) concentration in, for instance, offices, shopping malls, or metros, which then automatically regulate ventilation and heating. All these startups fulfill the role of an orchestrator since they defined the joint value proposition and earnestly sought partners.

In this third approach, both the orchestrator and its partners contribute to the value proposition, and the value proposition is standardized. Our cases have shown that convincing partners is easier when the orchestrator has not only a particular knowledge or network but can also provide the ecosystem with a key component. For example, in both the Maintenance Analytics and Smart Building cases, the startups were the companies in their ecosystem to have the know-how to build an innovative key module, while they required partners only for communication, design, supply, and other services. Therefore, the respective coordinating startup built a prototype of their key component, which was then presented to the potential partners, convincing them to provide further components to the ecosystem. The startup consequently fulfilled a triple role: it not only coordinated the ecosystem and brought knowledge and connections from its founding team, but it also actively contributed to developing the ecosystem's joint value proposition.

In this configuration, where the value proposition is standardized, half of our cases coordinated and scaled through a platform as soon as it was possible. Indeed, the Move 1 and Share cases, which both enable their clients to buy services through a two-sided

platform, also used this platform internally to coordinate their partners. The Maintenance Analytics and the Smart Building cases, however, did not use a platform to coordinate their partners, since their clients were businesses and governments, meaning that the number of customers (less than 100) was lower compared to B2C models and could be handled manually.

As the orchestrator also contributes to the value proposition, the partners' components must be aligned with the orchestrator's. In the Maintenance Analytics case, the developers from the coordinating company worked closely together with developers from the partnering companies to ensure this alignment, as the following quote highlights:

"We have partnered with [...] to develop AI and IP using their tools, and so far, we have developed our solution with [...] and [...] tools. [...]. Our developers are often almost weekly in contact with their support personnel while developing new features."
(E1)

The Move 1 and Share cases, with business models based on B2C, using peer-to-peer platforms to scale their business internally (to acquire new partners), as well as externally (to acquire new customers), assuming they reached a sufficient network effect. The Maintenance Analytics and Smart Building cases both used an internal platform, but they were used for calculations and not suited for partner management or scaling. To gain new customers, the Maintenance Analytics company instead used already existing data, which was collected through other users or market agents. The head of sales at the Maintenance Analytics described how they reached out to local governments, which are their main customers:

"The road scanners we use are placed under vehicles, and once a city owns one, they also often go to other places, allowing us to generate data from new regions. This opens a huge sales channel as now we can say, 'Hey, we have your entire data already – wanna take a look?'" (E1)

In terms of funding, the need for capital in these cases was much higher than in the previous archetypes, because the Virtuosoic Concert Master orchestrators developed a component of the value proposition for their respective ecosystems. Our examples in this archetype covered these capital needs differently regarding their ecosystem's use cases. In the Move 1 case, which is a B2C platform and represents Move's main value proposition, the company needed to market its product to build up a very significant network effect. This need for resources to be able to scale was the reason Move had five

funding rounds in a short period. In their fifth and final round, the company sought funding through venture capital, as described by its CEO:

“VCs are enormously well trained to let you grow very fast and strong.” (D3)

The Smart Building company, on the contrary, targeted businesses and governments, leading to a longer sales process than in the B2C market, and meant that the company required additional capital. However, selling to businesses and governments also has advantages, as the number of clients is lower. This also means that there was no need to use an external platform to sell the product and that the orchestrator started to earn revenues very soon, as explained by the following quote:

“Both first seed rounds [...] were provided by angels, which is more about a long-term investment, as they do not expect very quick returns. [...] And we only asked for a small funding, because we were able to earn some money on the way, with early products.” (F1)

To conclude, in this archetype, funding needs are much higher than in the previously described cases, as the orchestrator builds a technical component for the ecosystem. However, these relative capital needs differ in their amount and source, depending on the ecosystem’s use cases.

3.4.4 Archetype D: Busy Choirmaster

Finally, the last archetype was built on the Access and Visualization cases. The Access case provides keyless access to rental cars. It developed an app for the end customer and the technological equipment for the rental cars, which enables cars to be opened using a smartphone. The Visualization Case creates an extremely accurate 3D digital twin of the world, a so-called ‘true mirror world’, making it visible to software. This technology, which is based on high-resolution cameras, enables the building of spatial applications of the highest quality. Both cases had defined the value proposition of their ecosystems and were looking for partners to finalize and implement it. Similar to the last approach presented, the startup in the Busy Choirmaster archetype fulfilled a triple role: it coordinated the ecosystem and brought knowledge and connections into it, and it also actively contributed to developing the ecosystem’s joint value proposition.

In this fourth and last approach, regarding our two global dimensions, both the orchestrator and its partners contribute to the value proposition, and the value proposition is customized. In both the Visualization and Access cases, the startup developed a prototype of their component that could be tested by potential partners in

order to convince them to get onboard. The Visualization case's CEO describes this as follows:

"To be a viable partner in such an ecosystem, you need to bring something to the table that no one else has (...) We built a very high-resolution camera and the ability to create these 3D models, [...] that was our USP that we could bring to the table, and that made us actually interesting to the other partners." (G1)

Since the orchestrator also participated in the value proposition by providing a key module to the ecosystem, tech-savvy people were needed to develop the component and later align the high number of partners with it. In the Visualization case, finding these people was particularly challenging, to the extent that the startup relocated its office to be closer to universities teaching these technologies. Further, the customized nature of the value proposition made it even harder to coordinate, as the partners needed might differ from one value proposition for one customer to the other. As it is therefore not possible to standardize the coordination process through a platform, the Access case tried reducing transaction costs by processing certain administrative tasks more systematically, as described by the CEO:

"We were able to reduce our transaction costs by standardizing certain administrative processes, such as contract structures. This allowed us to process more partners at the same time." (H1)

In order to create value, the partners' components must be aligned with the orchestrator's. Also, with the value proposition being customized, a vivid and regular exchange is needed between the partners. To ensure this alignment, our cases have shown that the coordinating company needs people who perfectly understand the module they provide and develop the product together with the partners.

In the situation where each ecosystem is different, every new value proposition has to be rebuilt – with different partners – around the orchestrator's component. The situation is even more difficult when the orchestrator not only aligns the partners but also develops a module. We have seen in our cases that this makes the scaling process very challenging because each new value proposition requires different partners and thus coordination effort. In the Access case, for example, demand had to be generated via the B2B customers, who then exert pressure on the other customers:

"We want to scale by generating more demand from the value chain of our system integrators. [...] by generating a pull towards the manufacturers. And the larger this

pull is, the stronger is our lock-in [...] Accordingly, our solution will also spread to other lock manufacturers.” (H1)

The capital needs in this fourth archetype are the highest because the orchestrator faces costs for the development of its module and because the value proposition is customized, meaning that coordination efforts are increased. However, because scaling is a long and challenging process for this archetype for the aforementioned reasons, some types of funding are not well suited. In the Visualization case, for example, venture capital was explicitly not an option because of its tighter deadlines. Consequently, only business angels, former entrepreneurs, and high-net-worth individuals invested. Also, in the Visualization case, the orchestrator refused to take money from its ecosystem partners, as it wanted to remain independent in case one of the partners needed to be replaced:

“We did not consider raising money from our ecosystem partners. [...] Because, in the end, we want us to remain independent. I mean, having partners is nice, but you need to be independent in terms of maneuverability.” (G1)

The Access company did turn one of its partners into an investor, but regretted it for the reasons mentioned in the Visualization case, as illustrated by the following quote:

“That’s where we [...] came to the conclusion that it’s not so beneficial to turn your customer or partner into an investor, and we’ve been avoiding this ever since.” (H2)

In contrast to archetype B, where the orchestrator willingly strengthened the bond with its core partner, both the Access and Visualization cases intentionally avoided this source of funding. The reason is that in this fourth archetype, the orchestrators mainly contributed to the value proposition with their key technology, providing them with more power over their ecosystem partners. Having this power, the orchestrators were then able to maintain their independence towards partners in case one of them needed to be replaced. For all of these reasons, this last archetype needs long-term and independent investors.

3.5 Implications

The findings above are summarized in the previously introduced matrix, providing hands-on insights for researchers and practitioners alike.

VALUE CREATION BY

ORCHESTRATOR & PARTNERS
PARTNERS ONLY

CORE FINDINGS

VALUE CREATION BY	ORCHESTRATOR & PARTNERS	TYPE OF VALUE PROPOSITION	
		STANDARDIZED	CUSTOMIZED
A	Persuasion of partners	Feasibility through market knowledge and network	Feasibility through market knowledge and network
	Coordination	Comparably low effort since standardization enables the use of a platform	Comparably high efforts since staff is needed to orchestrate different partners in different use cases. However, the use of a platform to orchestrate recurrent, core partners is possible
	Product Development	Done only by partners, startup's role is to coordinate them	Done only by partners, startup's role is to coordinate them.
	Scaling	Through involving new partners via use of a platform	Through involving new partners via use of a platform
	Funding	Lowest funding needs which are usually covered by few investors, typically through smart money	Higher needs than in A because scaling is longer and more difficult, but still low since no product development costs incurred. Funding through core partner is attractive
C	Persuasion of partners	Feasibility through technical competence	Feasibility through technical competence
	Coordination	Comparably low effort since standardization enables the use of a platform	Very high effort since the use of a platform is not possible. Therefore, additional staff is needed. Additionally, since the startup develops a technical component, staff must be well trained
	Product Development	Together with partners	Together with partners, which vary depending upon use case
	Scaling	Fast scaling possible. Stage 1: New partners bring new customers into the ecosystem. Stage 2: through a standard API, new partner customers are transformed into ecosystem customers	Slow scaling since it happens through new use cases
	Funding	Needs higher than in A due to additional Development effort. B2C: VC money to grow fast and strong. B2B or B2G: low capital needs due to early products	Highest capital needs due to own development and high orchestration efforts. Requires long term thinking investors. To maintain independence, investments from partner or client should be avoided
B	Persuasion of partners	Feasibility through market knowledge and network	Feasibility through market knowledge and network
	Coordination	Comparably low effort since standardization enables the use of a platform	Comparably high efforts since staff is needed to orchestrate different partners in different use cases. However, the use of a platform to orchestrate recurrent, core partners is possible
	Product Development	Done only by partners, startup's role is to coordinate them	Done only by partners, startup's role is to coordinate them.
	Scaling	Through involving new partners via use of a platform	Through involving new partners via use of a platform
	Funding	Lowest funding needs which are usually covered by few investors, typically through smart money	Higher needs than in A because scaling is longer and more difficult, but still low since no product development costs incurred. Funding through core partner is attractive
D	Persuasion of partners	Feasibility through technical competence	Feasibility through technical competence
	Coordination	Comparably low effort since standardization enables the use of a platform	Very high effort since the use of a platform is not possible. Therefore, additional staff is needed. Additionally, since the startup develops a technical component, staff must be well trained
	Product Development	Together with partners	Together with partners, which vary depending upon use case
	Scaling	Fast scaling possible. Stage 1: New partners bring new customers into the ecosystem. Stage 2: through a standard API, new partner customers are transformed into ecosystem customers	Slow scaling since it happens through new use cases
	Funding	Needs higher than in A due to additional Development effort. B2C: VC money to grow fast and strong. B2B or B2G: low capital needs due to early products	Highest capital needs due to own development and high orchestration efforts. Requires long term thinking investors. To maintain independence, investments from partner or client should be avoided

Figure 22: Core findings Chapter 3

The matrix offers value for startups orchestrating an ecosystem in several ways. First, it allows the firm to classify itself as one of the archetypes and use the respective recommendations provided as guidance on how to do so. Further, it allows the startup to assess whether it is suitable to perform the *implications* given, which helps to assess whether it is feasible to orchestrate the ecosystem at hand. Beyond these guidelines, our findings and the framework may provide several interesting implications for startups as well as other types of organizations interested in the topic of ecosystems. These are presented in the following:

For startups

First and foremost, our findings demonstrate that startups can be successful ecosystem orchestrators. Even more, our research shows that to do so they do not even need to provide a core competency in the form of a technical module or key module to the ecosystem, as shown in archetypes A and B. Thus, the role of the orchestrator offers new possibilities for founders with small teams and few resources, as an orchestrator's core contribution may lie solely in the network and market knowledge its founders bring to the ecosystem. We show that it is possible for startups to build up an ecosystem without contributing a module. For this type of orchestration, the startup must at least have market knowledge and a network. The downside is that the orchestrator must be careful when selecting the necessary ecosystem partners: the startup must make sure that not all of the partners are aware of each other's involvement, otherwise they could make the orchestrating startup redundant. However, taking on the role as an orchestrator can also disclose some challenges, for instance, when the value proposition is customized, as in archetypes B and D. These ecosystems require a lot more human resources, which is a resource many startups lack. As a result, the capital needs are much higher, especially for persuasion and coordination.

For corporates

Beyond startups, which is our studies focus, the findings presented in our framework are also be of value to corporate firms.

First, when being the orchestrator, corporations and SMEs (which face challenges similar to those startups face when it comes to ecosystem orchestration (Radziwon & Bogers, 2019), especially the challenge of resource constraints) might also profit from our study, since we show how to orchestrate an ecosystem. Our research shows that, regarding resource constraints, standardization must be considered. Indeed, the number of resources needed decreases with the degree of standardization of the ecosystem,

regardless on whether the orchestrator is a startup or corporate. For this reason, we argue that customized value propositions are not well-suited to startups or corporate teams, where few employees are available to be assigned to the tasks necessary for ecosystem orchestration.

From the perspective of firms involved in a startup-led ecosystem as complementors, corporates also profit from this research as they can now assess if a startup might be able to orchestrate the type of ecosystem at hand. Hence, corporate firms have an additional decision-making basis for whether they should engage in a startup-led ecosystem or not.

For investors and accelerators

The findings presented in our framework are also valuable to investors and accelerators. The framework helps investors to evaluate startups that fulfill the roles of orchestrators. In particular, our findings help investors and accelerators assess the startup's capital needs and success potentials. Concretely, our research shows that funding needs may radically differ in terms of amount and duration from one orchestrator to the other, depending on its position in our framework. Obviously, funding needs increase in the case when the orchestrator develops a part of the value proposition, such as in archetypes C and D. However, they are also higher when the value proposition is customized as compared to standardized, as depicted in archetypes B and D. Therefore, archetype A displays the lowest capital needs and archetype D displays the highest. The funding type also depends on these two dimensions. Indeed, when the orchestrator does not contribute a module to the value creation, it will be interested in seeking funding from one of its core partners, such as in archetype B. On the contrary, when the startup contributes to the creation of value, such as in archetype D, it will avoid being funded by its partner or client to keep its independence. Further, our study shows that the type of funding also differs depending on the type of ecosystem. Indeed, in customized value proposition structures, such as archetypes B and D, scaling is slower and more complicated and, therefore, only suited for long-term investors.

Finally, for our research, we needed case studies of currently operating startups. As a result, one question that could not be addressed is how startups should enter the last phase of their lifetimes, the exit strategy. Thus, we argue that further research is needed concerning the exit strategy for orchestrating startups, depending on the archetype.

3.6 Contributions to Research

This Chapter aims to open up a new stream of research on startup-led ecosystems. Accordingly, we hope and believe that it sparks several new questions, based as much on its limitations as on its findings. First, we focused on the tasks of orchestration that are most crucial from the perspective of the structural view of ecosystems. However, in the course of our data analysis, we discovered an additional task, which emerged from the very nature of startups. Thus, while we believe that the tasks of orchestration, we focus on are of particular relevance, we would like to encourage future research on additional tasks of orchestration in order to create a more comprehensive view of how startups orchestrate ecosystems. This is in-line with previous calls for a better understanding of ecosystem orchestration in general (Jacobides et al., 2018). For the same reason, this study merely provides an overview of how the tasks of orchestration are being performed by startups, which we believe is justifiable given that the study is a first step in this direction. However, we would like to encourage more in-depth research along these lines, which could be particularly valuable for managers. Second, based on two contingencies, our study introduces four distinct patterns of how startups orchestrate ecosystems. However, there might be additional approaches in-between these polar types. Thus, future research might develop a more fine-grained view of ecosystem orchestration by startups by looking at more variances in the surrounding conditions and the resulting approaches. Third, given the nature of a case study, this study introduces approaches without discussing the outcomes. This raises the question of which approaches are particularly successful under which circumstances and how the quality of orchestration affects the success of the ecosystem. Finally, this study follows the structural perspective of ecosystems, which is characterized by a focus on the materialization of a joint value proposition. Other views of ecosystems, for instance platform, knowledge, or business ecosystems, are equally relevant but apply different foci. This raises the question of whether startups are acting as orchestrators in those kinds of ecosystems as well, and of how they are doing so. In other words, how do startups orchestrate ecosystems if the underlying intention goes beyond the materialization of a value proposition?

4 The Effects of Ecosystems on Research and Development Intensity and Corporate Innovation⁶

4.1 Introduction

Since innovation is linked to ecosystems as a new form of cooperation, and can be measured through innovation input (R&D expenses) and innovation output (patents, market cap, etc.) (Gerybadze et al., 2010), this Chapter focuses on identifying the impact of R&D expenses as well as innovation output on ecosystems. There is a consensus in research that R&D has a positive effect on firm performance (Lome et al., 2016). However, knowledge about the effects of R&D activities on ecosystems is scant and, thus far, offers no managerial guidance. Although it has been argued that innovating is one of the main ways that firms can adapt to changing environments, hardly any studies have considered the role of R&D on ecosystems. So far, the literature has focused on the way ecosystems are built (Dattée et al., 2018), on the impact of business model components on ecosystems (Madsen, 2020), on ecosystems as the new model of cooperation (Adner, 2017; Jacobides et al., 2018), and on the correlation between the amount of money a company spends on innovation and its overall financial performance (Jaruzelski et al., 2018).

In this Chapter, the STOXX Europe 50, an index consisting of the 50 largest European companies by market capitalization, serves as a database. Using the programming language R, we conduct a text analysis of the annual reports from STOXX Europe 50 companies between the years 2013–2018, to observe the development of specific words related to both innovation and ecosystems. Additionally, we analyze R&D intensity – the ratio of R&D expenses to net revenues – over the same time frame.

4.2 Literature Review

4.2.1 *Ecosystems*

An ecosystem's ultimate purpose is the realization by several actors of a joint value proposition that cannot be achieved by any one actor in isolation (Adner, 2017; Adner & Kapoor, 2010; Eisenhardt & Galunic, 2000; Hannah & Eisenhardt, 2018; Jacobides

⁶This Chapter is based on the working paper “The Effects of Ecosystems on Research and Development Intensity and Corporate Innovation” with co-authors Natalie Weiler and Christoph H. Wecht. The support of Natalie Weiler in the development of this paper is gratefully acknowledged. The student supported the data collection and parts of the data analysis for this research.

et al., 2018; Moore, 1993). This kind of inter-firm cooperation opens up a wide range of opportunities for companies, such as the development of emerging markets, products or technologies, as well as access to resources and skills that a stand-alone enterprise would not have on its own (Adner, 2006; Kahney, 2004; Moore, 1996). Ecosystem actors can only create a joint value proposition if it is modular and can be broken into several independent modules that the actors involved can independently produce (Baldwin & Clark, 2000; Jacobides et al., 2018). These complementary modules either mutually increase their respective values (so-called supermodularity) (Milgrom & Roberts, 1990; Topkis, 1978, 1998) or cannot work in isolation without the other modules (Teece, 1986). Therefore, the actors are called upon to create new modules in a targeted manner or to at least adapt their existing modules to fit with and complement the other actors' modules (Baldwin & Clark, 2000; Jacobides et al., 2018). For this reason, the actors must align themselves mutually with the joint value proposition (Adner, 2017). This orientation is multilateral by nature, i.e., links between the actors cannot be merely bilateral, and it ensures that all the modules fit together and exploit the full potential of their complementarity (Adner, 2017; Jacobides et al., 2018).

This implies a high degree of interdependency between the actors, especially since adaptation of the modules can entail considerable costs (Adner, 2017; Jacobides et al., 2018). Hence, if one actor leaves the ecosystem or fails, then the entire structure is at risk (Dattée et al., 2018; Moore, 1996). The possibility of joint innovation raises the question of whether ecosystem innovation or innovation partnerships have an impact on the R&D budgets of the respective companies.

4.2.2 R&D Intensity

According to the Schumpeterian definition of innovation (Hardy, 1945), innovations are strategic instruments that can be used to gain a competitive advantage and that lead, at least temporarily, to a monopolistic position, and thereby to higher returns for innovative firms in comparison to non-innovative companies (Aghion et al., 2014). As mentioned above, the ecosystem has recently emerged as a new opportunity for joint innovation, delivering a new value proposition thanks to a multilateral set of partners (Adner, 2017). In fact, both R&D and innovation are considered as drivers for change and key determinants of growth across several industries (Gerybadze et al., 2010). Only companies that continuously invest in R&D and rethink their businesses on an ongoing basis are able to maintain a long-term competitive advantage and achieve stable growth (Gerybadze et al., 2010). Although, the effect of R&D expenditures on growth and innovation has recently gained relevance in research (Park et al., 2018), there is still a

lack of studies that emphasize the relationship between R&D investment, corporate growth, and financial performance (Baumann & Kritikos, 2016; Gerybadze et al., 2010). Companies currently face several challenges when it comes to pursuing innovation and to gaining a leading position in the market. To assess this issue, ecosystems and R&D intensity can be drawn in as indicators to explore a possible relationship between the two and their effects on a company's degree of innovation and competitiveness. At the present time, the gap between the relationship of innovation input as R&D intensity and the ecosystem as a nascent, innovative form of partnership has not yet been addressed. Although there have been international studies on the importance of innovation and R&D, such as the European Innovation (ERI) Scoreboard (European Commission, 2018) and the Global Innovation Index, as well as surveys (McKinsey, 2019; BCG, 2019) conducted by well-known consulting firms, these have failed to highlight the link to ecosystems.

4.3 Methods

As mentioned above, the impact of innovation through R&D on joint innovative partnerships, such as ecosystems, has not yet been discussed. Therefore, this study aims to analyze the impact of R&D intensity on ecosystems, by considering companies that belong to the STOXX Europe 50 Index over a 5-year time frame from 2013 to 2018. This index (STOXX 2019) provides an overview of 50 stocks from 17 European countries based on market capitalization (please see Table 11). The data were collected in two ways and the analysis can be split into two parts (A and B):

- A. Analyzing R&D intensity with data retrieved from Bloomberg and cross checked with annual reports (for detailed information please see Table 12 in the appendix). The 5-year time frame and the CAGR (compounded annual growth rate) have been fundamental for the Global Innovation Index (Jaruzelski et al., 2018) and these metrics are therefore used in this study.
- B. Text analysis of annual reports using the programming tool R to identify and count specific words linked to ecosystems and R&D.

4.3.1 Data Sampling

The companies considered focus on Europe since research has not yet investigated the relation of R&D intensity and ecosystems. Thus, we chose the STOXX Europe 50 Index to address that research gap as the index groups the largest European companies by market capitalization.

STOXX EUROPE 50 INDEX (December 2019)				
AB INBEV	ABB	Adidas	Air Liquide	Airbus
Allianz	ASML Holding	Astrazeneca	Axa	Banco Santander
BASF	Bayer	BNP Paribas	BP	BAT
Daimler	Deutsche Telekom	Diageo	ENEL	ENI
Glaxosmith	HSBC	Iberdrola	ING Groep	ISP
L'oreal	Linde PLC	Lloyds Bank	LVMH	National Grid
Nestle	Novartis	Novo	Prudential	Reckitt
Relx PLC	Rio Tinto	Roche	Safran	Sanofi
SAP	Schneider Electric	Shell	Siemens	Total
UBS	Unilever	Vinci	Vodafone	Zurich

Table 11: STOXX Europe 50 (December 2019)

4.3.2 Data Collection

The data collection process was divided into A (R&D intensity) and B (word count analysis) and is shown in Figure 23.

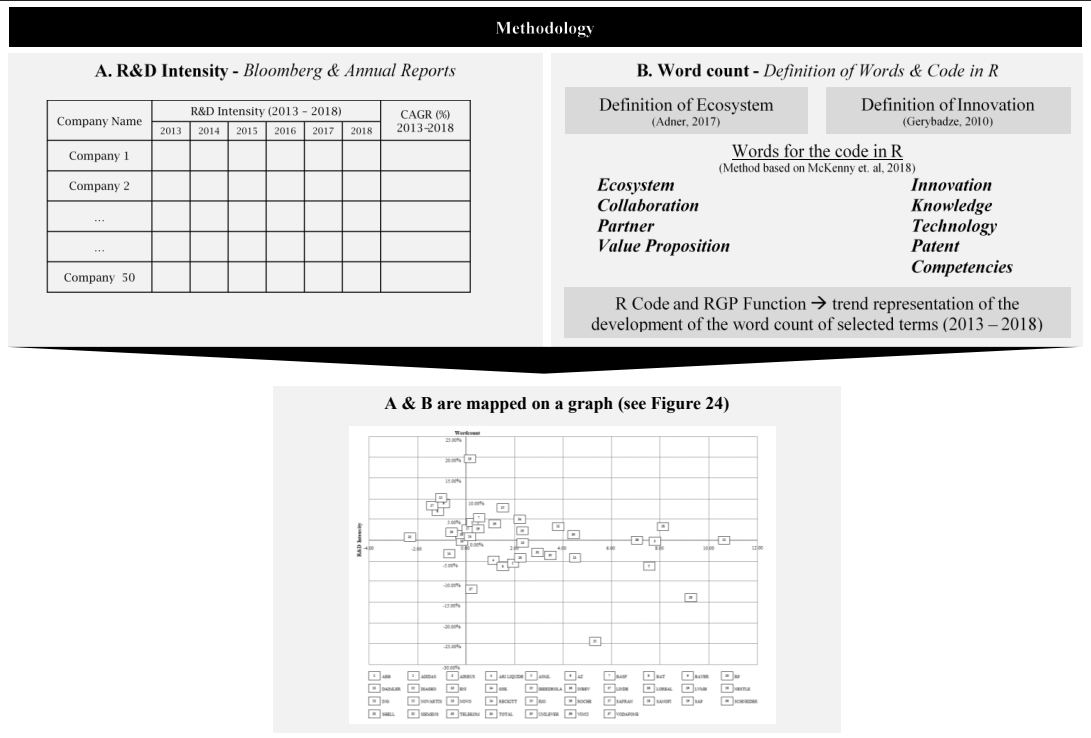


Figure 23: Methodology Chapter 4

4.3.1. R&D intensity

We used the Bloomberg database to retrieve the relevant data. For our research, we mainly focused on the financial information for publicly listed companies belonging to the STOXX Europe 50 Index to analyze the R&D intensity, i.e., the ratio of R&D expenses to net revenues. The index comprises 50 European companies from several countries and industries. The overall procedure for analyzing the companies' specific data was composed of three steps. First, we used Bloomberg to retrieve the revenues and the R&D expenses for all of the STOXX Europe 50 companies during 2013–2018, in order to then calculate each company's R&D Intensity, which we cross checked with the values that the companies issued in their annual reports (retrieved from the company websites). Second, we calculated the compounded annual growth rate (CAGR) of R&D intensity over the considered time frame to comprehend industry trends around research activities and the firms' investments in innovation. Third, based on a positive or negative value of CAGR, we were able to understand R&D intensity in relation to other parameters, like the results obtained by the word count analysis (part B).

4.3.2. Word count

In order to assess the text analysis by conducting a word count, we used a code that had the annual reports for each of the STOXX Europe 50 companies from 2013 to 2018 as a database. Annual reports provide information to support decision-making and are mainly provided as digital Portable Document Format (PDF) files. Outside of the United States, these reports represent companies' primary reporting vehicles (El-Haj et al., 2020). In general, annual reports consist of two elements: a narrative element and a mandatory one, the latter of which includes financial statements, footnotes, and other statutory information. The narrative components include management commentary on financial performance during the year, together with additional information, such as a letter to shareholders, information regarding primary risks, the company's corporate social responsibility policy, etc. (El-Haj et al., 2020). We proposed a procedure using R to retrieve text from the digital PDFs of the annual reports published by the firms listed in the STOXX Europe 50. When a large amount of information on an organization is captured through text (McKenny et al., 2018), it becomes important to find ways to evaluate this information. Computer-aided text analysis methods are currently being used to deal with these large volumes of written information (Blei, 2012) and are gaining more relevance in research (Banks et al., 2018). We programmed a code in R to assess the word count of the annual reports from each of the 50 companies over the

selected time frame of 2013–2018. R serves as a basic open-source programming tool for text analysis (Banks et al., 2018), which, in this case, automates the count of specific words related to both innovation (R&D input and R&D output) and ecosystems. Since R&D intensity (which is analyzed with numerical data in A) mainly focuses on innovation input, we decided to complement it with factors concerning innovation output, like patents, competencies, and knowledge. Gerybadze et al. (2010) suggest that a set of dynamic capabilities can help to transform innovation input into innovation output (see Figure 24). Based on Gerybadze et al. (2010), the following words were used to focus on innovation (innovation input and innovation output): ‘technology’, ‘competencies’, ‘knowledge’, ‘patent’, and ‘innovation’.

To define ecosystems, we chose words based on Adner (2017) definition of the term: *“Ecosystem—the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.”*

The words selected for ecosystems were: ‘ecosystem’, ‘collaboration’, ‘partner’, and ‘joint value proposition’. The process of selecting words was based on McKenny et al. (2018) who used a similar approach to conduct a text analysis.

After defining the key words, the R code revealed how the word count had developed over time, and a value represents the development using the Redemption Grace Period (RGP) function (for detailed information please see Table 13 in the appendix).

4.3.3. Data Analytics

In order to derive a link between the R&D intensity analysis (A) and the word count (B), we had to bring together both analyses. The value for A is simply defined by the CAGR value, which can be either positive or negative. It was more complex for B, as we had to find a way to represent the increasing or decreasing development of the word count over time. We used the function RGP to assess this issue, as it measures the trend over a specific time frame. It was then possible to evaluate whether the word count in sum was positive or negative.

By bringing together the two analyses, it was possible to get a positive or negative value for the R&D intensity in terms of CAGR and a positive or negative value for the word count. This information was subsequently mapped on a graph and the findings are discussed in the next section.

4.4 Findings

As Figure 24 shows, both the R&D intensity and the word count vary between sectors.

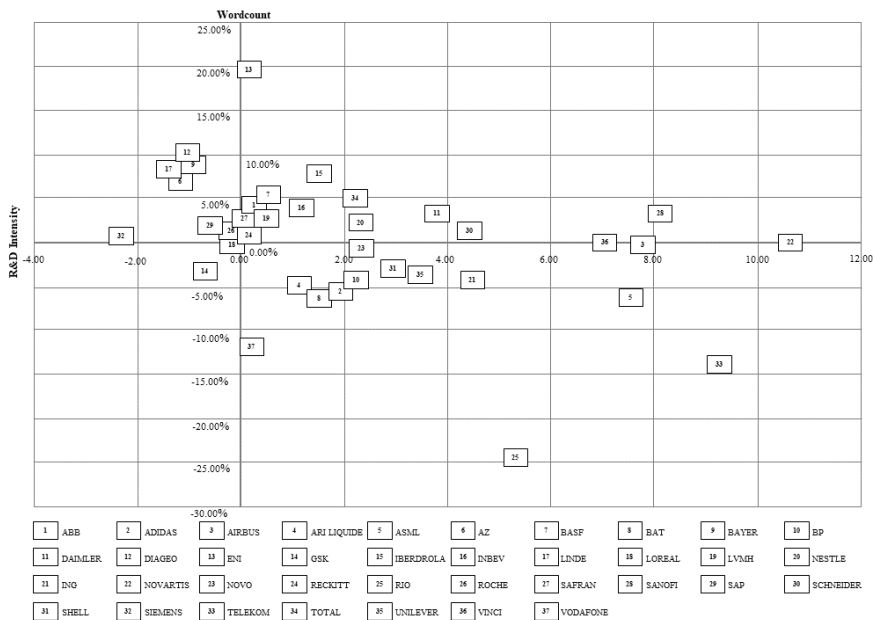


Figure 24: Matrix R&D intensity & word count

Overall, we can identify an increasing trend for both dimensions, meaning that the amount of R&D in relation to revenues increased, as did the words related to ecosystems and innovation. This is linked to the awareness that innovation is a factor that allows firms to be competitive and continue reinventing themselves. This trend is validated by several sources (European Commission 2018; McKinsey, 2019; BCG, 2019) that state that average R&D spending by firms has increased in the last few years (Jaruzelski et al., 2018).

Due to accounting and reporting standards, banks and insurance companies do not issue a value for R&D expenses. Therefore, we considered companies from these industries from our STOXX Europe 50 sample separately, and we did not plot them on our graph. Our analysis demonstrated that the word count for banks is positive, which indicates that the banks are doing an effective job of communicating their innovative activities to stakeholders through their annual reports. Many banks have created

accelerators/incubators or building platforms in response to new, smaller players, as these startups are closer to customers and can innovate faster. The analysis showed that a similar scenario is happening with insurance companies: they have a positive word count and are trying to innovate by cooperating with partners from several industries. Axa (Axa, 2018), for example, is working closely with Uber and is simultaneously building a digital insurance platform together with ING. Allianz has its own accelerator, Allianz X, to foster innovation (Allianz, 2018). Thus, the alignment of various partners to deliver a value proposition is fully embraced by banks and insurance companies. All of the other companies in our sample issue a value for R&D expenses in their annual reports and can therefore be illustrated in the graph.

Technological firms Siemens and SAP show a low but positive CAGR in R&D intensity and a negative word count. Siemens is facing a growing demand for energy efficiency in buildings as well as the need to reduce costs by increasing space efficiency and utilization. Additionally, customers demand smart space solutions (Siemens, 2018). SAP's stated aim is to connect technology-driven innovation and corporate leadership (SAP, 2018), while focusing on engineering solutions to fuel innovation. SAP targets acquisitions that complement their solution offerings, and one of their latest innovations has resulted in the Digital Partner Network – a new platform ecosystem to help customers to engage and manage external partners (SAP, 2018). Although the word count is not positive for either company, both SAP and Siemens promote the ecosystem concept by partnering with other players. Unlike the technology companies, the telecommunications companies Vodafone and Deutsche Telekom have a negative CAGR and a positive word count. The telecommunication industry has provided the network and data infrastructure that has enabled the internet to become smart and mobile. Yet there is now a stagnant number of new customers due to market saturation, which has led to declining profits in response to competition, both from within the industry and outside of the industry, and increased cybercrime. At the same time, there are opportunities related to rising trends, such as the Internet of Things (IoT), Machine-to-Machine (M2M); cloud computing, and 5G, waiting to be seized.

Consumer goods show both a positive word count and a positive CAGR, albeit low in both cases. Large Fast Moving Consumer Goods (FMCG) firms have to invest in innovation to remain competitive with the many start-ups entering the market. And since these younger, smaller companies are closer to customers and to the market, they can react faster to changes in consumers' preferences. Innovation for those companies is closely linked to products, packaging, and the way the products are produced, as these

represent ways the companies can differentiate their portfolios. Nestle acquired Atrium Innovations, a leader in natural supplements, and at the same time brought to market new products, such as KitKat Ruby, Perrier & Juice, Garden Gourmet, etc. (Nestle, 2018). Expanding the network of partners is one of the key resources Nestle can use to stay competitive in the market. Nestle thrives by driving growth through large R&D investments. Reckitt Benckiser, another consumer goods company, implemented two separate end-to-end business units to improve innovation focus and market execution, and also focuses on the e-commerce channel. To innovate effectively means to listen to consumers and to their needs. LVMH launched La Maison des Startups LVMH at STATION F, the world's biggest incubator, to focus on global innovation and sustainable development (LVMH, 2018). Looking at all these individual companies, it becomes clear that the words related to ecosystem partnership and technology in particular have been increasing in the last years. And once again, partnerships seem to be the key to remaining competitive in the future.

Pharmaceutical companies are known for their strong M&A (mergers and acquisitions) activities. Several start-ups have tried to disrupt the pharmaceutical industry, which is dominated by the big players from the diagnosis level all the way up to the delivery of medicine, by staying in proximity to the market and the customers. Additionally, big tech firms can threaten the industry since many solutions do not have to be regulated. In general, pharmaceutical companies must take advantage of the digitization wave to get closer to their customers along the entire value chain. As is shown in our graph, there is not a unified position for the pharmaceutical companies: although all these companies show a positive CAGR development for R&D intensity, the word count varies within a broad range when considering the whole word count trend.

The companies in the energy sector show a positive CAGR development and overall a positive development regarding the words 'collaboration', 'partner', 'knowledge', and 'technology'. In this sector, the positive word count can be explained by the fact that companies need to innovate in order to become sustainable producers of clean and renewable energies. Enel, for example, is the largest producer of renewable energies in the world, and has communicated its intention to be CO₂ free by 2050.

When we look at our analysis from a broader point of view, it becomes clear that the terms 'partner' and 'collaboration' have the highest counts in firms that have negative CAGRs in R&D intensity. This implies that even if a firm decides to invest less in R&D, it can still be innovative and competitive by fostering partnerships: a high R&D intensity does not seem to be a necessity to build an ecosystem.

On the other hand, firms with the largest spending on R&D over the past years show a rather low consolidated word count. Regarding the specific word ‘ecosystem’, only a few companies use the term in their annual reports. In our sample, only Adidas, Daimler and Schneider show a rather high positive development of the word ‘ecosystem’. Innovation is characterized instead by a positive word development for almost every company, which implies that the companies that belong to the STOXX Europe 50 all promote innovation.

As mentioned above, banks and insurance companies do not issue a value for their R&D expenses. Thus, we have determined their degree of innovation and their competitiveness through the word count analysis. This analysis shows that the terms ‘collaboration’ and ‘partner’ increased in the considered time frame, which therefore highlights that both insurance companies and banks engage in cooperation and innovative ways of collaborating to foster innovation. Additionally, engaging in partnerships allows these companies to meet increasingly demanding customer needs and to quickly adapt to industry trends.

When focusing on the industries considered in our sample data from the STOXX Europe 50, and taking into account the development of the word count and the R&D intensity, we can map them as shown in Figure 25. Overall, the companies tend to have a positive R&D intensity. Only the telecommunication industry sees a negative value for R&D intensity and a positive one for the word count. The pharmaceutical and chemical industries cannot be associated with one position, as R&D can be either positive or negative as can the word count. The energy and the FMCG industries are characterized by a positive value for both R&D intensity and word count. Lastly, the technology industry sees a negative word count but a positive value for R&D intensity.

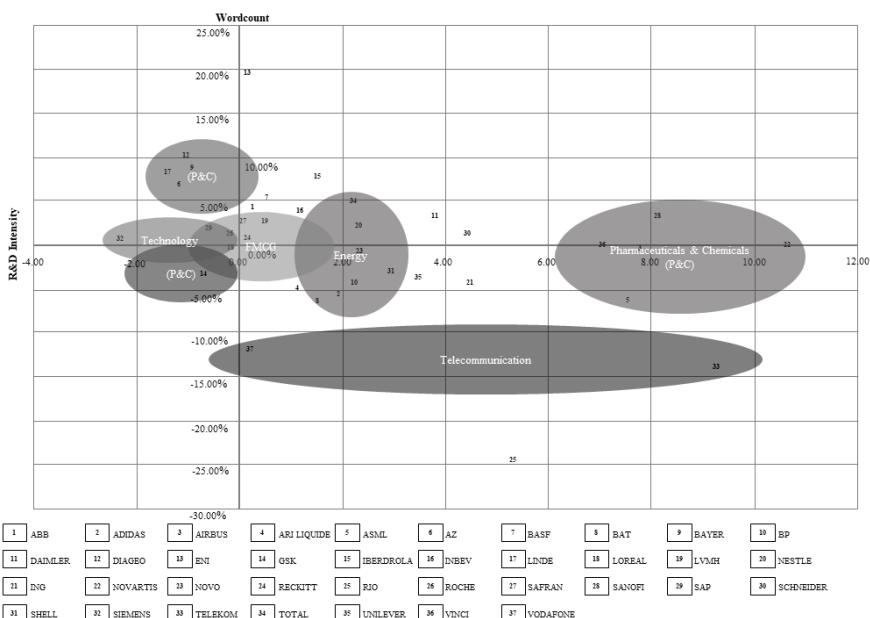


Figure 25: Cluster of industries

4.4. Implications

The aim of this Chapter is to highlight the relationship between innovation in terms of R&D intensity and a novel means of cooperation in the form of ecosystems, as there is still a lack of research targeting the impact of R&D and innovation on ecosystems in the European market. Our findings revealed that most companies belonging to the STOXX Europe 50 Index engage in partnerships in order to innovate. Additionally, our study shows that some words tend to be more relevant than others when it comes to analyzing and defining the concept of ecosystem. In fact, the terms ‘partnerships’ and ‘collaboration’ are widely used, whereas ‘value proposition’ and ‘competencies’ are less common. Concerning the development of the word count, we have to consider the varying lengths of the annual reports that we used as a database for our analysis, and we therefore need to be aware that the probability of getting more words is higher for longer reports. Moreover, the companies included in the STOXX Europe 50 can change and the makeup of the index could therefore be different at different points in time.

Previous literature (Dattée et al., 2018; Jacobides et al., 2018; Jaruzelski et al., 2018; Madsen, 2020) offers limited guidance to managers about the implications of R&D and innovation on ecosystems. Our findings reveal that ecosystems can be established as a new way of jointly collaborating without spending large amounts on R&D, and that the importance of innovation must be highlighted in annual reports, as is the case for all the firms listed on the STOXX Europe 50. This study therefore also addresses the call for research by Kapoor (2018) about the importance of how firms allocate their resources, such as R&D, alliances, and collaborations, to fix bottlenecks in their ecosystems.

Ecosystems represent an increasingly prevalent form of joint cooperation. This implies that new considerations must be taken into account and further researched to explain the mechanism behind this construct. Additionally, it is necessary to understand which activities firms undertake themselves and which activities they decide that others in the ecosystem should undertake.

Managers can use companies from the STOXX Europe 50 as an orientation when they need to analyze their R&D and innovation and the impact on their ecosystem as several industries and countries are taken into account. In sum, our research highlights how engaging in collaborations and partnerships – building ecosystems – without necessarily spending large amounts on R&D, can offer companies the possibility to continually innovate and be competitive in the present dynamic environment. This should be an incentive for managers to trigger and foster the above-mentioned opportunities. An example is given by the actions taken by banks and insurance companies, which realized that cooperating with partners allows them to be closer to the customer and to expand into other sectors they would otherwise not be able to access. Collaboration is the only way for these companies to change and/or adapt their existing business models, which are threatened by numerous small players that do not necessarily come from within the banking or insurance industries. Thus, the only way for big banks and insurance companies to stay in the market is by engaging in cooperation and starting to invest in R&D as, for example, the Spanish Bank Banco Santander has done. In fact, Santander is the first bank to be mentioned in the ERI Scoreboard study (European Commission, 2018).

Our findings have three main implications for future research. First, this study was conducted for a variety of countries and industries in Europe and future studies could focus on a specific country or industry. Second, further evidence to demonstrate the impact of R&D and innovation on ecosystems is necessary, particularly to show that innovation and competitive advantages can be achieved through new means of

collaboration and new partnerships. Third, additional methods, other than the RGP functions we used, could be proposed to measure the development of the specific word count over time.

5 Conclusion

In summary, the existing ecosystem literature lacks understanding in three areas: (1) the development process of value creation within an ecosystem and the dynamics of establishing and steering an ecosystem; (2) the characteristics of the orchestrator and the ability of a startup to orchestrate an ecosystem successfully; (3) the relationship between innovation in terms of R&D intensity and ecosystems. In light of these research gaps, the overall aim of this dissertation has been to explore the orchestration of innovation in ecosystems. By means of empirical data, I conducted twelve qualitative case studies to gain greater insights relevant for theory advancement and management practice alike. Additionally, a text analysis with R of the STOXX Europe 50 companies' annual reports in the years 2013–2018 was conducted to evaluate the ratio of R&D expenses to net revenues. Motivated by the gaps in research, the thesis was guided by three sub-questions.

1. First, I want to broaden insights on the process of ecosystem development by conceptually applying the theory of organizational search and by including three different search sub-processes: (1) the search for the value proposition, (2) the search for partners, and (3) the search for a better understanding of (potential) partners.
2. Secondly, I aim to create an understanding of how the specific company type *startup* – a key actor in terms of its innovative capabilities – orchestrates an ecosystem.
3. Lastly, I discuss the impact of ecosystems, as a novel kind of partnership, on innovation in terms of R&D intensity.

5.1 Theoretical Contributions

This dissertation offers contributions to the existing literature on ecosystem development, the role of startups, and the impact of ecosystems on R&D intensity. I structure the key theoretical contributions along three sub-questions:

Q1: How does a firm set up an ecosystem and what is the role of organizational search for finding and integrating potential ecosystem partners?

I contribute to theories on ecosystem development through interesting insights and mechanisms on organizational search. The existing literature on ecosystem development has been limited and the process of organizational partner search has not

been applied to ecosystems or to other forms of inter-firm collaborations. Therefore, my findings highlight that this process plays a crucial role in the ecosystem establishment. I have studied two type of search processes: local and distant search. As a result, I am able to illustrate the fact that if ecosystems are developed through local search, they do not necessarily ease distant search. In local search, the orchestrator searches for partners based on its existing knowledge and thereby drives the development of the ecosystem by itself. Contrary to existing literature on the search process, this finding does not necessarily mean that the orchestrator is less innovative, but rather invokes major innovation potential as seen in three cases (Access, Smart Building, and Sports). In the case of distant search, an interesting mechanism has emerged: Rather than searching by itself, the orchestrator waits to be found by potential partners (e.g. the Logistics case). The logic of this insight strongly correlates with the work of Afuah and Tucci (2012) on crowdsourcing. However, the underlying logic of crowdsourcing is that firms present a problem on a crowdsourcing platform and wait. Eventually, a member of the platform might be able to solve the presented issue. My findings present empirical evidence for this logic of thoughts and introduce it further and more importantly to the ecosystem concept. It needs to be stated that a low degree of co-specialization between the existing partners is fundamental to applying the approach in the ecosystem context. In this vein, I was also able to show that ecosystems appear to be effective vehicles for distant search, despite the fact that the existing literature has typically assumed that this type of search is difficult to execute. With regard to execution, the dominant notion in literature (Adner, 2017; Clarysse et al., 2014; Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004b; Jacobides et al., 2018; Nambisan & Baron, 2013; Zahra & Nambisan, 2012) also states that corporations display internal advantages when orchestrating an ecosystem and, therefore, startups are considered to be less suitable as orchestrators. However, in the course of my case analyses, it was possible for me to observe that some ecosystems were, indeed, successfully orchestrated by startups. This discovery contradicts the opinions of existing scholars regarding startups as orchestrators and has therefore been the basis of my second sub-question:

Q2: How do startups orchestrate ecosystems?

Sub-question 2 guided my empirical analysis in *Chapter 3*. My findings provide several crucial implications for startups as well as for other types of organizations in the field of ecosystem orchestration. Most importantly, it has been possible for me to refute major literature opinions as my findings demonstrate that a startup can successfully orchestrate an ecosystem. Second, the resulting framework can serve as a guideline and allows startups and corporate organizations to individually assess whether they are able to perform duties of an orchestrator, which further leads to an assessment of whether they could successfully orchestrate an ecosystem. Further, the framework also assists in the decision-making process to evaluate which strategy to use for the orchestration of a specific type of ecosystem. Fourth, I demonstrate approaches that startups use to orchestrate these different types of ecosystems with limited resources. Again, these approaches can also serve as guidance for corporations as I generally show how startups orchestrate ecosystems. And lastly, by presenting startups as capable in the new role of orchestration, I open up a new research stream along these lines. Given the high degree of innovation in these ecosystems, the question of R&D costs becomes interesting. Since there is a consensus that innovation as R&D intensity has a positive effect on a company's performance, this leads me to my third sub-question:

Q3: Does the fact that companies claim to innovate in ecosystems or with partners have an influence on their R&D budgets?

I contribute to the literature on R&D expenses and innovation by introducing the findings of my third empirical study. Overall, my findings reveal that most STOXX Europe 50 firms engage in ecosystems to innovate. The overall mining analysis shows that in the word count, the terms 'partner' and 'innovation' are targeted the most. I was further able to identify an increasing trend for both dimensions (word count and R&D intensity). This means that the amount of R&D in relation to revenues increased as did the words related to ecosystems and innovation. This enhancement might be due to an awareness of innovation as a component that enables firms to stay competitive. Surprisingly, firms with the greatest spending on R&D show a rather low word count for ecosystems. More specifically, only three of the STOXX Europe 50 companies show a rather high positive development of the term 'ecosystem'. However, the matrix (Figure 25) in the third study (Chapter 4) reveals that the word count varies within different industries. As a result, there are also differences within industries regarding the R&D intensity.

5.2 Managerial Implications

In addition to my theoretical insights, my research is valuable for management practice. First, managers can benefit from several insights into ecosystem development and be informed about potential challenges that may arise when building an ecosystem. In this regard, I introduce three scenarios for practitioners when defining a joint value proposition as the first task of an orchestrator: (i) the orchestrator is able to define the value proposition from the beginning onward; (ii) the orchestrator starts with a vision of the future joint value proposition (iii); or the orchestrator can define a solution without a specific application in mind. Each situation requires different actions for the definition of the joint value proposition. Next, this process is followed by ecosystem implementation, which includes the search for potential partners. For this, it is important to consider the degree of co-specialization. The degree of co-specialization defines how much the partners need to learn from one another to modify their input towards the joint value proposition. Managers are advised to integrate the partner providing the key modules into the ecosystem first, as this will reduce the level of uncertainty for subsequent partners.

Second, my findings identify two key dimensions: (i) *value creation* indicates whether the orchestrator contributes any key module to the ecosystem or if the orchestrator simply builds and coordinates the ecosystem. In this regard, I was able to demonstrate that there is no need for startups to provide a core competency in the form of a key module to orchestrate an ecosystem successfully, as seen in archetype A and B. The second dimension, (ii) *type of ecosystem*, indicates that an ecosystem is either ‘customized’ or ‘standardized’. The former includes the value proposition and its partners, and the latter defines a generic solution and its partners. Based on these two dimensions, I introduce a framework that illustrates four different archetypes of startup-led ecosystem orchestrations. Hereby, the framework also highlights some challenges startups might face as orchestrators, seen in archetypes B and D. Beyond the managerial implications for startups, my findings might also be of value to corporate managers (e.g. SME managers). Especially with regards to resources, my research shows that, regardless of whether the orchestrator is a startup or not, the amount of resources necessary decreases with the degree of standardization of an ecosystem. This indicates that standardized ecosystems are better suited for startups or corporations with few members and that, conversely, customized ecosystems are better suited for companies that have greater resources at their disposal. On top of this, corporations have an additional decision-making basis for evaluating whether they should engage in a

startup-led ecosystem or not. Finally, the framework provided enables investors and accelerators to better assess startup-led ecosystems, and to evaluate whether a startup meets the conditions for successfully orchestrating an ecosystem.

Third, as previous literature offers limited guidance to managers about the impact of ecosystems on R&D costs, my research offers managers guidance for analyzing a firm's R&D and innovation levels. Overall, my findings reveal that most companies belonging to the STOXX Europe 50 Index cooperate with other companies in order to innovate. I am able to demonstrate that when a company is a partner within an ecosystem, the ecosystem has a positive effect on the company's R&D costs. In this regard, my findings demonstrate how fostering collaboration, i.e., building an ecosystem, offers firms an opportunity to increase their degree of innovation and therefore remain competitive in a fast-changing business environment. Additionally, an ecosystem can be developed without spending large amounts on R&D. Moreover, this study addresses the importance of how companies allocate their resources, such as R&D, alliances, and collaborations, to solve bottlenecks in their ecosystems.

Overall, my contribution to research offers empirical insights on ecosystem development, the role of startups as orchestrators, and the relationship of R&D intensity and innovation ecosystems. Best-practice management evaluations and decisions can be guided by my empirical findings for an organization's own ecosystem activities.

5.3 Future Research

The three studies within this dissertation relate to the orchestration of innovation in ecosystems (*Chapters 2, 3, 4*). They are characterized by a strong inductive and phenomenon-based research approach. Thereby, some topics have emerged that could be of great interest for future research. In the first study (*Chapter 2*), one case study demonstrated a very successful strategy of implementing new staff into an established company to ensure the knowledge overlap required for a high degree of co-specialization. This insight raises the first question for future research: How can the knowledge overlap required for high co-specialization be achieved in existing companies when the integration of new staff might be challenging to accomplish? Moreover, I hope that future research might address the emergence of ecosystems even more directly. Lastly, there is potential to rethink the existing perspectives on distant search, as I was able to show that ecosystems appear to be an effective vehicle for this type of search. In this vein, a stimulus question could be: Is it more unlikely or rare for an ecosystem to be established by distant search rather than by local search?

For my second study (*Chapter 3*), the question of how startups should enter the last phase of exit could be a thought-provoking question, since further research is needed concerning the exit strategies of orchestrating startups. Further, and more precisely, research could analyze how exactly a startup orchestrates an ecosystem (e.g. resource allocation). And lastly, a more detailed analysis of the types of orchestration could be conducted. For instance, what are the distinctions between the differently classified startups in my introduced framework?

The findings from my third study (*Chapter 4*), suggest four main implications for further research. First, the study was conducted for a variety of countries and industries, thus, future research could focus on a specific country or industry to illustrate the various trends for R&D intensity in different industries. Second, my findings need further evidence of exactly how innovation and competitive advantage can be achieved through ecosystems as a new form of collaboration. Third, this study gives some line of thought to extending the existing literature regarding the ecosystem establishment. Fourth, I propose utilizing a different method to measure the increase of the word count used.

5.4 Discussion

In recent years, interest in the ecosystem concept has grown. Yet research is still in its early stages, and there are questions and research gaps that need to be answered and explored. Therefore, this thesis focuses on three unexplored sub-questions that relate to the orchestration of innovation in ecosystems.

With my first study (*Chapter 2*), I contribute to the process of ecosystem development in general. I was able to extend the process-centric view of ecosystem creation introduced by Dattée et al. (2018). Whilst I focus on the same stage of development, I build my research upon a broader case sample to provide a more holistic approach. Dattée et al. (2018) found that an initially broad proto-vision crystalizes into a clear blueprint of interdependencies as mutual alignment within the ecosystem increases. However, I was able to identify decreasing significance for the blueprint with the development of an ecosystem. As a result, my findings highlight the importance of initial blueprint clarification in literature. Further, whilst Dattée et al. (2018) examine the influence and steering of the dynamic interdependencies and relationships within an ecosystem, I focus on the development of such interdependencies and relationships. In doing so, I provide a complementary viewpoint on the process of ecosystem development. Moreover, Jacobides et al. (2018) called for a better understanding of the

government of ecosystems and the fulfillment criteria of an orchestrator. My analysis sheds light on these two significant topics: It describes the process of search in great detail and discusses two different approaches (local and distant search) to searching for potential partners. Importantly, my analysis highlights how the degree of co-specialization is a fundamental influence on the governance of ecosystems in situations of distant search.

In the context of governance and orchestration, the literature has repeatedly claimed that young companies – *startups* – are not ideal for orchestrating ecosystems. Indeed, size and bargaining power might be helpful for ecosystem development and its coordination as this generates significant coordination efforts, development costs, and transaction costs for the orchestrator (Jacobides et al., 2018). In this vein, Skala (2019) also points out that this can be especially challenging for startups, given their limited resources. However, unlike the work of these scholars, the analysis of my second study (*Chapter 3*) was able to prove that startups can overcome significant challenges and can fulfill the characteristics to successfully orchestrate an ecosystem. I introduce four archetypes to offer value for startups and corporate organizations alike. The framework aims to provide guidance to help firms assess whether they are capable of orchestrating an ecosystem at hand and, importantly, demonstrates that startups can be considered as orchestrators.

Startups are closely associated with innovation, and as innovation is linked to ecosystems as a new form of partnership, my last study (*Chapter 4*) addresses the limitations given by scholars (Dattée et al., 2018; Jacobides et al., 2018; Jaruzelski et al., 2018; Madsen, 2020) regarding the implications of R&D and innovation on ecosystems. It provides firms with great insight into the establishing ecosystems without spending large amounts on R&D. Additionally, this study closes the gap to ecosystems, as several studies (e.g. ERI Scoreboard and the Global Innovation Index) have drawn attention to the importance of innovation and R&D, but have neglected to make the connection to ecosystems. My findings can be used as an orientation to analyze R&D and innovation and the impact on ecosystems, as several industries and countries are considered in my research. In this vein, my research highlights how building an ecosystem to constantly innovate and be competitive is possible with low investment in R&D.

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7 Appendix

7.1 Study-related Appendices

7.1.1 Study I (Chapter 2)

Interview Questionnaire 1: Business Ecosystem Development

Presentation of the definition of business ecosystems/ presentation of results of initial interviews with the goal of creating equal understanding

1. Creation of timeline
 - a. Temporal classification
 - i. From when to when was the ecosystem built?
 - ii. What were the milestones?
 - b. Classification of the main construction steps in the timeline (inclusive intermediate steps)
 - i. Actors: When were and how were actors integrated into business ecosystems?
 - ii. Activities: What has been done to ensure that business ecosystems can offer a value proposition (operational work)?
 - iii. Position: When and how were the roles and tasks of the individual actors defined?
 - iv. Links: When and how was exchange between the actors defined? (information, material, money, influence)
 - v. Value Proposition: What was done when and how to define the value proposition of the business ecosystem?
 - c. Classification of the key steps for building the business model
 - i. Value Capturing: How was it defined and determined?
 - ii. Value Creation: How was it defined and established?
 - iii. Customer: How was the customer defined and acquired?
 - d. Internal Organization
 - i. When and how were the strategy and objectives for business ecosystem defined?
 - ii. Was there an internal department for development? If so, who was involved (number/function of employees)?
 - iii. How has the organization changed over time (more/fewer employees/ distribution of tasks)?

- e. Contingencies
 - i. What were the objectives when the Business Ecosystem was set up?
 - ii. How did the uncertainty about the timing develop?
 - iii. What was the resource base for the construction and operation over the timeline?

Interview Questionnaire 2: Complementors in Business Ecosystems

1. Was the business ecosystem rebuilt or did it already exist at the time of joining?
 - a. Recognition
 - i. Do complementors recognize a business ecosystem?
 - ii. Does awareness of participation in a business ecosystem (complementor) change the relationship with the orchestrator or the negotiating position?
 - b. Partner search
 - i. How were the individual complementors identified/found?
 - ii. If complementor: how did one become aware of business ecosystem?
 - iii. How were roles defined in the business ecosystem?
 - iv. If available: what was the initial contribution/benefit ratio?
 - c. Accession
 - i. How has governance been dealt with? (Confidence versus contract (hard or soft))
 - ii. If available (investment/ M&A): how was the bond structured, and to what extent?
 - iii. What time horizon was agreed?
 - d. Participation
 - i. What is the relationship between the individual partners? (cooperative versus competitive)?
 - ii. How did the contribution/benefit ratio develop during the cooperation?
 - iii. What was the role of the individual complementors (participation versus extension)?
 - iv. Is there parallel participation in other business ecosystems?
 - v. What is the relationship with the orchestrator?
 - e. Perspective/Modification
 - i. In your opinion, what is the current perspective for the business ecosystem?

- ii. What is the motivation for a possible modification of the business ecosystem?
- iii. What are the other plans related to the business ecosystem?
- iv. What are exit conditions or what would exit conditions be?

Interview Questionnaire 2: Follow-Up Questions

1. Understanding Partners
 - a. How do I understand partner pain points?
 - i. If I have no knowledge of this field myself?
2. Planned or Iterative / Satisfying or Maximizing
 - a. Was the selection of partners (according to partner 1) planned or was iteratively searched (problemistic)?
 - b. Was the first available partner (satisfying) or the true BEST partner (maximizing) searched and selected?
3. Value Propositions
 - a. Are value propositions mostly pain points which arise from cooperation with partners or own experience?
4. Partner Search
 - a. How were partners convinced to participate in the business ecosystem? Value proposition? “Big Picture”? Opportunity?
 - b. Are value proposition partners added to the ecosystem first and then sales partners?
 - c. Why are sales partners integrated into the ecosystem last or late? If rather: Does a sales partner also contribute to the value proposition?
 - d. Why is the customer not the focus of a business ecosystem (usually sales partner first)? Is there a presumption of superior Value Proposition that customers will accept?
5. Is the clock ticking after the conclusion of the contract with partner 1, because partners are at risk of jumping ship after a certain time?
6. If partner 1 is integrated, do I already need a plan for the other partners?
7. How do I search in *distant search* situations?
8. If I have a search partner: Do I have this permanently or do I learn by project progress and the search partner is eventually eliminated?
9. Is there a specific *search partner path*?

10. How are search partners remunerated/incentivized? Interested in value proposition? Money? Equity?

- a. Is there a possible downside?

11. Big Picture

- a. Can I only share the Big Picture of the business ecosystem if I contribute to the value proposition?

12. Attentional Capacity

- a. Since attentional capacity is limited:
 - i. What happens after Partner 1?
 - ii. Are you searching and working in parallel?
 - iii. Is search done exclusively by you and work by the partners, or are you exclusively working?
 - iv. Is a hybrid form bad for success?
 - v. If not, how can a hybrid form be successful? Through a good plan/big picture?

7.1.2 Study II (Chapter 3)

Interview Questionnaire 4: Startups as Orchestrators of Ecosystems

Let's choose together an ecosystem you are involved in. An ecosystem has the following characteristics:

- At least 3 partners who together provide a service to the customer that a single partner could not provide
- The partners jointly provide the service to the customer
- Diverse interdependence between the partners

Goals - How do you achieve your goals in the ecosystem context?

1. What are your goals as a young company? (e.g. growth, financing, technology development, profitability, exit etc.)
2. How do you plan to achieve each of these goals?
3. Why are you doing this? What are the reasons for this due to the ecosystem?

Orchestrator - How a startup fulfills the role of an orchestrator

1. Why are you an orchestrator & why does none of the partners have this role?
2. What influence does your orchestrator role have on the goals?

Goals in general – What are your goals as a startup?

- a. Scaling
 - i. How and why has scaling been achieved so far?
 - ii. What role do the partners play in scaling?
- b. Financing
 - i. What type of financing has been chosen so far?
 - ii. Why was this funding chosen? Does the ecosystem/partner have an influence?
- c. Development of technology
 - i. What is the process of technology development?
 - ii. What role do the partners play in technology development?
- d. Exit
 - i. What type of exit is intended (secondary, trade sale, IPO)
 - ii. Why this kind?
 - iii. What role do Ecosystem partners play in an exit?

Interview Questionnaire 5: Follow-Up Questions

Startup as Orchestrator

1. How does a Startup manage to orchestrate despite low resources?
2. What does the initial phase look like, where do I focus the greatest resources?
(after all partners have agreed)
3. What were the focal points you set? How has the focus changed over time?
→ Challenge as startup through specifics (Corporates expect performance)
4. What are Pain Points? Startup-specific or business ecosystem topic? Question statements by asking: What is the problem? Startup problem? Business ecosystem problem? Both of which are reinforced by business ecosystem?
5. Individual financing rounds? More or less financing through business ecosystems? Smart money or just cash?
6. More or less financing needs because of business ecosystems?
7. Query dimensions of the matrix (scale 0-3).
8. How generic were the modules?
9. Is a startup the orchestrator because modules are not generic?
10. Is a startup the orchestrator for competitive reasons (generic modules)?

Figure 26: Sketch Factoring case

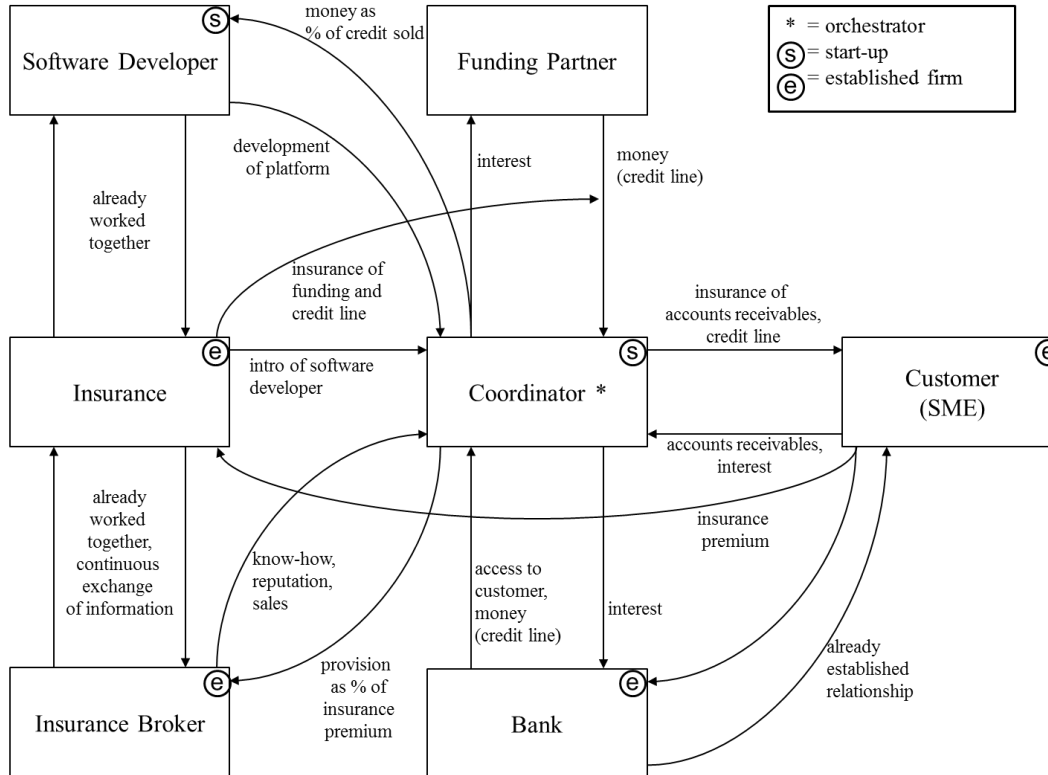


Figure 27: Sketch Sports case

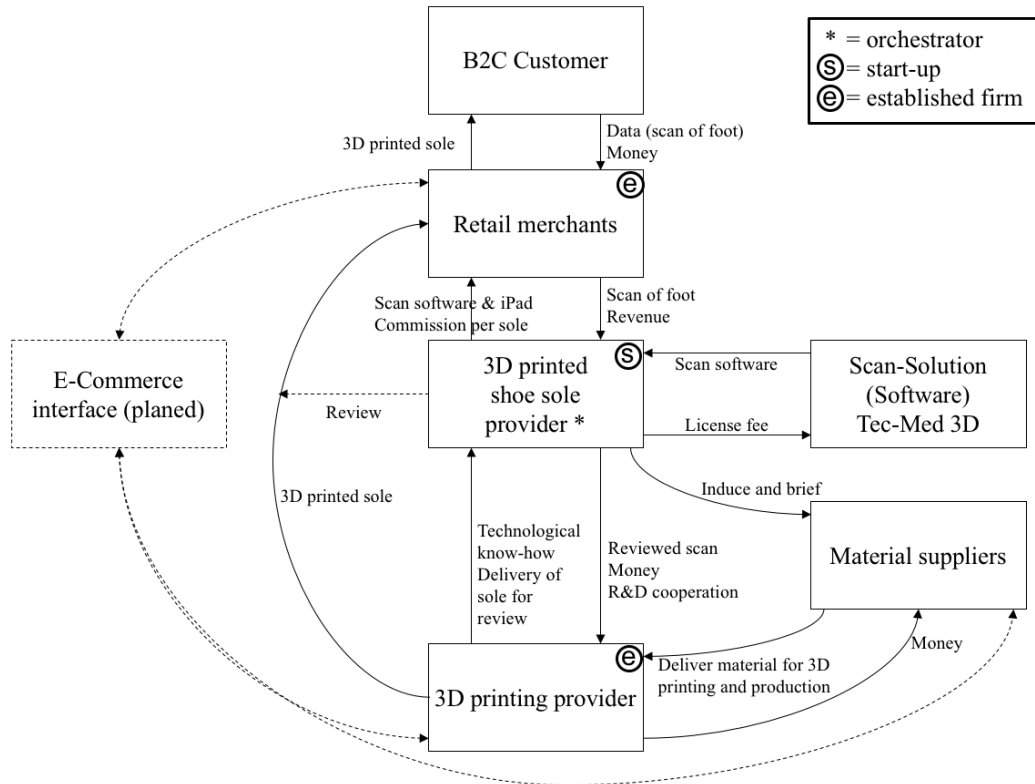


Figure 28: Sketch InsurTech case

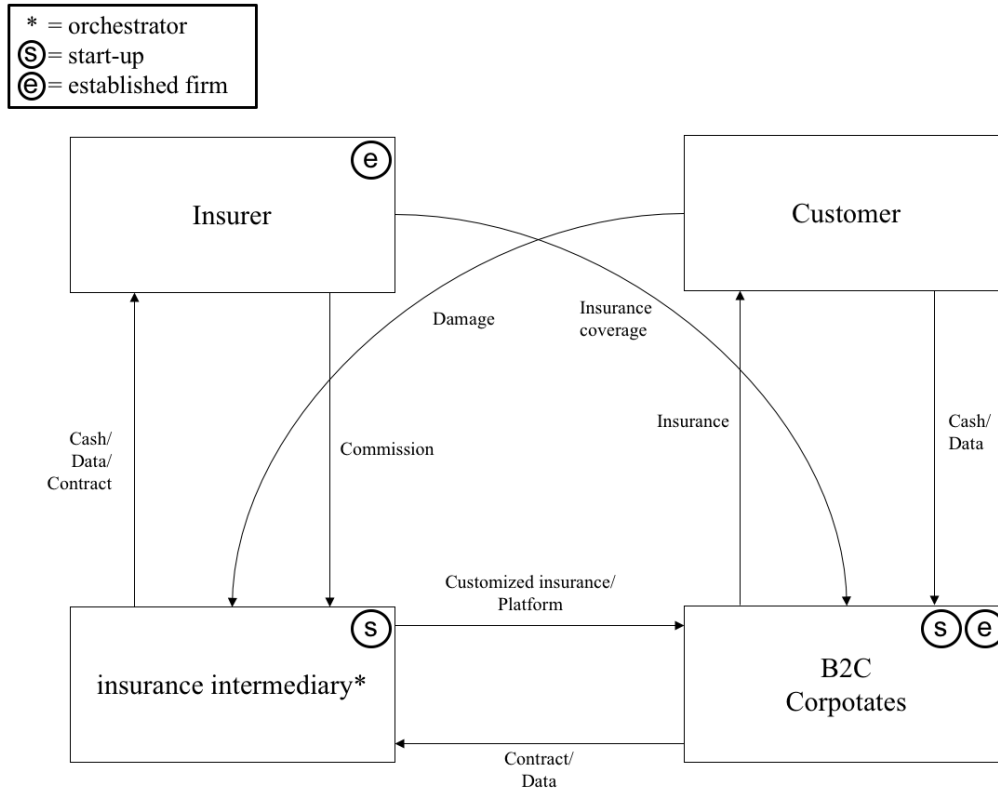


Figure 29: Sketch Move case

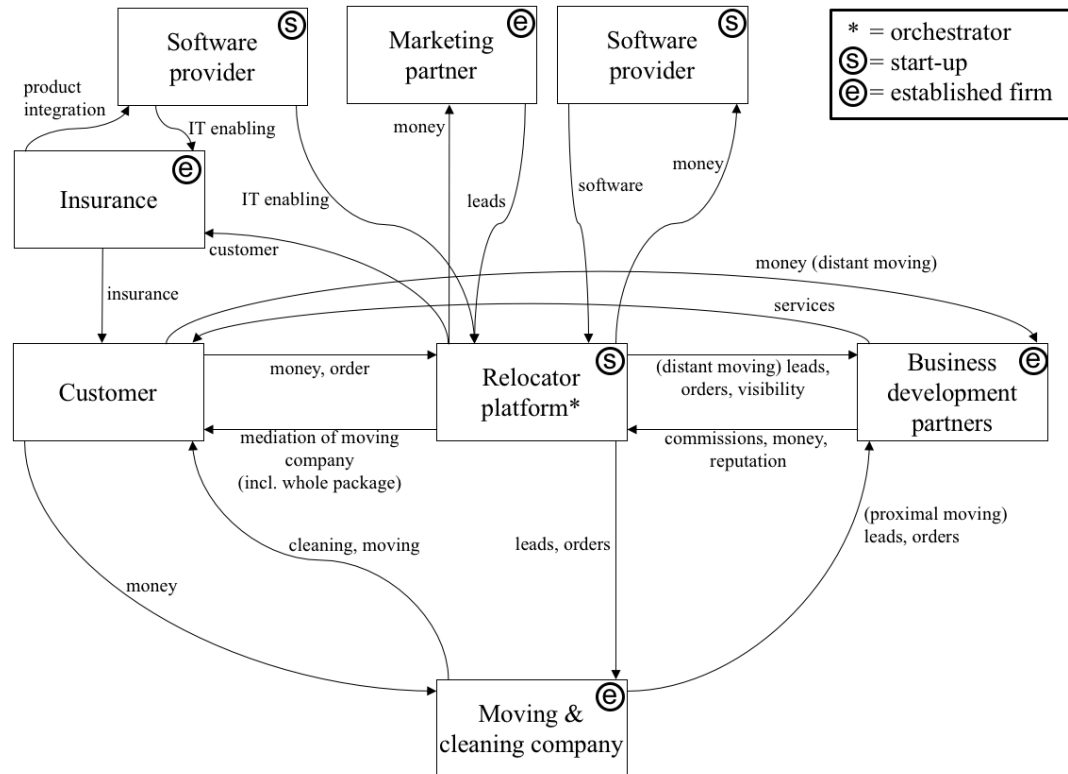


Figure 30: Sketch Share case

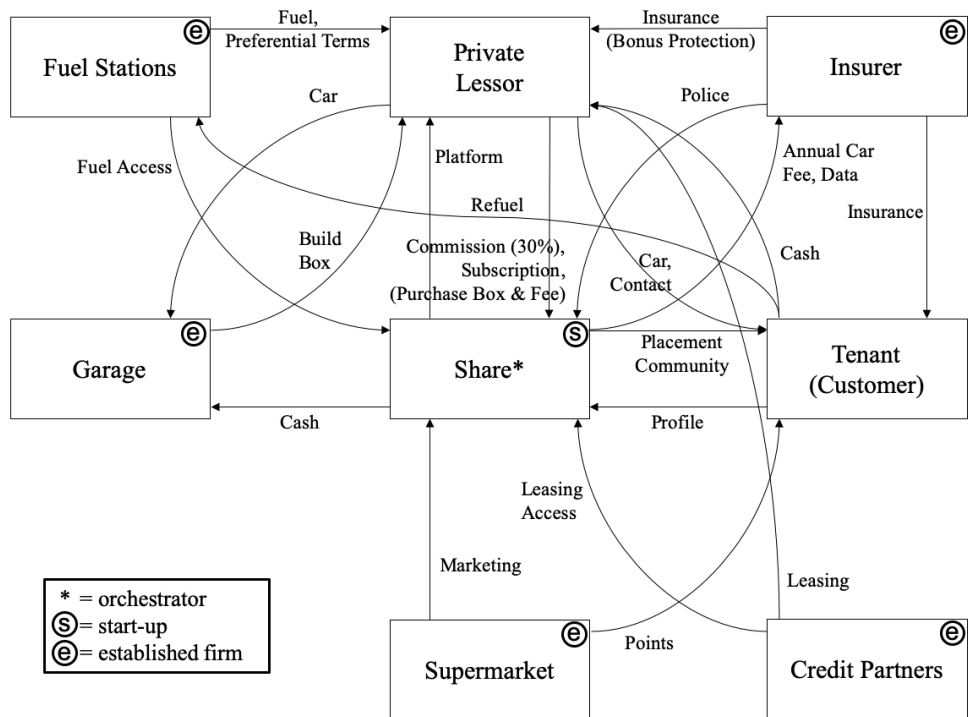


Figure 31: Sketch Maintenance Analytics case

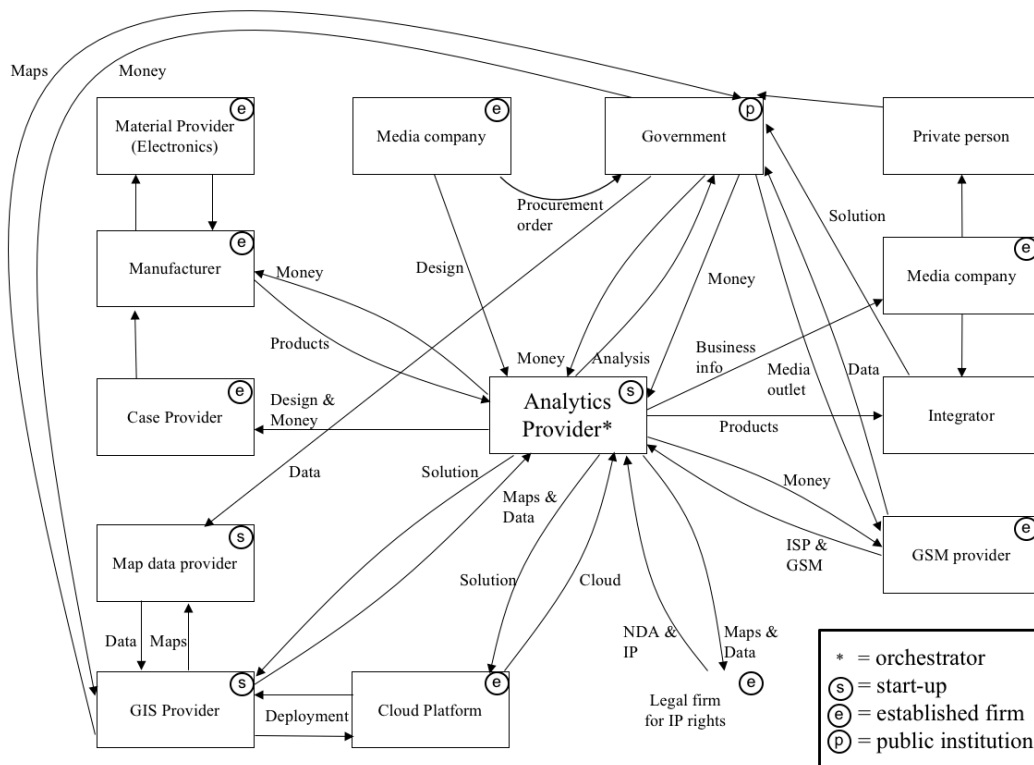
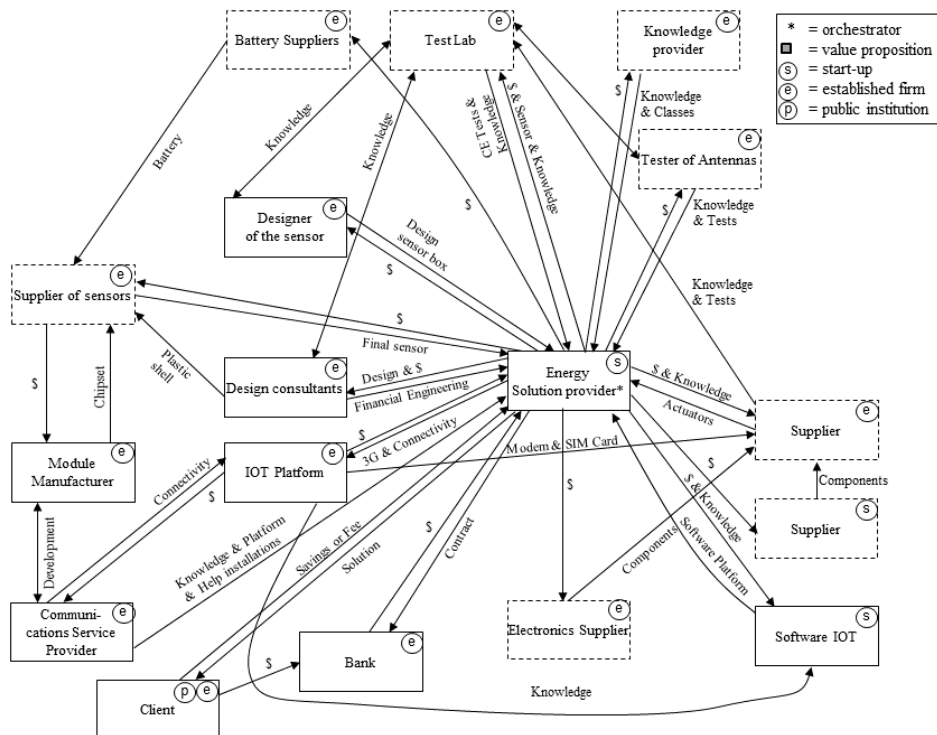


Figure 32: Sketch Smart Building case



--- indicates that it is a supplier and is no actor with an unique module

Figure 33: Sketch Visualization case

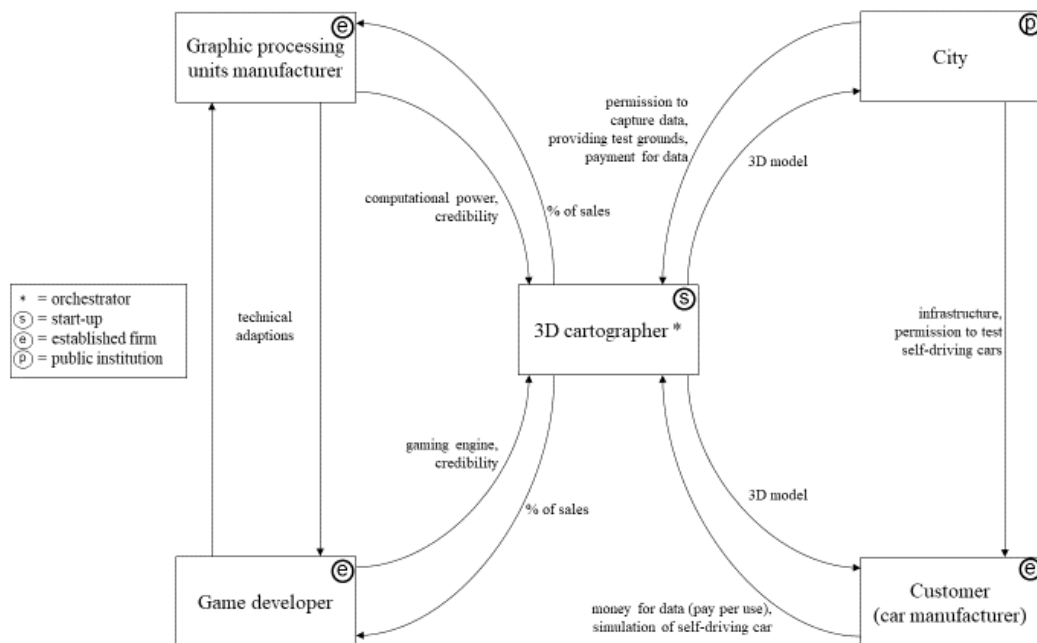
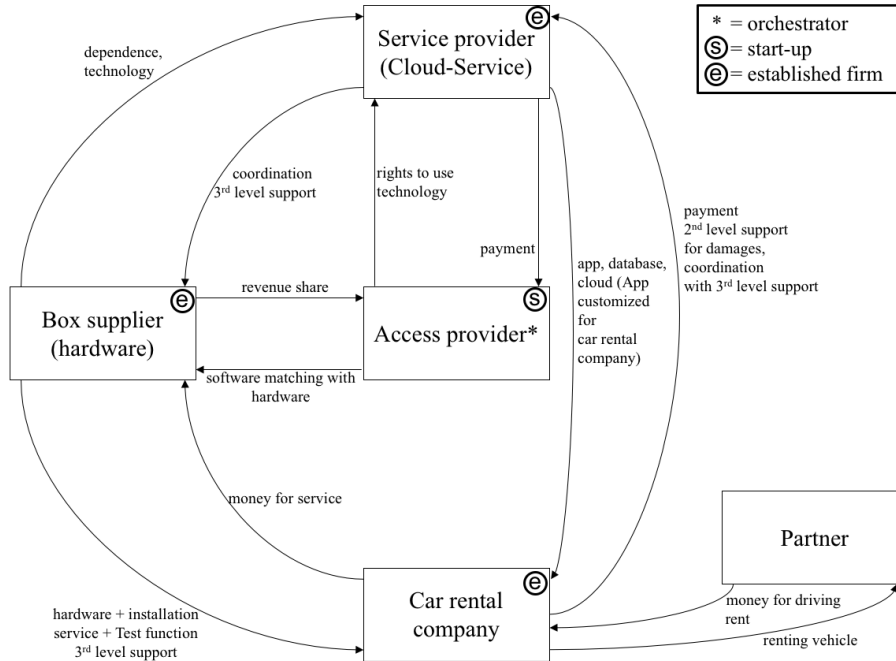


Figure 34: Sketch Access case



7.1.3 Study III (Chapter 4)

Table 12: Data about R&D intensity

	Revenues (Million)							R&D Expenditures (Million)							R&D Intensity						
Name	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR
AB INBEV	43195	47063	43604	45517	56444	54619	4,81%	185	217	207	244	276	285	9,03%	0,43%	0,46%	0,47%	0,54%	0,49%	0,52%	4,03%
ABB	41848	39830	35481	33828	25196	27662	-7,95%	1470	1499	1406	1300	1013	1147	-4,84%	3,51%	3,76%	3,96%	3,84%	4,02%	4,15%	3,37%
ADIDAS	14203	14534	16915	19291	21218	21915	9,06%	124	126	139	164	187	153	4,29%	0,87%	0,87%	0,82%	0,85%	0,88%	0,70%	-4,37%
AIR LIQUIDE	15225,2	15358	16379	18134,8	20349,3	21011	6,65%	264,8	215	191,1	202	184	277	0,90%	1,74%	1,40%	1,17%	1,11%	0,90%	1,32%	-5,39%
AIRBUS	59256	60713	64450	66581	59022	63707	1,46%	3160	3391	3460	3000	2800	3200	0,25%	5,33%	5,59%	5,37%	4,51%	4,74%	5,02%	-1,19%
ALLIANZ	98967	100399	107062	107718	107395	102958	0,79%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
ASML HOLDING	5245,32 6	5856,27 7	6287,37 5	6794,75 2	8962,7	10944	15,85%	882,029	1074,03 5	710,161	718,793	898,9	1347	8,84%	16,82%	18,34%	11,30%	10,58%	10,03%	12,31%	-6,05%
ASTRAZEN ECA	25711	26547	24708	23002	22465	22090	-2,99%	4821	5579	5997	5890	5757	5932	4,23%	18,75%	21,02%	24,27%	25,61%	25,63%	26,85%	7,45%
AXA	119829	117169	110424	121136	132592	106407	-2,35%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
BANCO SANTANDE R	72976	75046	74920	72578	74326	72849	-0,03%	na	na	na	na	na	1468	na	na	na	na	na	na	2,02%	na
BASF	73973	74326	70449	57550	61223	62675	-3,26%	1849	1884	1953	1863	1843	2028	1,87%	2,50%	2,53%	2,77%	3,24%	3,01%	3,24%	5,30%
BAYER	40157	41339	46085	34943	35015	39586	-0,29%	3406	3537	4274	4405	4504	5246	9,02%	8,48%	8,56%	9,27%	12,61%	12,86%	13,25%	9,34%

	Revenues (Million)							R&D Expenditures (Million)							R&D Intensity						
Name	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR
BNP PARIBAS	59846	62829	67486	67492	59049	60895	0,35%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
BP	379136	353568	222894	183008	240208	298756	-4,65%	707	663	418	400	391	429	-9,51%	0,19%	0,19%	0,19%	0,22%	0,16%	0,14%	-5,09%
BRITISH AMERICAN TOBACCO	15260	13971	13104	14751	19564	24492	9,92%	91	74	60	53	80	105	2,90%	0,60%	0,53%	0,46%	0,36%	0,41%	0,43%	-6,39%
DAIMLER	117982	129872	149467	153261	164154	167362	7,24%	5489	5680	6564	7572	8711	9107	10,66%	4,65%	4,37%	4,39%	4,94%	5,31%	5,44%	3,18%
DEUTSCHE TELEKOM	60132	62658	69228	73095	74947	75656	4,70%	97	95,6	108,1	84,1	57,7	57,7	-9,87%	0,16%	0,15%	0,16%	0,12%	0,08%	0,08%	-13,91%
DIAGEO	11303	10258	10813	10485	12050	12163	1,48%	21	24	26	28	33	36	11,38%	0,19%	0,23%	0,24%	0,27%	0,27%	0,30%	9,76%
ENEL	75427	73328	73076	68604	72664	73134	-0,62%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
ENI	114697	93187	72286	55762	66919	75822	-7,94%	122	134	176	161	185	197	10,06%	0,11%	0,14%	0,24%	0,29%	0,28%	0,26%	19,56%
GLAXOSMITH	26505	23006	23923	27889	30186	30821	3,06%	3923	3450	3560	3628	4476	3893	-0,15%	14,80%	15,00%	14,88%	13,01%	14,83%	12,63%	-3,12%
HSBC	83837	81086	77769	63459	67306	76324	-1,86%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
IBERDROLA	31077,112	30032,27	31418,693	28759,148	31263,262	35075,873	2,45%	159	170	200	211	246	267	10,92%	0,51%	0,57%	0,64%	0,73%	0,79%	0,76%	8,27%
ING GROEP	55932	52285	51206	49492	48994	33326	-9,84%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
INTESA SAN PAOLO	36545	44264		32933	37290	33430	-1,77%	na	na	na	na	na	na	na	na	na	na	na	na	na	na

	Revenues (Million)							R&D Expenditures (Million)							R&D Intensity						
Name	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR
L'OREAL	22124,2	22532	24290,2	24916,3	26023,7	26937,4	4,02%	748,3	760,6	794,1	849,8	877,1	914,4	4,09%	3,38%	3,38%	3,27%	3,41%	3,37%	3,39%	0,07%
LINDE PLC	16655	17047	17944	16948	17113	14900	-2,20%	92	106	132	121	112	123	5,98%	0,55%	0,62%	0,74%	0,71%	0,65%	0,83%	8,37%
LLOYDS BANK	33645	26320	25163	25970	25129	22956	-7,36%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
LVMH	29016	30638	35664	37600	42636	46826	10,04%	71	79	97	111	130	130	0,12859 2086	0,24%	0,26%	0,27%	0,30%	0,30%	0,28%	2,56%
NATIONAL GRID	14359	14809	15201	13212	15035	15250	1,21%	15	12	23	19	14	13	-2,82%	0,10%	0,08%	0,15%	0,14%	0,09%	0,09%	-3,98%
NESTLE	92158	91612	88785	89469	89590	91439	-0,16%	1503	1628	1678	1736	1739	1687	2,34%	1,63%	1,78%	1,89%	1,94%	1,94%	1,84%	2,50%
NOVARTIS	52716	53634	50387	49436	50135	53166	0,17%	9071	9086	8935	9039	8972	9074	0,01%	17,21%	16,94%	17,73%	18,28%	17,90%	17,07%	-0,16%
NOVO	83572	88806	107927	111780	111696	111831	6,00%	11733	13762	13608	14563	14014	14805	4,76%	14,04%	15,50%	12,61%	13,03%	12,55%	13,24%	-1,17%
PRUDENTIAL	52375	60126	41305	71842	86562	26846	-12,51%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
RECKITT	9266	8836	8874	9480	11449	12597	6,33%	152	146	140	149	187	223	7,97%	1,64%	1,65%	1,58%	1,57%	1,63%	1,77%	1,54%
RELX PLC	6035	5773	5971	6889	7341	7492	4,42%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
RIO TINTO	51171	47664	34829	33781	40030	40522	-4,56%	231	112	104	60	58	45	-27,90%	0,45%	0,23%	0,30%	0,18%	0,14%	0,11%	-24,46%
ROCHE	46780	47462	48145	50576	53299	56846	3,97%	9270	9895	9581	11532	11292	12092	5,46%	19,82%	20,85%	19,90%	22,80%	21,19%	21,27%	1,43%

	Revenues (Million)							R&D Expenditures (Million)							R&D Intensity						
Name	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR	2013	2014	2015	2016	2017	2018	CAGR
SAFRAN	14158	15044	16222	16482	16376	21025	8,23%	672	898	832	867	980	1124	10,84%	4,75%	5,97%	5,13%	5,26%	5,98%	5,35%	2,41%
SANOFI	33306	31999	34861	34708	36221	35677	1,38%	4770	4667	5082	5172	5472	5894	4,32%	14,32%	14,58%	14,58%	14,90%	15,11%	16,52%	2,90%
SAP	16815	17560	20793	22062	23461	24707	8,00%	2282	2331	2845	3044	3352	3624	9,69%	13,57%	13,27%	13,68%	13,80%	14,29%	14,67%	1,57%
SCHNEIDER ELECTRIC	23392	24939	26640	24459	24743	25720	1,92%	1119	922	937	1209	1183	1299	3,03%	4,78%	3,70%	3,52%	4,94%	4,78%	5,05%	1,09%
SHELL	451235	421105	264960	233591	305179	388379	-2,96%	1318	1222	1093	1014	922	986	-5,64%	0,29%	0,29%	0,41%	0,43%	0,30%	0,25%	-2,77%
SIEMENS	30305	30394	26454	25763	26888	28185	-1,44%	2878	2781	2417	2454	2619	2788	-0,63%	9,50%	9,15%	9,14%	9,53%	9,74%	9,89%	0,82%
TOTAL	227969	212018	143421	127925	149099	184106	-4,18%	949	1245	980	1050	912	986	0,77%	0,42%	0,59%	0,68%	0,82%	0,61%	0,54%	5,17%
UBS	39910,7 558	39934,5 066	40411,9 077	37960,7 331	39204,8 232	43316	1,65%	na	na	na	na	na	na	na	na	na	na	na	na	na	na
UNILEVER	49797	48436	53272	52713	53715	50982	0,47%	1040	955	1005	978	900	900	-2,85%	2,09%	1,97%	1,89%	1,86%	1,68%	1,77%	-3,31%
VINCI	40740	39043	39161	38073	40248	43159	1,16%	51	48	50	50	50	na	na	0,13%	0,12%	0,13%	0,13%	0,12%	na	-0,15%
VODAFONE	46709,7 252	45467,8 364	58326,0 7	49810	47631	46571	-0,06%	376,958 7	253,745 3	253,745 3	0	0	0	- 100,00 %	0,81%	0,56%	0,44%	0,00%	0,00%	0,00%	-11,62%
ZURICH	72033	72781	60529	67328	64043	47204	-8,11%	na	na	na	na	na	na	na	na	na	na	na	na	na	na

Table 13: Word count

		Ecosystem					R&D / Innovation						
Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
ABB	2013	0	2	10	11		34	9	3	0	11		
ABB	2014	0	1	10	24		36	7	3	4	8		
ABB	2015	1	2	12	28		44	10	2	1	39		
ABB	2016	1	2	15	34		47	10	2	2	7		
ABB	2017	0	1	5	19		38	5	2	0	7		
ABB	2018	0	1	6	23		46	8	3	3	12		
	RGP	-6,63485E-18	-0,142857143	-0,914285714	1,457142857		1,971428571	-0,314285714	-0,085714286	0,114285714	-0,857142857		
	Value					0,1						0,165714286	0,265714286
ADIDAS	2013	0	2	22	99		55	20	11	3	82		
ADIDAS	2014	0	2	19	84		38	19	7	4	62		
ADIDAS	2015	8	0	34	102		32	15	5	4	58		
ADIDAS	2016	8	0	34	90		19	19	3	5	32		
ADIDAS	2017	11	0	40	108		29	30	4	3	46		
ADIDAS	2018	10	2	42	142		35	25	5	3	70		
	RGP	2,371428571	-0,171428571	4,657142857	7,857142857		-4	1,771428571	-1,171428571	-0,057142857	-3,828571429		
	Value					3,678571429						-1,457142857	2,221428571
AIRBUS	2013	0	0	0	3		0	2	0	0	0		
AIRBUS	2014	0	0	0	5		2	3	0	0	0		
AIRBUS	2015	1	0	5	51		44	10	4	3	39		
AIRBUS	2016	1	1	7	47		40	10	2	2	24		
AIRBUS	2017	6	1	5	60		32	15	1	3	33		
AIRBUS	2018	2	2	5	68		36	14	1	3	35		
	RGP	0,8	0,4	1,2	13,88571429		7,6	2,742857143	0,171428571	0,657142857	7,4		
	Value					4,071428571						3,714285714	7,785714286

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
AIRLIQUIDE	2013	7	0	3	46		26	23	34	2	66		
AIRLIQUIDE	2014	12	1	4	46		33	21	34	4	75		
AIRLIQUIDE	2015	8	0	7	50		41	31	31	3	73		
AIRLIQUIDE	2016	10	0	5	53		52	28	30	3	91		
AIRLIQUIDE	2017	13	0	7	59		39	30	25	4	74		
AIRLIQUIDE	2018	14	0	3	53		34	32	21	3	67		
	RGP	1,142857143	-0,085714286	0,2	2,2		1,971428571	1,971428571	-2,657142857	0,142857143	0,571428571		
	Value					0,864285714						0,4	1,264285714
ALLIANZ	2013	0	1	1	18		6	15	0	1	5		
ALLIANZ	2014	0	2	1	31		10	16	0	1	6		
ALLIANZ	2015	0	0	0	19		8	13	0	1	6		
ALLIANZ	2016	0	0	0	2		1	10	0	1	0		
ALLIANZ	2017	0	0	1	6		3	10	0	0	2		
ALLIANZ	2018	0	0	0	11		7	15	0	0	8		
	RGP	0	-0,314285714	-0,142857143	-3,628571429		-0,657142857	-0,6	0	-0,228571429	-0,085714286		
						-1,021428571						-0,314285714	-1,335714286
ASML	2013	0	0	0	20		100	7	30	0	3		
ASML	2014	0	0	0	20		99	8	61	0	2		
ASML	2015	0	0	1	31		109	10	64	0	4		
ASML	2016	1	0	0	19		108	12	46	0	2		
ASML	2017	2	1	8	30		155	34	46	7	39		
ASML	2018	2	2	11	35		178	39	22	9	42		
	RGP	0,485714286	0,371428571	2,228571429	2,657142857		15,91428571	6,857142857	-2,942857143	1,885714286	8,685714286		
	Value					1,435714286						6,08	7,515714286

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
AXA	2013	0	0	2	27		0	27	2	1	4		
AXA	2014	0	1	2	37		2	25	2	1	5		
AXA	2015	0	0	2	66		7	27	2	0	6		
AXA	2016	1	0	1	65		13	32	3	1	11		
AXA	2017	1	1	2	69		13	33	4	5	18		
AXA	2018	2	3	5	104		13	33	4	6	22		
	RGP	0,4	0,428571429	0,4	13,71428571		2,971428571	1,685714286	0,485714286	1,085714286	3,828571429		
	Value					3,735714286						2,011428571	5,747142857
AZ	2013	0	0	81	57		42	17	210	0	57		
AZ	2014	0	0	79	51		57	16	178	0	45		
AZ	2015	0	0	113	53		49	13	200	0	42		
AZ	2016	0	0	83	72		45	14	166	0	33		
AZ	2017	0	0	94	73		45	20	184	0	34		
AZ	2018	0	0	76	77		46	17	167	2	26		
	RGP	0	0	-0,285714286	5,285714286		-0,571428571	0,371428571	-6,6	0,285714286	-5,628571429		
	Value					1,25						-2,428571429	-1,178571429
BASF	2013	6	0	10	50		88	17	12	3	42		
BASF	2014	6	0	9	69		76	22	11	4	42		
BASF	2015	9	0	17	96		72	30	26	3	62		
BASF	2016	4	1	15	72		49	27	22	6	49		
BASF	2017	0	1	13	81		47	23	15	5	48		
BASF	2018	0	1	10	77		51	23	17	7	70		
	RGP	-1,514285714	0,257142857	0,285714286	4,2		-8,428571429	0,857142857	0,942857143	0,742857143	4,142857143		
	Value					0,807142857						-0,348571429	0,458571429

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	trend innovation	Consolidated trend word count
BAT	2013	0	0	2	19		11	18	0	0	29		
BAT	2014	0	1	1	11		8	19	0	0	22		
BAT	2015	0	1	4	17		8	20	0	0	22		
BAT	2016	0	0	2	9		10	14	0	0	21		
BAT	2017	0	0	2	21		10	18	10	0	15		
BAT	2018	0	0	3	29		16	30	10	0	34		
	RGP	0	-0,114285714	0,171428571	2,057142857		0,942857143	1,457142857	2,285714286	0	0,085714286		
	Value					0,528571429						0,954285714	1,482857143
BAYER	2013	1	0	40	77		61	20	78	4	52		
BAYER	2014	0	0	59	67		46	16	69	4	41		
BAYER	2015	3	0	47	72		28	15	64	5	64		
BAYER	2016	3	0	40	72		23	17	57	3	68		
BAYER	2017	3	0	35	74		30	16	63	3	75		
BAYER	2018	1	0	48	58		35	13	73	3	80		
	RGP	0,257142857	0	-1,114285714	-2,114285714		-5,228571429	-0,942857143	-1,428571429	-0,285714286	7,028571429		
	Value					-0,742857143						-0,171428571	-0,914285714
BMW	2013	0	0	4	25		23	8	0	0	19		
BMW	2014	0	0	4	29		32	9	0	0	16		
BMW	2015	0	0	3	33		26	11	0	0	17		
BMW	2016	0	0	6	29		26	16	0	0	20		
BMW	2017	0	0	5	31		21	22	0	0	19		
BMW	2018	2	0	8	37		26	24	0	1	17		
	RGP	0,285714286	0	0,742857143	1,771428571		-0,514285714	3,542857143	0	0,142857143	0,057142857		
	Value					0,7						0,645714286	1,345714286

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
BNP	2013	3	0	8	69		2	22	1	0	8		
BNP	2014	2	4	7	75		4	26	1	0	15		
BNP	2015	7	3	8	92		8	24	1	0	33		
BNP	2016	6	3	4	106		8	29	1	1	31		
BNP	2017	9	1	2	92		18	32	1	0	29		
BNP	2018	11	0	8	80		25	37	1	0	31		
	RGP	1,714285714	-0,257142857	-0,542857143	3,428571429		4,485714286	2,8	0	0,028571429	4,428571429		
	Value					1,085714286						2,348571429	3,434285714
BP	2013	2	0	3	78		96	22	4	1	6		
BP	2014	1	0	6	75		80	19	4	1	4		
BP	2015	0	0	3	82		87	25	7	1	6		
BP	2016	0	0	8	89		94	26	7	1	9		
BP	2017	0	0	9	94		105	22	7	1	9		
BP	2018	0	0	8	91		96	33	5	1	5		
	RGP	-0,371428571	0	1,114285714	3,685714286		2,342857143	1,857142857	0,4	0	0,371428571		
	Value					1,107142857						0,994285714	2,101428571
DAIMLER	2013	0	0	0	67		66	9	5	0	22		
DAIMLER	2014	0	0	1	71		67	15	5	0	29		
DAIMLER	2015	0	0	0	60		70	12	9	1	39		
DAIMLER	2016	5	0	1	71		64	13	10	1	43		
DAIMLER	2017	15	0	2	93		74	26	7	2	43		
DAIMLER	2018	8	0	0	98		66	26	4	1	38		
	RGP	2,571428571	0	0,114285714	6,628571429		0,428571429	3,4	0,057142857	0,314285714	3,6		
	Value					2,328571429						1,56	3,888571429

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
DIAGEO	2013	0	0	5	50		10	7	2	0	67		
DIAGEO	2014	0	0	3	58		2	8	0	0	34		
DIAGEO	2015	0	0	2	35		4	10	0	0	41		
DIAGEO	2016	1	0	4	46		5	9	0	0	32		
DIAGEO	2017	1	0	6	56		3	10	0	0	29		
DIAGEO	2018	2	0	5	52		12	14	0	0	20		
	RGP	0,4	0	0,314285714	0,428571429		0,4	1,142857143	-0,285714286	0	-7,4		
	Value					0,285714286						-1,228571429	-0,942857143
ENEL	2013	2	0	4	18		24	5	2	0	19		
ENEL	2014	2	0	2	21		20	5	6	0	13		
ENEL	2015	2	0	7	17		27	8	5	0	22		
ENEL	2016	5	0	7	20		28	5	6	0	25		
ENEL	2017	6	0	13	30		38	11	7	1	23		
ENEL	2018	4	0	5	19		22	6	5	0	17		
	RGP	0,714285714	0	1,085714286	1		1,285714286	0,571428571	0,542857143	0,085714286	0,657142857		
	Value	-	-	-	-	0,7	-	-	-	-	-	0,628571429	1,328571429
ENI	2013	9	0	8	48		28	19	14	2	8		
ENI	2014	3	0	5	33		23	2	21	0	6		
ENI	2015	2	0	5	27		12	1	10	0	6		
ENI	2016	2	0	1	26		11	2	2	0	8		
ENI	2017	4	0	6	38		20	5	4	1	7		
ENI	2018	15	0	11	73		16	7	9	0	7		
	RGP	0,942857143	0	0,4	3,971428571		-2	-1,428571429	-2,4	-0,2	0		
	Value					1,328571429						-1,205714286	0,122857143

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	trend innovation	Consolidated trend word count
GSK	2013	2	0	22	56		16	34	135	0	29		
GSK	2014	0	0	15	42		15	41	111	0	27		
GSK	2015	0	0	14	49		17	32	90	0	33		
GSK	2016	0	0	20	44		25	36	119	0	38		
GSK	2017	0	0	15	49		31	32	71	0	39		
GSK	2018	0	0	26	73		37	28	53	0	50		
	RGP	-0,285714286	0	0,742857143	2,885714286		4,6	-1,514285714	-14,31428571	0	4,171428571		
	Value					0,835714286						-1,411428571	-0,575714286
HSBC	2013	0	0	31	11		14	24	0	0	5		
HSBC	2014	0	0	21	17		9	23	0	1	2		
HSBC	2015	0	0	6	38		27	26	0	0	1		
HSBC	2016	0	0	3	24		33	13	0	0	4		
HSBC	2017	0	0	4	30		19	9	0	1	5		
HSBC	2018	0	0	5	34		31	9	0	1	7		
	RGP	0	0	-5,257142857	4		3,457142857	-3,714285714	0	0,142857143	0,628571429		
	Value					-0,314285714						0,102857143	-0,211428571
IBERDROLA	2013	1	0	2	0		7	1	0	0	5		
IBERDROLA	2014	1	0	2	0		7	1	0	0	5		
IBERDROLA	2015	2	0	2	1		10	4	0	0	7		
IBERDROLA	2016	2	0	2	0		6	5	0	1	9		
IBERDROLA	2017	3	0	3	1		10	6	0	1	17		
IBERDROLA	2018	3	0	6	6		7	6	0	1	21		
	RGP	0,457142857	0	0,657142857	0,914285714		0,142857143	1,171428571	0	0,257142857	3,371428571		
	Value					0,507142857						0,988571429	1,495714286

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	trend innovation	Consolidated trend word count
INBEV	2013	0	0	1	6		5	3	1	0	11		
INBEV	2014	0	0	1	2		6	3	1	0	12		
INBEV	2015	0	0	2	28		12	7	1	0	26		
INBEV	2016	0	0	4	17		9	4	1	0	16		
INBEV	2017	1	0	3	44		16	9	1	0	23		
INBEV	2018	0	0	1	4		5	3	1	0	11		
	RGP	0,085714286	0	0,228571429	3		0,771428571	0,428571429	0	0	0,657142857		
	Value					0,828571429						0,371428571	1,2
INDITEX	2013	0	0	0	0		0	0	0	0	0		
INDITEX	2014	1	0	42	14		13	30	0	1	14		
INDITEX	2015	0	0	0	0		0	0	0	0	1		
INDITEX	2016	2	0	55	28		23	37	0	2	21		
INDITEX	2017	6	0	86	32		19	45	0	1	21		
INDITEX	2018	7	0	108	39		67	58	0	1	38		
	RGP	1,485714286	0	20,77142857	7,914285714		10,74285714	10,62857143	0	0,2	6,6		
	Value					7,542857143						5,634285714	13,17714286
ING	2013	0	1	11	32		25	17	5	0	9		
ING	2014	0	0	10	23		31	30	5	3	40		
ING	2015	0	1	9	35		18	25	5	1	61		
ING	2016	10	6	5	35		27	26	6	0	56		
ING	2017	4	1	10	51		22	29	5	0	41		
ING	2018	3	4	13	44		24	30	5	5	72		
	RGP	1,057142857	0,657142857	0,171428571	4,114285714		-0,657142857	1,8	0,028571429	0,428571429	8,942857143		
	Value					1,5						2,108571429	3,608571429

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	trend innovation	Consolidated trend word count
ISP	2013	1	0	17	37		18	14	1	2	17		
ISP	2014	1	0	10	36		20	6	0	2	34		
ISP	2015	1	0	16	23		15	6	0	2	29		
ISP	2016	3	0	14	28		19	14	0	5	47		
ISP	2017	3	0	8	26		23	18	1	5	43		
ISP	2018	2	0	23	49		22	16	0	4	36		
	RGP	0,371428571	0	0,628571429	1		0,942857143	1,542857143	-0,057142857	0,628571429	4		
	Value					0,5						1,411428571	1,911428571
LINDE	2013	0	0	0	0		0	0	0	0	0		
LINDE	2014	1	0	8	63		53	7	5	0	23		
LINDE	2015	3	0	3	46		48	7	6	1	22		
LINDE	2016	3	0	5	35		32	9	4	1	19		
LINDE	2017	2	0	7	31		28	12	6	2	20		
LINDE	2018	0	0	0	0		0	1	0	0	0		
	RGP	0,085714286	0	-0,028571429	-3,057142857		-2,6	0,628571429	0,028571429	0,171428571	-0,342857143		
	Value					-0,75						-0,422857143	-1,172857143
LLOYDS	2013	0	1	0	35		11	27	0	0	5		
LLOYDS	2014	1	0	2	30		7	27	0	0	2		
LLOYDS	2015	0	0	3	29		31	29	0	0	4		
LLOYDS	2016	0	0	5	39		21	24	0	0	4		
LLOYDS	2017	0	0	5	39		30	30	0	2	13		
LLOYDS	2018	0	0	7	55		43	37	0	0	18		
	RGP	-0,085714286	-0,142857143	1,314285714	3,914285714		6,257142857	1,542857143	0	0,171428571	2,8		
	Value					1,25						2,154285714	3,404285714

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	trend innovation	Consolidated trend word count
LOREAL	2013	1	0	1	16		9	5	3	0	58		
LOREAL	2014	2	0	1	10		6	6	2	0	23		
LOREAL	2015	0	0	0	9		5	3	2	0	25		
LOREAL	2016	3	0	1	7		5	2	1	0	33		
LOREAL	2017	0	0	1	14		4	3	3	0	42		
LOREAL	2018	4	0	1	14		7	4	2	0	43		
	RGP	0,342857143	0	0,028571429	-1,06158E-16		-0,457142857	-0,428571429	-0,085714286	0	-0,285714286		
	Value					0,092857143						-0,251428571	-0,158571429
LVMH	2013	1	0	8	34		11	6	2	1	40		
LVMH	2014	1	0	4	24		4	5	1	0	46		
LVMH	2015	3	0	12	18		8	6	0	0	44		
LVMH	2016	4	0	10	20		8	6	3	0	50		
LVMH	2017	3	1	9	40		3	5	0	0	46		
LVMH	2018	5	0	11	31		3	3	0	0	47		
	RGP	0,771428571	0,085714286	0,8	1		-1,228571429	-0,428571429	-0,285714286	-0,142857143	1,171428571		
	Value					0,664285714						-0,182857143	0,481428571
NESTLE	2013	0	1	0	3		3	0	1	0	2		
NESTLE	2014	0	0	5	5		4	3	0	0	18		
NESTLE	2015	0	0	2	14		5	0	1	0	26		
NESTLE	2016	0	0	1	10		5	4	0	0	21		
NESTLE	2017	1	0	7	25		8	7	0	0	22		
NESTLE	2018	0	1	2	8		10	6	0	0	38		
	RGP	0,085714286	0	0,428571429	2,314285714		1,342857143	1,314285714	-0,171428571	0	5,342857143		
	Value					0,707142857						1,565714286	2,272857143

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
NG	2013	0	0	0	28		17	21	0	2	15		
NG	2014	0	0	1	23		15	14	0	2	21		
NG	2015	0	1	1	23		22	16	0	2	20		
NG	2016	0	1	3	36		28	29	0	2	20		
NG	2017	1	0	3	44		28	24	0	2	23		
NG	2018	2	0	6	44		50	36	0	15	42		
	RGP	0,371428571	-6,63485E-18	1,085714286	4,457142857		6	3,371428571	0	1,857142857	4,028571429		
						1,478571429						3,051428571	4,53
NOVARTIS	2013	0	0	11	34		31	23	43	0	59		
NOVARTIS	2014	0	0	16	20		32	15	31	0	88		
NOVARTIS	2015	0	0	20	29		40	17	32	0	88		
NOVARTIS	2016	0	0	24	40		41	10	40	1	65		
NOVARTIS	2017	0	0	35	50		40	9	39	2	90		
NOVARTIS	2018	0	0	40	35		64	3	332	2	47		
	RGP	0	0	5,885714286	3,028571429		5,428571429	-3,571428571	42,2	0,485714286	-2,2		
	Value					2,228571429						8,468571429	10,69714286
NOVO	2013	0	0	8	17		7	12	45	0	7		
NOVO	2014	0	0	4	17		8	13	43	0	8		
NOVO	2015	0	0	6	29		4	14	36	0	10		
NOVO	2016	0	1	9	35		7	8	29	0	18		
NOVO	2017	2	0	7	36		7	14	29	0	24		
NOVO	2018	1	0	12	49		17	13	28	0	27		
	RGP	0,314285714	0,028571429	0,914285714	6,371428571		1,428571429	0,057142857	-3,828571429	0	4,457142857		
	Value					1,907142857						0,422857143	2,33

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
PRUDENTIAL	2013	0	0	0	91		4	22	0	0	7		
PRUDENTIAL	2014	0	0	1	106		9	22	0	0	10		
PRUDENTIAL	2015	0	0	1	113		8	22	0	0	13		
PRUDENTIAL	2016	0	0	1	138		13	15	0	0	6		
PRUDENTIAL	2017	1	0	4	97		19	24	0	1	13		
PRUDENTIAL	2018	3	1	19	205		30	39	0	0	15		
	RGP	0,514285714	0,142857143	2,971428571	16,22857143		4,714285714	2,4	0	0,085714286	1,2		
	Value					4,964285714						1,68	6,644285714
RECKITT	2013	0	0	19	15		8	12	24	0	27		
RECKITT	2014	0	0	5	13		8	18	9	0	24		
RECKITT	2015	0	0	4	17		7	21	9	0	44		
RECKITT	2016	0	0	5	14		2	21	0	0	53		
RECKITT	2017	2	0	1	10		3	16	0	1	38		
RECKITT	2018	1	0	1	27		6	25	1	1	56		
	RGP	0,314285714	0	-2,885714286	1,371428571		-0,857142857	1,685714286	-4,314285714	0,228571429	5,6		
	Value					-0,3						0,468571429	0,168571429
RELX	2013	0	1	10	19		44	18	1	0	19		
RELX	2014	0	1	8	18		38	17	1	1	15		
RELX	2015	0	1	9	28		48	20	1	0	12		
RELX	2016	0	1	6	28		48	22	3	0	7		
RELX	2017	0	2	7	31		60	23	6	0	11		
RELX	2018	2	2	11	37		49	26	5	0	12		
	RGP	0,285714286	0,228571429	-0,028571429	3,685714286		2,6	1,714285714	1,057142857	-0,085714286	-1,485714286		
	Value					1,042857143						0,76	1,802857143

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
RIO	2013	1	0	2	40		25	22	7	0	9		
RIO	2014	0	0	5	44		28	23	7	0	13		
RIO	2015	1	0	2	45		21	25	7	1	11		
RIO	2016	0	0	2	71		19	30	7	1	12		
RIO	2017	0	1	4	113		29	32	7	0	15		
RIO	2018	2	0	7	110		41	32	10	1	9		
	RGP	0,114285714	0,085714286	0,628571429	16,65714286		2,314285714	2,342857143	0,428571429	0,142857143	0,2		
	Value					4,371428571						1,085714286	5,457142857
ROCHE	2013	0	0	23	38		18	9	8	2	59		
ROCHE	2014	0	0	26	64		38	16	2	0	40		
ROCHE	2015	0	0	27	65		27	8	4	1	40		
ROCHE	2016	3	0	27	80		25	7	1	1	41		
ROCHE	2017	3	0	27	58		22	7	3	0	35		
ROCHE	2018	4	0	16	65		17	16	1	0	37		
	RGP	0,914285714	0	-0,914285714	3,771428571		-1,571428571	0,2	-1	-0,285714286	-3,542857143		
	Value					0,942857143						-1,24	-0,297142857
SAFRAN	2013	0	0	4	140		68	21	10	0	39		
SAFRAN	2014	0	0	6	150		70	23	12	0	43		
SAFRAN	2015	0	0	7	143		64	43	12	0	52		
SAFRAN	2016	0	0	6	146		66	41	13	0	51		
SAFRAN	2017	1	0	2	117		64	37	16	1	45		
SAFRAN	2018	0	0	2	135		64	33	17	1	55		
	RGP	0,085714286	0	-0,657142857	-3,457142857		-1,028571429	2,857142857	1,371428571	0,228571429	2,428571429		
	Value					-1,007142857						1,171428571	0,164285714

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
SANOFI	2013	1	0	67	43		42	11	230	3	16		
SANOFI	2014	1	0	71	53		34	12	262	1	18		
SANOFI	2015	1	0	87	52		40	11	283	1	24		
SANOFI	2016	0	1	90	57		35	13	328	1	24		
SANOFI	2017	0	1	101	67		39	14	319	11	17		
SANOFI	2018	2	0	112	67		49	13	318	14	18		
	RGP	0,028571429	0,114285714	9,085714286	4,771428571		1,285714286	0,514285714	18,74285714	2,428571429	0,2		
	Value					3,5						4,634285714	8,134285714
SANTANDER	2013	0	5	0	2		23	23	0	0	4		
SANTANDER	2014	0	0	2	7		47	26	0	2	30		
SANTANDER	2015	0	6	2	4		60	36	0	1	30		
SANTANDER	2016	0	2	8	3		68	34	0	1	39		
SANTANDER	2017	6	6	9	8		72	34	0	1	42		
SANTANDER	2018	6	8	22	30		81	57	0	21	49		
	RGP	1,371428571	0,828571429	3,914285714	4,057142857		10,65714286	5,485714286	0	2,914285714	7,714285714		
	Value					2,542857143						5,354285714	7,897142857
SAP	2013	33	0	13	154		115	16	27	2	116		
SAP	2014	26	1	18	144		88	12	36	3	88		
SAP	2015	23	2	17	151		92	11	21	2	84		
SAP	2016	28	1	16	140		85	23	17	2	114		
SAP	2017	26	1	16	142		93	23	13	1	102		
SAP	2018	33	0	20	169		95	24	11	2	98		
	RGP	0,142857143	-0,028571429	0,8	1,657142857		-2,628571429	2,428571429	-4,371428571	-0,171428571	-0,514285714		
	Value					0,642857143						-1,051428571	-0,408571429

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
SCHNEIDER	2013	5	1	20	134		33	39	2	13	45		
SCHNEIDER	2014	5	3	14	145		42	43	2	15	33		
SCHNEIDER	2015	6	4	19	155		46	53	3	10	52		
SCHNEIDER	2016	7	7	14	156		51	49	3	7	58		
SCHNEIDER	2017	23	9	14	165		40	52	4	8	65		
SCHNEIDER	2018	28	10	6	164		30	59	5	9	67		
	RGP	4,857142857	1,885714286	-2,142857143	6,028571429		-0,457142857	3,514285714	0,6	-1,257142857	6,057142857		
	Value					2,657142857						1,691428571	4,348571429
SHELL	2013	0	0	0	30		42	18	4	0	4		
SHELL	2014	0	0	0	30		36	20	4	0	4		
SHELL	2015	0	0	0	35		43	23	4	1	7		
SHELL	2016	0	0	0	53		40	23	4	1	7		
SHELL	2017	0	0	0	52		49	21	4	1	8		
SHELL	2018	2	0	6	57		54	35	4	1	9		
	RGP	0,285714286	0	0,857142857	6,257142857		2,742857143	2,514285714	0	0,228571429	1,057142857		
	Value					1,85						1,308571429	3,158571429
SIEMENS	2013	0	0	11	60		121	23	11	2	54		
SIEMENS	2014	0	1	6	73		53	19	10	3	33		
SIEMENS	2015	0	0	1	23		30	4	7	0	11		
SIEMENS	2016	0	0	1	27		27	5	7	0	17		
SIEMENS	2017	2	0	1	26		27	12	7	0	15		
SIEMENS	2018	1	0	1	24		27	19	7	1	16		
	RGP	0,314285714	-0,085714286	-1,857142857	-9,057142857		-15,74285714	-1,142857143	-0,828571429	-0,4	-6,8		
	Value					-2,671428571						0,372571429	-2,298857143

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
TELEKOM	2013	0	3	12	144		101	13	5	1	82		
TELEKOM	2014	2	1	28	119		102	19	2	1	88		
TELEKOM	2015	10	1	33	128		85	23	9	1	199		
TELEKOM	2016	11	0	20	94		67	20	2	1	85		
TELEKOM	2017	9	0	30	210		148	38	4	2	162		
TELEKOM	2018	9	0	42	151		158	39	12	2	146		
	RGP	1,914285714	-0,542857143	4,085714286	7,828571429		11,57142857	5,257142857	0,971428571	0,228571429	12,22857143		
	Value					3,321428571						6,051428571	9,372857143
TOTAL	2013	12	0	5	105		27	36	3	2	7		
TOTAL	2014	17	0	9	139		19	46	3	3	7		
TOTAL	2015	11	0	6	103		17	37	2	5	14		
TOTAL	2016	11	0	5	111		21	26	6	2	15		
TOTAL	2017	16	0	2	143		20	32	10	6	24		
TOTAL	2018	16	0	5	142		27	29	11	4	23		
	RGP	0,485714286	0	-0,628571429	5,857142857		0,2	-2,514285714	1,857142857	0,457142857	3,771428571		
	Value					1,428571429						0,754285714	2,182857143
UBS	2013	0	0	0	11		0	0	1	0	1		
UBS	2014	2	2	21	34		29	10	2	0	5		
UBS	2015	0	3	21	30		34	10	2	0	20		
UBS	2016	0	1	9	29		20	9	2	4	6		
UBS	2017	0	1	12	41		32	11	2	6	9		
UBS	2018	1	0	21	38		47	7	2	7	29		
	RGP	-0,028571429	-0,142857143	1,885714286	4,428571429		6,571428571	1,057142857	0,142857143	1,628571429	3,942857143		
	Value					1,535714286						2,668571429	4,204285714

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
UNILEVER	2013	0	0	0	1		2	0	5	0	5		
UNILEVER	2014	1	0	1	23		11	2	4	0	24		
UNILEVER	2015	0	0	3	41		23	19	4	1	40		
UNILEVER	2016	0	0	2	34		23	16	10	1	45		
UNILEVER	2017	1	0	5	28		13	6	3	0	21		
UNILEVER	2018	1	0	3	30		31	7	7	0	35		
	RGP	0,142857143	0	0,742857143	4,371428571		4,314285714	1,257142857	0,371428571	-6,63485E-18	4,171428571		
	Value					1,314285714						2,022857143	3,337142857
VINCI	2013	4	0	9	144		6	24	10	0	11		
VINCI	2014	4	0	3	146		9	25	12	0	8		
VINCI	2015	9	0	8	198		21	33	10	0	31		
VINCI	2016	12	0	9	191		17	30	8	0	33		
VINCI	2017	7	0	13	181		20	28	11	1	63		
VINCI	2018	10	0	14	210		26	32	6	1	68		
	RGP	1,2	0	1,6	12,22857143		3,685714286	1,314285714	-0,714285714	0,228571429	12,91428571		
	Value					3,757142857						3,485714286	7,242857143
VODAFONE	2013	0	0	3	63		43	19	1	0	7		
VODAFONE	2014	0	0	2	45		38	20	1	0	5		
VODAFONE	2015	0	0	6	31		27	14	1	0	3		
VODAFONE	2016	0	0	0	33		21	12	5	0	10		
VODAFONE	2017	0	0	2	46		47	18	6	0	8		
VODAFONE	2018	0	0	0	51		46	22	8	0	7		
	RGP	0	0	-0,6	-1,571428571		1,028571429	0,2	1,542857143	0	0,457142857		
	Value					-0,542857143						0,645714286	0,102857143

Firm	Year	Ecosystem	Value Proposition	Collaboration	Partner	Trend ecosystem	Technology	Knowledge	Patent	Competencies	Innovation	Trend innovation	Consolidated trend word count
ZURICH	2013	0	0	0	4		1	0	0	0	0		
ZURICH	2014	0	1	2	13		16	9	0	0	0		
ZURICH	2015	0	0	3	14		12	10	0	0	1		
ZURICH	2016	0	0	1	15		19	18	0	0	1		
ZURICH	2017	0	1	3	14		16	18	0	1	3		
ZURICH	2018	0	0	3	9		17	19	0	0	8		
	RGP	0	5,30788E-17	0,457142857	0,828571429		2,485714286	3,714285714	0	0,085714286	1,4		
	Value					0,321428571						1,537142857	1,858571429

7.2 Curriculum Vitae

Personal Details

Date of birth	June 5 th , 1992
Place of birth	Varel, Germany
Nationality	German

Higher Education

Since 11/17	University of St. Gallen St. Gallen, SUI Research Associate and Ph.D. in Management
10/15 – 04/17	University of Vienna Vienna, AUT Master of Science in International Business Administration
10/12 – 06/15	University of Vienna Vienna, AUT Bachelor of Science in Business Administration

Working Experience

11/17 – 08/20	Institute of Technology Management – HSG St. Gallen, SUI Project Manager and Co-Lead Ecosystem Living Lab
09/14 – 10/17	updoon GmbH Varel/Vienna, GER/AUT Founder and Managing Director
10/15 – 12/2016	Airspott GmbH Vienna, AUT Co-Founder