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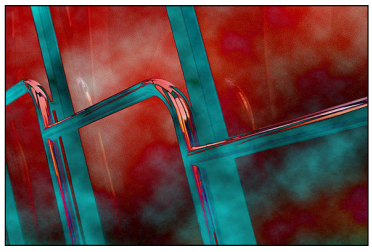

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Insights

Welcome to the February issue of the *Technology Innovation Management Review*. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

The *Technology Innovation Management Review* (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints – from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others – to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

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Contribute to the TIM Review in the following ways:

- Read and comment on articles.
- Review the upcoming themes and tell us what topics you would like to see covered.
- Write an article for a future issue; see the author guidelines and editorial process for details.
- Recommend colleagues as authors or guest editors.
- Give feedback on the website or any other aspect of this publication.
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Please contact the Editor if you have any questions or comments: timreview.ca/contact

About TIM

The TIM Review has international contributors and readers, and it is published in association with the Technology Innovation Management program (TIM; timprogram.ca), an international graduate program at Carleton University in Ottawa, Canada.

Editorial: Insights

Chris McPhee, Editor-in-Chief

Welcome to the February 2019 issue of the *Technology Innovation Management Review*. The authors in this issue share insights on the sharing economy, innovation ecosystems, digital transformation, and digital innovation processes.

First, **Aurélien Acquier** and **Valentina Carbone** from ESCP Europe's Paris Campus and **David Massé** from Télécom ParisTech develop a typology of business models for the sharing economy. They identify four configurations – shared infrastructure providers, commoners, mission-driven platforms, and matchmakers – that each exhibit specific value-creation logics, scalability issues, sustainability impacts, and potential controversies. Their results have implications for academics, entrepreneurs, established businesses, and public actors interested in the sharing economy.

In the second article, **Sanna Ketonen-Oksi** from Talent Vectia Oy in Espoo, Finland, and **Katri Valkokari** from VTT Technical Research Centre of Finland consider innovation ecosystems as structures enabling multi-actor value co-creation in real-life innovation ecosystems. Based on two empirical case studies, they identify and discuss the key prerequisites to support the ecosystem actors' abilities to first unfold and then either maintain or remodel the different structures and practices of value co-creation.

Next, **Lucija Ivančić**, **Vesna Bosilj Vukšić**, and **Mario Spremić** from the University of Zagreb, Croatia, examine the process of digital transformation using case studies of three companies from different industries that are in different stages of digital transformation. Through their analysis of the case studies, they propose a digital transformation framework including dimensions, subdimensions, lessons learned, and examples of best practice. Their findings emphasize the importance of change management, innovation management, and talent development in determining the success of digital transformation.

The final article, by **Jesper Lund** and **Esbjörn Ebbesson** from Halmstad University in Sweden examine how different architectural layers of digital technology interplay with digital innovation processes. Based on a case study of an innovation and development project, this article adds to earlier research about the complexity of digital innovation and suggests that a layered architectural perspective can provide valuable insights concerning how innovation processes within this domain can be coordinated and managed.

For future issues, we are accepting general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions, and proposals for future special issues.

Finally, we invite you to attend **ISPIM Connects Ottawa** (ispim-connects-ottawa.com), which will be held in Ottawa, Canada, from April 7–10, 2019. ISPIM Connects Ottawa is a three-day event that will bring together world-renowned innovation managers, researchers, and business and thought leaders to share insights on specific local and global innovation challenges as well as general innovation management hot-topic. The TIM Review and its associated academic program at Carleton University, the TIM Program (timprogram.ca), are proud to be the local hosts of the event in collaboration with other partners.

Chris McPhee
Editor-in-Chief

Editorial: Insights

Chris McPhee

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. Chris holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. He has 20 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

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How to Create Value(s) in the Sharing Economy: Business Models, Scalability, and Sustainability

Aurélien Acquier, Valentina Carbone, and David Massé

> *"Sharing economy is a catch-all that includes ambitious young Internet startups, companies that are worth millions on the stock market, and neo-hippies with political and social objectives."*
>
> Cerise Sudry-le-Dû
> Journalist
> In *Les Inrockuptibles* (2015)

By organizing peer-to-peer exchanges and promoting access over ownership, the sharing economy is transforming a great variety of sectors. Enjoying fast growth, the sharing economy is an umbrella term encompassing heterogeneous initiatives that create different types of economic, environmental, or social value. This heterogeneity triggers tensions and intense disputes about the perimeter of the field. Do Airbnb and Uber belong to the sharing economy? How do we consider practices such as gifting, renting, and swapping that existed before the sharing economy boom? To sort out this complexity, we have adopted a pragmatic and grounded approach examining 27 initiatives that claim to be part of, or are perceived as emblematic of the sharing economy. We develop a typology of sharing economy business models revealing four configurations: shared infrastructure providers, commoners, mission-driven platforms, and matchmakers. Each configuration exhibits specific value-creation logics, scalability issues, sustainability impacts, and potential controversies. Our results provide guidance for sharing entrepreneurs, for established businesses that want to embrace the principles of the sharing economy, and for public actors wishing to regulate or support the field.

Introduction

A central idea of the sharing economy is the optimization of under-used assets (e.g., physical assets such as cars, apartments, individual devices, and money or intangible assets such as skills and knowledge) by pooling or sharing them through digital platforms (Benkler, 2004). From this initial idea, the sharing economy emerged as a popular label to refer to different initiatives that either connect individuals through platforms to carry out sales, rentals, swaps, or donations (Gansky, 2012) or set up more centralized "product-service systems" to provide access instead of use, thus intensifying the use of idle assets (Botsman & Rogers, 2010).

Sharing practices such as gifting, renting, swapping, or bartering have existed for ages. They traditionally took place at the individual or community level and in the domestic sphere, outside the market logic, with a strong sense of informality and social reciprocity. Over the last decade, these formerly domestic and local practices have been "dramatically scaled by the capitalist engine of technology-powered markets" to give rise to "stranger-sharing" in global markets (Sundararajan, 2016). According to PwC, the sharing economy was estimated at $15 billion USD in revenue worldwide in 2015, with the potential to reach $335 billion USD by 2025 (PWC, 2015). As of 2016, 72% of Americans had used some type of sharing platform or space (Smith, 2016).

As the rapid success of platforms such as Kickstarter, Coursera, Uber, and Airbnb illustrate, the development of the sharing economy reshapes a large number of economic sectors (e.g., finance, education, mobility, hospitality), simultaneously offering real entrepreneurial opportunities and constituting a threat of disruption for traditional sectors (Fréry et al., 2015; Guttentag, 2015).

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SNCF, the national railway company in France, estimated that the rise of BlaBlaCar, a European-based shared mobility platform created in 2006, had already caused a more than 10% decrease in their business. Subsequently, SNCF invested €28 million (~$42 million CAD) in June 2015 to acquire Ouicar, a peer-to-peer car rental platform.

The sharing economy is fascinating and complex because it combines ingredients from both market and non-market logics, along with inspirations from a variety of cognitive and normative frames, encapsulated in very different types of organizations (Acquier, Carbone, & Massé, 2017). By combining environmental concerns for resource optimization, a social orientation towards communities and social exchange, and pointing to market opportunities, the sharing economy holds great promise in terms of sustainability or shared-value creation, "which involves creating economic value in a way that also creates value for society by addressing its needs and challenges" (Porter & Kramer, 2011). The hybrid nature of the sharing economy generates definitional disputes in the academic world (see Table 1), and triggers controversial debates among experts, such as the one concerning the logic driving sharing economy entrepreneurs: a pure for-profit logic versus the pursuit of social and environmental goals. Indeed, the sharing economy is riddled with tensions and paradoxes (Acquier, Daudigeos, & Pinkse, 2017), thereby creating a lot of complexity and confusion for entrepreneurs, established companies, and public regulators and making it hard to understand the underlying mechanisms of value creation, value distribution, and societal impacts of the sharing economy.

In this article, we propose to sort out the complexity of the sharing economy field by developing a typology of sharing economy business models. By distinguishing value-creation and value-distribution mechanisms, we reveal four configurations of sharing economy organizations: *shared infrastructure providers, commoners, mission-driven platforms,* and *matchmakers.* Each configuration rests on specific value-creation logics and exhibits scalability issues, specific sustainability impacts, and potential controversies. Beyond providing guidance for sharing economy entrepreneurs, our model has also significant implications for established businesses seeking to grasp business opportunities in the sharing economy, as well as for public actors who wish to regulate or support the field.

Definitional Disputes Around the Sharing Economy

There are currently many different definitions of the sharing economy, and agreeing on a shared definition is a conceptual challenge for several reasons. Because of its normative dimension, the sharing economy can be analyzed as an "essentially contested concept" that "inevitably involve[s] endless disputes about [its] proper uses on the part of its users" (Gallie, 1955). Indeed, the field is riddled with normative, empirical, and conceptual contestations about its scope and impacts.

First, many disputes are related to the environmental and social impacts of the sharing economy. Its advocates have praised the sharing economy for being a sustainable alternative to the currently unsustainable economy (Chase, 2015; Voytenko Palgan et al., 2017) by creating social bonding (John, 2013; McLaren & Agyeman, 2015), fighting against planned obsolescence (Demailly & Novel, 2014), favouring a better usage of resources and assets (Heinrichs, 2013), standing against the power of monopolistic firms (Kostakis & Bauwens, 2014), and creating initiatives to move towards more "conscious capitalism" (O'Toole & Vogel, 2011). On the other hand, opponents denounce the sharing economy as a form of "pseudo-sharing, […] whereby commodity exchange and potential exploitation of consumer co-creators present themselves in the guise of sharing" (Belk, 2014). In this perspective, the "feel-good" sharing rhetoric constitutes a form of mystification that tends to hide the true impacts of the sharing economy. Studies have shown that the environmental benefits of the sharing economy may be overstated, as economic motivations generally prevail over environmental concerns in user motivations (Barnes & Mattsson, 2016; Böcker & Meelen, 2017). Most critics also point to the social costs of sharing economy platforms, denouncing what they perceive as a parasitical development logic that rests on irresponsible business models of platforms, which extend harsh free-market practices into previously protected areas of our lives (Slee, 2015). From this perspective, the sharing economy is thought to conceal a neoliberal agenda creating unregulated marketplaces, unprotected labour markets based on new forms of digital slavery, unfair competition, tax avoidance, and a transfer of risks to individual users (Martin, 2016).

Second, the conceptual boundaries are unclear between the sharing economy and other neighbouring concepts such as collaborative consumption, the peer-

to-peer economy, crowd-based/platform capitalism, on-demand/gig economy, economy of access, or the circular economy. Though these concepts partly overlap, they are not completely synonymous and seem to be largely shaped by each author's ideological or academic ends (Murillo et al., 2017).

Definitions of the sharing economy concept itself vary greatly among authors and seem difficult to reconcile. Broadly speaking, there are two types of definitions of the sharing economy: narrow and broad definitions (see Table 1 for illustrations). Researchers who adopt narrow definitions tend to start from a normative characterization of sharing in order to frame the sharing economy as a more specific, restricted, and workable empirical object. While this strategy may be more rigorous from an analytical and academic point of view, it may simply bypass the complexity of the sharing economy as a field of practices. Moreover, the criteria used to define the sharing economy may be specific to each author, resulting in an assortment of individually coherent, but inconsistent definitions at the field level. For example, some observers argue that Uber should not be considered as part of the sharing economy, either because it focuses solely on value capture (Godelnik, 2014) or because, instead of car-sharing, it offers a permanent professional taxi service (Frenken & Schor, 2017; Meelen & Frenken, 2015). At the same time, many critics seem to equate the sharing economy with "Uber-like" initiatives (peer-to-peer and profit-driven platforms) and disregard other forms of initiatives that explore different logics of value creation (founded on peer-to-peer "commoning" or non-profit objectives) (Slee, 2015). Keeping in mind the "essentially contested" nature of the sharing economy concept, this may lead to endless academic and normative debates about what the sharing economy is, is not, or should be.

Other studies tend to define the field more broadly, including both peer-to-peer and business-to-peers initiatives, covering both market and non-market mechanisms (Schor, 2014). These approaches tend to be more focused on how actors make sense of the field, exploring its complexity, tensions, and hybridity. We adopt this perspective and define the sharing economy as a set of initiatives that increase the availability and efficiency of sub-utilized resources in society by organizing peer-to-peer exchanges or promoting access over ownership, or both. This broad and comprehensive definition is coherent with our objective to make sense of the complexity of the field by analyzing the different value-creation mechanisms in the field. It is coherent with other definitions, for example, that of Munoz and Cohen, who define the sharing economy as "a socio-economic system enabling an intermediated set of exchanges of goods and services between individuals and organizations which aim to increase efficiency and optimization of sub-utilized resources in society" (Muñoz & Cohen, 2017).

Methodology

This paper is based on a two-year project (between 2014 and 2016) aimed at assessing the environmental and social impacts of sharing economy initiatives in France and other countries in Europe (Acquier et al., 2016). The empirical research was focused on material goods, exploring how production, gifting, resale, lending, and repair are being transformed by the rise of online exchange platforms and "third places" (mainly hackerspaces and fab labs). To overcome the definitional disputes around the sharing economy, we have adopted a pragmatic and grounded approach. We start from initiatives that claim to be part of the sharing economy or that are commonly perceived as very emblematic of this economy. The bulk of our empirical material is made up of 30 semi-structured interviews with the founders of 27 collaborative projects – mainly in France – covering a variety of practices (gifting, rental, lending, production, repair, and resale) and diverse industries (see Appendix 1). The questions were structured around four main topics: the background and motivation for creating the project, the social and environmental promises and impacts, the choice of business model, and the initiative's growth potential and issues. In addition, we interviewed 11 managers from established companies to understand how they engage in the sharing economy. We also collected secondary data to provide further examples and illustrations supporting our arguments.

A Business Model Approach

Although it was originally developed and formalized in the context of for-profit companies (Zott & Amit, 2010), the business model concept has also been applied to a variety of governance models and limited-profit initiatives such as social innovation (Yunus et al., 2010) to understand how the organization interacts with a broader ecosystem (Lepak et al., 2007), and how it responds to sustainability issues (Boons & Lüdeke-Freund, 2013) or to growing expectations in terms of taking responsibility for handling its products at the end-of-life stage (Kortmann & Piller, 2016). Research on business models mainly focuses on: 1) how initiatives create value for clients and 2) how the value created is captured by the

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Table 1. Examples of narrow vs. broad definitions of the sharing economy (continued on next page)

Examples of Narrow Definitions	Definition	Key Hypotheses
Benkler (2004)	Refers to "sharing goods" as "a class of resources or goods that are amenable to being shared within social sharing systems rather than allocated through markets" (p. 356) Social sharing also constitutes an "alternative modality of production" (p. 330) based on gifting and free participation among "weakly connected participants" (p. 332–334)	• Social sharing constitutes a distinct mode of transaction (distinct from market price mechanism) and a distinct mode of production (different from market, hierarchies, and state mechanisms) • Excludes secondary markets from social sharing • As a mode of production, social sharing involves a logic of gifting by contributors
Belk (2014)	Distinguishes "true" vs. "pseudo-sharing" "Sharing is an alternative to the private ownership that is emphasized in both marketplace exchange and gift-giving" (p. 10) Pseudo-sharing is a "phenomenon whereby commodity exchange and potential exploitation of consumer co-creators present themselves in the guise of sharing" (p. 7) or "business relationship masquerading as communal sharing" (p. 11)	• "True sharing" excludes commercial exchange, reciprocation, and self-interest or transfer of individual property • Gifting is not sharing • Sharing implies a sense of collective property/belonging
Cockayne (2016)	"The on-demand or 'sharing' economy is a term that describes digital platforms that connect consumers to a service or commodity through the use of a mobile application or website" (p. 73)	• Restricts the sharing economy field to peer-to-peer, digital, profit-driven platforms
Eckhardt & Bardhi (2016)	"The access economy, [...] also known as the sharing, or peer-to-peer, economy, [...] provides temporary access to consumption resources for a fee or for free without a transfer of ownership" (p. 210)	• Access (vs. ownership) • Excludes gift giving or bartering • Sharing and access take on different meanings in market vs. non-market economies
Frenken & Schor (2017)	Define the sharing economy as "consumers granting each other temporary access to under-utilized physical assets ('idle capacity'), possibly for money" (p. 2–3)	• Excludes centralized systems • Excludes reselling platforms • Excludes the provision of on-demand services • Excludes production (focuses on consumption)
Stephany (2015)	"The sharing economy is the value in taking underutilized assets and making them accessible online to a community, leading to a reduced need for ownership of those assets" (p. 9)	• Focuses on for-profit initiatives that promote access instead of ownership • Beyond peer-to-peer platforms, the sharing economy includes business-to-consumer (B2C) companies such as Zipcar and Rent the Runway that rent directly to consumers

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Table 1. (continued) Examples of narrow vs. broad definitions of the sharing economy

Examples of Broad Definitions	Definition	Key Hypotheses
Habibi et al. (2017)	"[We] suggest a sharing-exchange continuum that helps distinguish the degree to which actual sharing is being offered" (p. 115)	• The sharing economy is a diverse field with hybrid forms that fall along a continuum between "true" and "pseudo-sharing"
Lessig (2008)	Defines the hybrid economy as "either a commercial entity that aims to leverage value from a sharing economy, or it is a sharing economy that builds upon a commercial entity to better support its sharing aims" (p. 177)	• Most initiatives exhibit for-profit and non-profit dimensions simultaneously
Munoz & Cohen (2017)	"A socio-economic system enabling an intermediated set of exchanges of goods and services between individuals and organizations which aim to increase efficiency and optimization of sub-utilized resources in society"	• Includes both business-to-business, business-to-customers, for-profit and non-profit initiatives, reselling, gifting
Schor (2014)	"Sharing economy activities fall into four broad categories: recirculation of goods, increased utilization of durable assets, exchange of services, and sharing of productive assets" (p. 2)	• Includes both business-to-business, business-to-customers, for-profit and non-profit initiatives, reselling, gifting
Botsman (2013)	"An economic model based on sharing underutilized assets from spaces to skills to stuff for monetary or non-monetary benefits"	• Includes both business-to-business, business-to-customers, for-profit and non-profit initiatives, reselling, gifting

organization or distributed in the initiative's ecosystem (Bowman & Ambrosini, 2000). Examining these two questions, we reveal two central tensions in the sharing economy field, as described in the sub-sections that follow.

Value-creation mechanisms: From peer-to-peer intermediation to centralized resource pooling

Overall, the sharing economy creates value by providing access and intensifying the use of under-utilized assets. It does so through two principal value-creation mechanisms:

1. *Peer-to-peer intermediation:* some initiatives create value by organizing decentralized peer-to-peer transactions. Typically, these are sharing economy platforms (such as Airbnb) that connect peers through distributed, large-scale digital networks in order to organize decentralized production, distribution, and exchange of products and services.
2. *Centralized resource pooling:* some initiatives create value by creating and providing access to a centralized resource pool. This typically corresponds to "access-driven business models" or "product-service systems" where for-profit companies (such as ZipCar) create a centralized infrastructure that is accessible for short-term rental. This also corresponds to initiatives such as Wikipedia, where individual decentralized contributions are stored and aggregated in a central pool (the Wikipedia website) that is made freely available to users.

These two modes of value creation are not necessarily exclusive, and a hybrid mode may be formed by combining them. For example, collaborative production initiatives intend primarily to give access to production resources by pooling data and material assets (premises, machines, expertise, etc.). Additionally, many such initiatives build decentralized networks of peers to facilitate learning and exchange through personal interactions

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(Kohtala & Bosqué, 2014). These two value-creation mechanisms can therefore be viewed as two shaping forces of the sharing economy, emphasizing either peer-to-peer decentralization or resource pooling.

Value capture and distribution mechanisms
Most scholars studying sharing economy as a field of practices observe that "the sharing economy spans the continuum between market economies and gift economies." (Mair & Reischauer, 2017; Schor, 2014; Sundararajan, 2016). Accordingly, we distinguish two mechanisms for capturing and distributing value in the sharing economy:

1. *Dominant focus on economic value creation and capture:* this refers to a series of for-profit initiatives endorsing shareholder value maximization, adopting a market logic and monetizing their services (Teece, 2010). This typically corresponds to initiatives that are discussed under the label "platform capitalism" (Kenney & Zysman, 2016; Morozov, 2014): access business-models driven by market logics (Bardhi & Eckhardt, 2012).

2. *Dominant focus on extended/shared value creation and distribution:* in contrast, other initiatives are set up as non-profit or limited-profit initiatives, where economic sustainability is a means to promote a social or environmental mission (Seelos & Mair, 2007; Yunus et al., 2010). These initiatives may be entirely non-profit (such as Wikipedia) or hybrid projects using market mechanisms to promote their social mission. As a result, while they may develop for-profit activities and capture part of the value created, they do so with the publicly-stated aim of sharing this value within their ecosystem according to their mission and governance.

Once again, the differentiation between these mechanisms should be viewed as a continuum rather than a strict cleavage, and they are likely to evolve according to the life of each project (Schor et al., 2015).

Four Business Model Configurations in the Sharing Economy

By plotting a matrix with these two dimensions, we derive a typology of four sharing business models that we call *shared infrastructure providers, commoners, mission-driven platforms,* and *matchmakers* (see Figure 1). Each type relies on distinct mechanisms of value creation and value capture, is confronted with different scalability potential, holds different societal promises and impacts, and must manage different potential controversies (see Table 2).

Shared infrastructure providers
Shared infrastructure providers are for-profit initiatives that create value by providing monetized, temporary access to a centralized pool of proprietary resources (machine tools for DIYers, cars, bike, etc.). Individuals and professional clients can use the service as fee-paying members or on a pay-per-use basis. TechShop, a chain of digital fabrication workshops founded in 2006 in California, illustrates this type of initiative. Mark Hatch (2017), CEO & Co-Founder of TechShop, explains: "TechShop is a membership-based, do-it-yourself fabrication studio. 'Membership-based' means you get access to it, just like a gymnasium or a health club. It's $125 a month. 'Do-it-yourself' means you have all these amazing tools – machine tools, woodworking, glass, electronics – but you use the tools yourself (…)."

Similar logics abound in the mobility sector. Examples include Zipcar (an American car-sharing company founded in 2000) and analogous initiatives such as Communauto (Montreal), Car2go (Europe, US, Canada), as well as other types of mobility services offering bikes or scooters. These initiatives set up and manage a proprietary network of vehicles in urban areas. Members can access such services by paying a monthly or annual membership fee in addition to usage fees, and by using a technology device to book and unlock the cars.

To scale, they require a sufficient level of activity to ensure operational profitability, as well as significant financial resources. Initiatives may explore different development strategies depending on market maturity, need for operational control, and access to financial resources. When initiatives have access to significant financial resources, and when the need for fast growth is relatively low, internal growth strategies may be appropriate but risky. In the US, TechShop opted for an internal growth strategy, steadily growing its operating base across the country. However, TechShop failed to find a sustainable business model, due to the high cost of operating its studios, and in 2017, shut down all the US locations and declared bankruptcy. In parallel, TechShop started its international expansion by forming strategic partnerships with organizations willing to co-invest in the creation of new sites (see section on implications for established organizations). Four TechShop sites exist now in different cities around the world (Tokyo, Abu Dhabi, Paris, and Lille).

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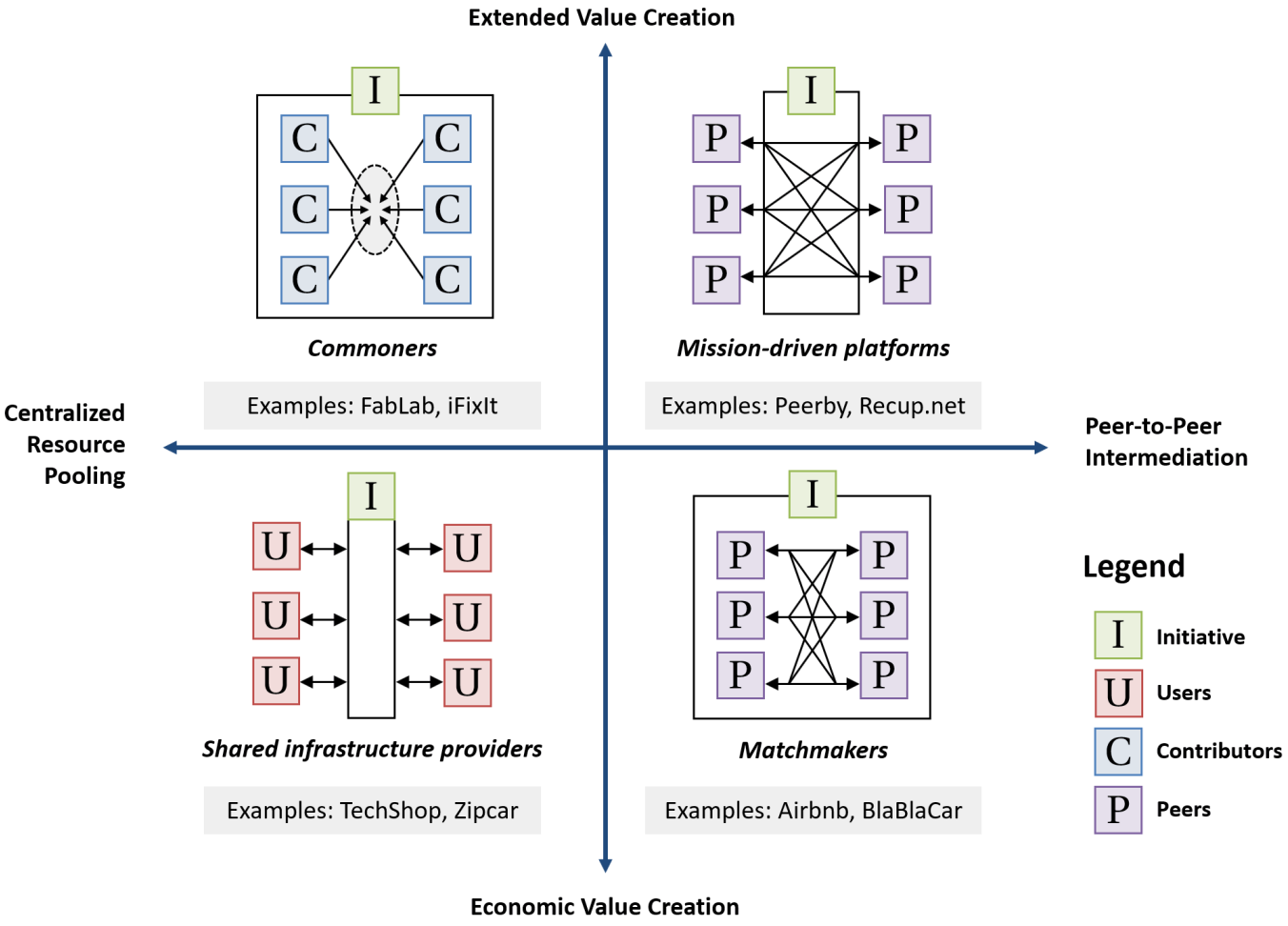

Figure 1. Four business model configurations of sharing organizations

In order to expand faster or in more competitive, mature markets, initiatives can explore alliances, partnerships, or external growth strategies by acquiring competitors. In 2007, Zipcar (now the world's largest car-sharing company) merged with Flexcar (the oldest and second-largest car-sharing company in the US). The company then started its international expansion by acquiring Avancar in Spain in 2009 and Streetcar in the UK in 2010. Eventually, Zipcar itself was acquired by the rental company Avis Budget Group in 2013.

In terms of social and environmental promises, as *shared infrastructure providers* offer access instead of ownership and intensify resource use, they hold significant promise at the local/city level, where the current under-optimization of assets such as cars may create social and environmental problems. For example, shared mobility services may be particularly attractive for cities that wish to reduce inner-city congestion, decrease pollution through more environmentally friendly engines, reduce city access to privately-owned vehicles, and promote multimodal and soft transportation modes such as bike-sharing (Cohen & Kietzmann, 2014). Studies have shown that initiatives such as Zipcar or other car-sharing services tend to reduce private car ownership: by discouraging car purchases or substituting for private ownership, every car-sharing vehicle in the fleet replaces 9 to 13 privately-owned vehicles (Martin & Shaheen, 2011). Accordingly, for public actors, developing such shared infrastructures may be part of a more general city innovation strategy (Cohen et al., 2016), opening the way for public/private partnerships to co-invest in "merit-based business models" (Cohen & Kietzmann, 2014).

Despite such social and environmental promises, these organizations are likely to face controversies. Some studies on car sharing contest the existence of a

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Table 2. Overview of the four business model configurations of sharing organizations

	Shared Infrastructure Providers	Commoners	Mission-Driven Platforms	Matchmakers
Examples	TechShop, Zipcar, Communauto	Wikipedia, FabLab, iFixIt	Peerby, Mutum, Recup.net	Airbnb, BlaBlaCar
Value-creation mechanisms	Providing monetized access to a centralized pool of proprietary resources	Creating and providing free access to public goods	Intermediating between peers to promote a societal cause	Intermediating between peers to develop decentralized market transactions
Value-capture mechanisms	• Membership fees • Pay per use • Public subsidies	• Free work by community members • Public and private donations • Complementary for-profit activities	• Introduce market mechanisms (advertising, commissions, etc.) compatible with the mission • Non-monetary contributions from members/founders	• Commissions • Freemium model • Two-sided market business models
Scalability issues	Building a capital-intensive infrastructure through: • Market concentration (M&A) • Investment capital • Public/private partnerships • Franchising	Scaling the organization through: • Project economic sustainability • Community growth Cause-related (non-proprietary) scaling: • "Free franchising" (charts, rules, etc.) • Launching a social movement	Overcoming low scalability through: • Hybrid arrangements (combining economic and social value creation) • Access to financial capital • Development of professional skills (digital/local communities)	Managing high scaling potential through: • constant sourcing of supply and demand • development of trust among clients • access to financial capital • managing regulation and social controversies
Social & environmental promises/impacts	Local societal transformation towards access-based economy	Global cultural and societal transformation towards open-access, DIY, reparability	• Promises are high: intermediation is a tool to generate societal impacts	• Promises are low: initiatives may capitalize on unintended externalities

"community logic" among Zipcar users, and suggest that market expectations prevail instead (Bardhi & Eckhardt, 2012). In the same vein, *shared infrastructure providers* may be criticized for using social and environmental promises as an entrepreneurial subterfuge, using "pseudo-sharing" as a way to hide the true capitalist nature of the field, and to facilitate big-business centralization. Accordingly, shared infrastructure providers should be cautious with their environmental or social claims and pay particular attention to measuring such impacts.

Commoners

Commoners create and provide free access to public goods. They are mostly non-profit initiatives that pool resources and skills in order to make them available to the greatest number. Wikipedia constitutes a central reference for many of these initiatives. Through their initiatives, they promote an ideology based on alternative and non-market values, such as open-knowledge, do it yourself (DIY), and the democratization of resources enabling decentralized production, repair, free contribution, and free access. In such initiatives, value is created by and for the community or the initiative's ecosystem. While their ideology is strongly rooted in the digital culture (Turner, 2006), these initiatives are found in both the digital and physical worlds.

Initiatives such as iFixit (a US private company founded in 2003) or Comment Réparer (a French non-profit equivalent started in 2011) replicate a similar logic for repairing consumer goods. These initiatives build online communities of individuals searching for or offering solutions to repair goods. Their website aggregates

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these decentralized interactions and oversees an editorial process to develop free repair guides, developed by community members and made accessible to all. Both initiatives explicitly promote their project as a way to fight against waste (in particular e-waste) and planned obsolescence, and to boost the circular economy.

Fab labs (fabrication laboratories) offer an example of *commoners* in the physical world, oriented towards production. The movement appeared in the late 1990s, spearheaded by Neil Gershenfeld, a professor at MIT who wanted to make digital production tools widely available for people to fabricate "almost anything" (Gershenfeld, 2011). Today, "fab labs are a global network of local labs, enabling invention by providing access to tools for digital fabrication" (MIT, 2012), particularly computer-controlled machine tools (such as 3D printers) for the design and production of physical objects. As of February 2019, there are more than 1000 fab labs located in more than 40 countries (Fablabs.io, 2019). And, next to fab labs as defined by MIT, related initiatives have emerged under different labels such as hackerspaces or makerspaces.

Commoners develop specific business models, where value is created *by* and *for* the community. Thanks to contributors' voluntary work (members freely give their time, energy, and skills), operational costs are reduced. Most financial needs are related to the central coordination of the initiative and the development and running of its operational infrastructure. These costs can grow significantly as the initiative develops or when it involves physical assets, such as fab labs or makerspaces.

Due to the non-profit character of such initiatives, finding sustainable business models can be a challenge for *commoners,* which explains why many such initiatives remain local and fail to scale. They may capture value by combining various indirect approaches. First, *commoners* may look for support from third parties (public authorities, universities, private donors, etc.) who provide financial or physical resources (premises, machines, etc.). A second mechanism consists of introducing complementary for-profit activities to financially support the mission. For example, iFixit earns money through its online shop, by selling toolkits or spare parts. Third, the initiatives can move away from a completely open and free model by introducing monthly member subscriptions. This has been done by many non-university fab labs to cover operating expenses (electricity, rent, etc.). The challenge is to maintain these market mechanisms within acceptable boundaries to avoid shifting into a market and professional logic (which would be more characteristic of *shared infrastructure providers*) and compromise the mission of openness that characterizes *commoners.*

Commoners aspire to have a global impact, and they often position their undertaking within a broader political and social movement whose scope is not confined to an isolated and local initiative. When *commoner* initiatives are resource hungry (such as fab labs or physical spaces), they may explore forms of non-proprietary scaling or "free-franchising model". For example, building on the MIT Fab Lab, Neil Gershenfeld developed a worldwide network of fab labs following a charter (MIT, 2012) that stipulates a certain number of principles (openness, collaboration, free equipment, ownership of inventions, etc.) that members have to comply with to belong to the network.

As *commoners* seek change at societal and cultural levels, their action often entails changes related to copyright laws, access and creative commons. Consequently, they generate political and social controversies, and they have to engage in political struggles. iFixit, for example, fights for a "right to repair": "Ownership means you should be able to open, hack, repair, upgrade, or tie bells on it. Once you've paid money for a product, the manufacturer shouldn't be able to dictate how you use it – it's yours." (iFixit, 2019). Other controversies include managing legal conflicts with incumbent firms because of closed business models (as suggested by the history of open source software in the computer industry), the tensions between non-market and market logics as the initiative grows, and finding a workable balance between the non-profit orientation and for-profit activities, to avoid organizational drift towards a *shared infrastructure provider* model.

Mission-driven platforms

Mission-driven platforms intermediate between peers to promote a societal cause. Like *commoners,* they pursue a mission to transform the economy and to engender new practices in the areas of consumption, exchange, and relationships. They may promote various societal causes, such as reducing waste, cutting out supply chain intermediaries, or re-creating social links among strangers or neighbours. In spite of these commonalities, the central mechanism they use to make a social impact differs from *commoners:* instead of creating a centralized pool of resources accessible to anyone, they create value by organizing local decentralized exchanges among individuals, harnessing the power of local peer-to-peer interactions. *Mission-driven platforms* may take the form of non-profit, for-profit, or hybrid structures.

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Many initiatives aim to reduce waste. Recup.net is a non-profit example of such initiatives. Launched in 2001 by a software developer working in an investment bank but wanting to promote environmental values outside his professional activities, it is a simple Internet platform whose aim is to facilitate gifting among peers and avoid generating unnecessary waste. Fighting against food waste, Too Good To Go is an application developed in 2016 that enables restaurants and hotels to make unsold food available for a fraction of the price before it gets thrown away. In the same vein, Couchsurfing was launched in 2003 as a free online hospitality network, where global travellers offer each other accommodation free of charge in their homes (Molz, 2012). This "free version of Airbnb" claims a global community of 400,000 hosts and 4 million members. Other initiatives aim to create social links in neighbourhoods by facilitating the borrowing of objects or free services among members of a given community. Examples such as ShareVoisins and Mutum in France, or Peerby in the Netherlands fall into such a category. Launched in 2013, Peerby enables each user to lend or borrow objects from other members in the same geographic area. The platform claims that there is an 85% chance of finding the sought-after object free of charge within 30 minutes. In 2016, this 15-person start-up had more than 100,000 users across the Netherlands, Belgium, London and Berlin, and raised €2.2 million (~$3.3 million CAD in crowdfunding, out of €3.7 million (~$5.5 million CAD) in total, to pursue its development.

For *mission-driven platforms,* the search for a business model often constitutes the stumbling block of the initiative. Purely non-profit models rest on voluntary contributions to meet operational needs. However, such models often fail to scale beyond a limited threshold. For example, Recup.net has been running for a decade and continues to run with 200 gifts and 15,000 views a day, but it has never scaled beyond that level. While they may raise funds through crowdfunding, they often struggle to find economically sustainable business models based on gifting and non-monetary transactions.

Intermediating peers also involves resources to develop dense local communities at the local level. Learning from local demand was also central for Peerby in efforts to scale up, as it was confronted with a huge imbalance between supply and demand: "We had probably 20 times as much supply as we had people requesting items" (CEO, Peerby). Peerby teams discovered that, while people were happy to supply material goods for free, demanders felt uncomfortable borrowing for free, preferring a monetary transaction which would allow them to expect a certain level of quality, availability, and convenience. To stimulate demand, Peerby decided to launch Peerby Go in 2016, a peer-to-peer renting platform involving monetary transactions which eventually grew much faster than the original lending platform.

Scaling the platform and keeping social innovation logics requires initiatives to select an appropriate governance model. Some actors currently explore how "platform cooperativism" (Scholz, 2016) could provide a relevant and coherent model of governance for mission-driven platforms, resting on collective ownership and democratic governance. For more classical governance structures, managers must select and choose financial partners that are compatible with the project's mission, which can be difficult with conventional venture capitalists. Couchsurfing experienced such problems in 2010, when it changed its legal status from a non-profit to a for-profit company and raised about $8 million from venture capital, provoking contestation from users complaining about a mismatch between free transactions and the for-profit orientation of the company (Belk, 2014). To finance its development while preserving a strong focus on community and environmental logics, Peerby launched a crowdfunding campaign and raised €2.2 million (~$3.3 million CAD) in four days, with about 70% coming from its user community. Another issue for *mission-driven platforms* is to identify a business model that is economically sustainable and compatible with the values of the project.

To add to this managerial complexity, *mission-driven platforms* are also confronted with various controversies. First, their initial activism may be called into question as the organization grows. There is a typical tension for such initiatives between staying small and committed to a non-profit ideology or growing bigger and running the risk of mission drift (Battilana & Dorado, 2010), falling in the *matchmaker* category (described below). While it maintains a strong environmental and community logic, Peerby could be criticized for distancing itself from "true" or "pure" sharing, as it introduced monetary transactions in addition to borrowing.

In view of these elements, the promise of *mission-driven platforms* to combine the scaling potential of platforms with a social mission proves both very promising and challenging. Initiatives must find ways to sustain hybridity over time, finding a third way between pure market logics (without a mission) and pure non-profit logics (with limited scaling potential). If they overcome

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the barriers to scaling, they may combine both scalability and strong social impact (Seelos & Mair, 2017).

Matchmakers

Matchmakers intermediate between peers to develop decentralized market transactions. They are for-profit commercial platforms that build networks of individuals who can conduct transactions for goods or services on a peer-to-peer basis in the physical world (Evans & Schmalensee, 2016). They begin by identifying a resource that is dispersed, under-exploited, and has a high sharing value. Instead of owning the productive assets needed for the service, they outsource most productive assets from peers, acting as a broker and taking a commission from the market exchanges they enable. In the transportation and hospitality sectors, matchmakers are platforms such as Uber, Lyft, BlaBlaCar, or Airbnb. These initiatives often promote a free-market ideology, fighting against the economic rents of established corporations. Within the continuum between "pure sharing" and "pure exchange" evidenced by Habibi and co-authors (2016), they definitely fall into the market-exchange logic.

Airbnb is an iconic example of an initiative that intermediates between peers to provide hospitality services. Started in 2007 as a private company, the platform lists over three million lodgings in 81,000 cities and 191 countries in 2019. While it remains a private company, its value is estimated at $30 billion USD (more than Hilton and Hyatt combined, in 2017). Along with its exponential growth, the platform has generated major controversies because of its impact on urban housing markets and the regulation of short-term rentals, leading many cities such as New York, Paris, and Berlin to introduce administrative restrictions on short-term property rentals.

In the transportation sector, BlaBlaCar is a ridesharing platform. Founded in France in 2006 by Frederic Mazella, it connects drivers and passengers willing to travel together and share travel costs, mainly over long distances. With more than $300 million USD raised, the company is one of Europe's best-funded startups, valued at $1.6 billion USD at the end of 2015. It is now present in more than 20 countries, has more than 600 employees, and has a community of 60 million members.

Matchmakers have high scaling potential and are likely to generate massive impacts. These impacts are to be understood as externalities, meaning that they are unintended positive or negative economic, social, or environmental consequences. While they rarely claim a social mission at the core of their organization (lower social promise), many *matchmakers* claim to generate positive externalities. For example, as the occupancy rate for its cars is 2.8 people (while the European average is 1.7), BlaBlaCar takes pride in its positive impacts on greenhouse gas emissions and energy use: "When you share your ride, you're directly helping to reduce CO2 emissions." (BlaBlaCar, 2019) While the actual story may be more nuanced (because of complex substitution effects with more energy efficient collective transportation), a European study shows that car-sharing can yield city-friendly and environmentally-friendly effects, when combined with other eco-transportation modes (public transport, bicycling or walking) (Loose, 2010). In the social dimension, one of the biggest controversies generated by matchmakers relates to the impacts of platform capitalism on work (Casilli, 2019). For-profit platforms are criticized for building quasi-monopolistic market positions, exploiting regulatory voids, and leading to increased precariousness for self-employed people and independent contractors who are highly dependent on platforms. The platforms are accused of using sophisticated algorithms to create new "digital economy feudalism" and externalizing welfare, social costs, responsibility, and risks to workers (Friedman, 2014; Redfearn, 2016; Slee, 2015). The affiliation of such initiatives with sharing economy values is thus met with skepticism, and these privately-owned platforms have been denounced for organizing forms of "pseudo-sharing" based on market mechanisms instead of social exchange and shared value creation.

Overall, because of their high scaling potential, *matchmakers* are confronted with massive social controversies and regulatory issues related to their intermediation power, the status of their workers, their effects on cities, or their economic impact on incumbent companies or professions (such as taxi vs. Uber drivers). While these platforms may claim various positive environmental and social benefits, such arguments need to be considered with caution, as they may be part of *matchmakers'* political strategies to respond to the social controversies they generate.

Implications

Implications for sharing economy initiatives

Our study has various implications for sharing economy entrepreneurs. We provide a framework for sorting out the complexity of the field. In a situation where external observers mostly focus on one dimension and refer to one particular subset of the sharing economy,

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we group the complexity of the sharing economy into four possible configurations of initiatives. While other sharing economy typologies have already been proposed, the purpose of many of them is descriptive, and they simply provide an empirical mapping of the field (Botsman & Rogers, 2010; Owyang, 2014; Stokes et al., 2014). Consequently, they fail to provide guidance on the managerial and social issues behind the development of the sharing economy. In our model, each of the four categories is constructed according to variables based on value creation and value distribution/capture, providing clear managerial guidance to sharing economy entrepreneurs. Our model has some points in common with the more analytical typology proposed by Schor (2014), but we are much more specific in our explanation of the specificities of each configuration, what kind of value (economic, social, environmental) is created by sharing economy entrepreneurs, the scalability challenges they may face, and how value is captured and distributed in each type. By locating their initiative in the matrix, sharing economy entrepreneurs can understand which competitive, managerial, and social forces are likely to play a key role for them. Accordingly, our model provides guidance for sharing economy entrepreneurs to spot internal scalability issues and potential external controversies.

Sharing economy entrepreneurs can also use our framework to identify potential opportunities to hybridize their current model or to think about possible strategic trajectories. Sharing economy initiatives can combine features of different models, creating hybrid forms from the four we have depicted (See the example of The Food Assembly in Box 1). For example, *commoners* such as iFixit or Comment Réparer develop a common good that is accessible to all, but also use mechanisms typical of *mission-driven platforms* as they aggregate decentralized peer-to-peer interactions to sustain their cause. Similarly, Uber's stated efforts to develop fleets of autonomous self-driving cars would constitute a significant shift from a *matchmaker* configuration to that of a *shared infrastructure provider*. This move could be viewed as a response to the controversies and regulatory risk that currently characterize *matchmakers,* related to the uneven value distribution between the platform and its drivers, the externalization of social risks to drivers, and the related legal risks of seeing its drivers reclassified as salaried workers. However, owning a centralized infrastructure would mean that Uber is drastically changing its business model to compete with established companies such as Zipcar, with different (more capital intensive) scaling mechanisms and different environmental and social issues to manage.

Box 1. Combining market logic and societal impact: The example of "The Food Assembly"

The Food Assembly is a European-based platform created in 2010. It enables individuals to organize local micro-markets for food products by connecting local consumers with local food producers (within a maximum range of 250 kilometres) through a digital platform. Once a minimum number of pre-orders is reached, food producers agree to deliver the products at a given date in a physical place (the micro-market) where producers and consumers meet. Each micro-market is managed locally by a network member who is incentivized on the volume of transactions realized (through a fixed commission of 8.35%). These individuals, who operate as self-employed entrepreneurs or associations, organize the local market by creating a local network of supply and demand, and regularly organizing a physical market in a localized physical space. Through its activity, The Food Assembly claims to create economic value and pursues a social mission to reduce the number of intermediaries between small agricultural producers and consumers, to promote local and small-scale farming and bypass large-scale distributors, and to give power and value back to consumers and local producers. To finance its activities and development, The Food Assembly takes a commission of 8.35% of the platform's turnover – about two to three times less than commissions from market platforms such as Uber or Airbnb in 2016. It also offers an equivalent commission to micro-market managers. The system is also meant to enable an increased margin for food producers who freely set their prices on the platform. In order to strengthen ties with its network, in 2016 The Food Assembly also distributed 10% of its capital as free shares to the network of micro-market managers.

This example suggests that our typology should also be used dynamically, to reveal trajectories for rapidly changing sharing economy business models. Observing the evolution of the field suggests that *mission-driven platforms* often experience tensions when seeking to scale up while preserving their mission. Mission-driven initiatives often run the risk of drifting towards a *matchmaker* approach, in particular when they introduce transactional logics that may weaken or run counter to community-based logics. In our sample, Peerby was

started as a site for peers to borrow material goods for free. It eventually developed a rental site (Peerby Go) for commercial transactions among peers, generating commissions and scaling much faster. Likewise, BlaBlaCar was first created as a free carpooling site (covoiturage.fr) in 2006, and switched to a commission model in 2012. That moment was critical in the life of BlaBlaCar: while it enabled the site to finance its growth and to improve the service by decreasing cancellations, many long-time users strongly criticized this change, which went against the free spirit of carpooling. Such changes may be criticized as resulting from purely strategic and opportunistic calculations instead of the espoused mission: organizations such as BlaBlaCar or Peerby may be criticized by external stakeholders for building communities of users with a free model, before monetizing transactions in a second stage, once a critical mass and traffic have developed. Moreover, The Food Assembly may also see their legitimacy contested by competing models grounded in more activist or more commercial logic. The initiative had to face intense criticism in France from the older and activist AMAP movement (community-supported agriculture associations), which create a direct and offline relationship between a group of consumers who support one small farm (in this system, consumers also support agriculture-related risks). Strongly-rooted in non-market ideology, AMAP criticize the digital, professionalized, for-profit orientation of The Food Assembly, calling it an example of "pseudo-sharing". To avoid such criticisms, organizations need to pay particular attention to avoid being associated with the *matchmaker* category and avoid such drifts. BlaBlaCar constantly professes to be a "cost-sharing platform" and refuses to be identified as an "on-demand platform". By underscoring its environmental and societal mission – reducing congestion and pollution and creating a trust-based community – it seeks to differentiate itself from other highly criticized actors in the mobility sector, such as Uber.

Implications for established companies

The sharing economy is traditionally depicted as a disruptive trend, shaking up established organizations and raising serious threats for established businesses. Recent research (Cusumano, 2015; Kathan et al., 2016; Matzler et al., 2015; PWC, 2015) has highlighted the need for established companies to respond to sharing initiatives and adapt their business models, for example by improving service to compete with this new source of competition (Kibum & Jeong-Dong, 2016). By bringing to light the multiple models and value-creation mechanisms of the sharing economy, our framework reveals opportunities for established companies to go beyond the sharing economy as a source of disruption and analyze the sharing economy as a field of potential opportunities to explore. Managers of established companies can explore each sharing economy logic while taking into account their different rationales, mechanisms, and potential benefits (cf. Table 3).

Shared infrastructure providers inspire established companies that want to explore service-driven innovation (Kastalli et al., 2013), exemplified by the access-based model. Providing access instead of selling a product requires new skills, such as complex resource-orchestration skills (due to the significant assets needed) as well as a shift towards a service mindset for organizations traditionally engaged in selling products (Matzler et al., 2015). Car manufacturers such as Peugeot and BMW are examples of companies that are exploring the product-service system (Tukker, 2004) business model by offering a short-term mobility solution through online car rental services, such as "Peugeot Rent" and "Drive Now", or by investing in mobility businesses (Peugeot bought a stake in Communauto in September 2016). In this way, they complement their traditional product offering with an on-demand service to satisfy users' mobility needs. Pursuing the same objective of business diversification, Leroy Merlin – a retailer present in Europe, Asia, and South America that specializes in construction materials, DIY, and gardening – partnered with TechShop to open its first 2000 square metre collaborative production space near Paris in autumn 2015. This market-diversification strategy enables the company to explore a new service for independent professionals, target younger and more "high-tech" customers, and benefit from the expertise of a recognized player in the field of shared DIY spaces. It also creates new sales opportunities for the Leroy Merlin store located next to the TechShop space, by capturing new flows of potential DIY customers.

Commoners provide a source of inspiration for companies wishing to implement community-driven innovation by allowing internal and external stakeholders access to corporate resources. Using the *commoners* logic may help companies to improve their relationships with internal and external stakeholders, thus increasing the legitimacy of the organization, with the aim of expanding the service offering to customers and engaging employees in an innovation culture. This can be done by giving external stakeholders access to unused and unvalued resources. For example, the French national railway company (SNCF) launched "Open Gare", a project aimed at upgrading and revitalizing former and abandoned railway stations. By making these physical

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Table 3. Established companies and sharing logics

	Shared Infrastructure Providers	Commoners	Mission-Driven Platforms	Matchmakers
Examples	• Peugeot (Peugeot Rent), BMW (Drive Now), Daimler (Car2Go) • Leroy-Merlin (partnership with TechShop) • Marriott (Workspring)	• SNCF (Open Gare) • Castorama (Wiki for Home) • Renault, Air Liquide (internal fab labs)	• Patagonia (Worn-Wear + partnership with eBay for second-hand sales) • Decathlon (Trocathlon)	• Mercedes Benz (Croove) • Fnac (online peer-to-peer platform) • IKEA (car-sharing partnership with BlaBlaCar)
Rationale	Service driven	Community driven	Sustainability driven	Competition driven
Key mechanisms	Develop for-profit services based on internal resources or external partnerships	Open the access to corporate resources for external and internal stakeholders by: • creating new resource pools • opening access to existing but unvalued resources	Develop a community of committed users/customers to promote corporate social and environmental values	Business diversification in sharing economy activities Develop partnerships with sharing economy companies to offer new services
Potential benefits	• Market diversification (exploring access-based business models) • Commitment to environmentally efficient solutions	• Enhanced corporate reputation with external stakeholders • Increased service for customers • Foster employees' motivation and a culture of innovation	• Strengthen/promote a sustainable corporate identity • Enhance customer service, increase customer loyalty • Build brand communities associated with social and environmental values	• Market diversification to platform business models • Enhanced service to customers (logistics, transport, etc.)

assets available to local associations, communities, start-ups, etc., the company allows and encourages the setting up of makerspaces, co-working spaces, and other collaborative schemes. Through this project, the SNCF saves money on maintenance and asset management, and improves its legitimacy by supporting local societal initiatives. And local stakeholders can develop collaborative projects without requiring huge investments. Taking inspiration from the Wikipedia model, Castorama, a French retailer of construction materials, DIY, and gardening products, launched "Wiki for Home" which aims to be France's largest free encyclopedia for home DIY knowledge and know-how. The platform places the brand at the core of a community of contributors and users who advise each other while sourcing their DIY material from Castorama. Managing such a community of young and digitally-savvy consumers engaged in the new reciprocal service provision through the wiki, has also enlarged the brand's traditional base of customers.

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Mission-driven platforms are likely to inspire companies who wish to promote their commitment to sustainability and shared-value creation by developing brand communities with strong values. For example, the outdoor clothing company Patagonia, building from its older in-house initiative "Worn Wear", partnered with eBay in 2011 to create an online marketplace for consumers to buy and sell used Patagonia clothing. Patagonia does not make any direct profit from these second-hand product sales, but it fosters its mission to protect the environment by increasing the usage of its products via peer-to-peer resale. An initiative like this also makes the brand's products available to buyers who may not have been able to afford them otherwise. Similarly, in 2014, Decathlon, one of the world's largest sporting goods retailers, opened an online version their "Trocathlon" initiative (a consignment sale for sports items held twice a year in their stores' parking lots) to make the service available year-round, commission free. Customers can buy and sell secondhand equipment and earn vouchers to spend at the retailers' physical and online shops. First, the company helps its customers manage the lifecycle of their sports equipment, favouring the recirculation of goods and thus reducing their environmental impact through extended use. Second, this initiative increases sales and customer loyalty, as consumers who improve their sport skills are encouraged to sell their old equipment through the platform and reinvest in new, upmarket and better-performing equipment.

Finally, *matchmakers* may appeal to companies exploring new areas of competition and see business opportunities in the sharing economy through peer intermediation (Evans & Schmalensee, 2016). Established businesses may take advantage of their reputation in established markets to become a trusted third party in the peer-to-peer market and compete with sharing economy companies. For example, Mercedes-Benz (a Daimler brand) launched Croove, a peer-to-peer rental platform in Germany. This type of initiative directly competes with other peer-to-peer initiatives in car sharing. It may also be a way to explore the future of mobility and new market developments. Such peer-to-peer platforms may also serve as an incentive to purchase, by showing how occasionally renting out one's new car may help pay back the initial investment. When a company already has an online marketplace, it is easy to open it to peer-to-peer exchanges and further develop customer loyalty by offering the possibility to intensify the usage/exchange of goods. For example, the French electronics and cultural retail chain La Fnac opened its online marketplace to individuals and companies wishing to resell their CDs, books, computers, etc. New customer services can also be pursued through the *matchmaker* logic by developing partnerships with sharing economy companies. In Europe, IKEA partnered with BlaBlaCar to launch a specific car-pooling service to tackle a major obstacle for city dwellers: transport from the city to their outlets. By making it easier to travel back and forth to stores, IKEA is attracting new customers and improving customer service.

Implications for policymakers

The sharing economy constitutes a challenge for policymakers. Impacts of the sharing economy vary according to the levels (city/national/transnational) and types of actors involved. Governments have to combine contradictory objectives: act in the public interest, take into consideration customers' appetite for peer-to-peer services, stimulate societal innovation, favour the growth of sharing economy companies while ensuring fairness for incumbents, limit and regulate potentially negative externalities related to the rise of independent work on digital platforms, etc. Moreover, the co-existence of a great variety of profiles and value-creation mechanisms in the sharing economy further complicates the task for regulators. Our four-part framework for the sharing economy field gives rise to differentiated recommendations for public bodies for either regulating, sustaining, or shaping the sharing economy.

1. *Regulate: Matchmakers* are quite controversial in terms of their social impact, as shown by repeated tensions and struggles related to the regulation of platforms in the hospitality and on-demand mobility sectors. This new platform economy has global economic impacts: it is reshaping the boundaries between the professional and domestic spheres, transforming work and employment relationships, and raising new issues in terms of taxation, insurance, customer protection and trust, labour law, and welfare protection (Redfearn, 2016). Complex questions arise about the legal and social responsibilities of these platforms, as they tend to externalize responsibilities to participants. Because of their global scale and their capacity to grow exponentially, *matchmakers'* social and environmental impacts can be enormous, on a national or transnational scale. For governments, the challenge is to better assess how *matchmakers* produce positive or negative externalities and build their expertise in this area, which includes encouraging independent studies on the environmental and social impacts of platforms, accessing data from platforms and producing external data, promoting virtuous practices to encourage positive externalities or regulating to reduce the negative ones.

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2. *Sustain:* As activists seeking to promote a cause, *mission-driven platforms* and *commoners* have the potential to introduce major environmental and social innovations, but their development is often inhibited by difficulties in raising financial resources or identifying adequate revenue models to support growth, as well as by the lack of certain skills, including community management/information systems and solutions development. For example, the promises of greater circulation of goods, reduced planned obsolescence and more responsible consumption announced by some non-profit lending and gifting platforms are hampered by technical and scalability issues. Organizations with hybrid governance models seem better able to overcome such challenges, by combining the activist logic of the *mission-driven platforms* and the commercial logic of the *matchmakers* while mastering the rules of the game of the digital sphere and developing the competencies required to deploy and scale up their platforms. Governments, as well as educational institutions (business, engineering, or design schools) and investors could encourage cross-fertilization between social entrepreneurship and the peer-to-peer digital world through multiple actions, such as dedicated incubators, tools and policies for funding, and collaborative projects between educational institutions.

3. *Shape:* With their focus on the access economy, both *shared infrastructure providers* and *commoners* are innovative spaces that combine social and technical innovations. *Commoners* also promote an ideology based on open knowledge, public goods and DIY, calling for democratic governance and open organizational models. These initiatives are often rooted at a more local level and may have strong impacts at the level of the community, city or region. For example, the project of Barcelona Fab City was born in 2014 as a partnership between the Barcelona City Council and the Barcelona Fab Lab, with the objectives of stimulating local creativity and transforming cities into productive hubs using digital fabrication technologies. Likewise, shared mobility services may be financially supported by cities that co-invest in such projects as part of their transportation policies. As a result, *shared infrastructure providers* and *commoners* may be shaped by local authorities (cities/regions) to promote policies in line with their local economic, environmental, and social strategies.

Conclusion

We have identified four different business model configurations that testify to the variety of profiles, promises, and postures adopted by sharing economy initiatives. Each configuration is characterized by specific economic, social, and environmental value creation and distribution mechanisms, and internal tensions that need to be managed to achieve sustainable growth and cope with controversial issues. Our model has important implications for the management of sharing initiatives and for the management of established organizations, which may learn how to integrate the sharing economy logic into the core of their own business. Our results also enlighten policymakers on how to regulate and support the growth of the sharing economy, according to its sustainability implications and society-level transformations.

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Appendix 1. Sample of people interviewed at the collaborative initiatives

Project Name	Number and Title of Interviewees	Type of Practice	Interview Location	Date	Duration
Recup.net	1 Founder	Donation	Paris	27/03/15	79
Co-Recyclage	1 Co-Founder	Donation	Paris	14/04/15	138
C'est bon esprit	1 Co-Founder	Donation	Paris	15/06/15	83
Place de la Loc	1 Co-Founder	Rental	Paris	11/06/15	82
DressWing	1 Founder	Rental	Paris	01/09/15	60
ShareVoisin	1 Co-Founder	Lending	Paris	15/04/15	56
Mutum	1 Co-Founder	Lending	Paris	22/04/15	101
Peerby	1 Founder	Lending	Paris	21/05/15	71
Peuplade	1 Director	Lending	Paris	21/05/15	41
Kikawa	2 Co-Founders	Lending	Paris	28/06/15	69
L'Etablisienne	1 Founder	Production	Paris	02/06/15	37
Ici Montreuil	1 Co-Founder	Production	Paris	08/06/15	62
La Nouvelle Fabrique	1 Director	Production	Paris	15/06/15	46
Mon Atelier En Ville	1 Co-Founder	Production	Paris	25/06/15	62
Fablab de Rennes	1 Co-Founder	Production	Paris	29/06/15	109
Volumes	1 Co-Founder	Production	Paris	30/06/15	51
Electrolab	1 Co-Founder	Production	Paris	01/07/15	114
Hall Couture	1 Founder	Production	Paris	07/07/15	54
WoMa	1 Co-Founder	Production	Paris	16/07/15	47
FacLab	1 Founder	Production	Telephone	13/08/15	66
Comment Réparer	1 Founder	Repair	Paris	26/03/15	128
Repair Café Coeur d'Alsace	1 Founder	Repair	Telephone	22/04/15	61
Vestaire Collective	2 Co-Founders	Resale	Paris	15/04/15	79
Brocante Lab	2 Co-Founders	Resale	Paris	04/05/15	63
A Little Market	1 Co-Founder and Director	Resale	Paris	06/07/15	53
M&A for Ladies	1 Co-Founder	Resale	Paris	07/09/15	58
The Food Assembly	1 Co-Founder and Director	Market platform	Paris	23/11/15	90

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Innovation Ecosystems as Structures for Value Co-Creation

Sanna Ketonen-Oksi and Katri Valkokari

> *"The most important inventions and the most successful people are driven by collaboration. Collective inventions, by definition, require tolerance and diversity, and they cannot be cut from the same cloth."*
>
> Francisco Varela (1946–2001)
> Biologist, philosopher, and neuroscientist

Despite the many recent discussions on "innovation ecosystems" as well as on open innovation or other co-innovation models, a more in-depth understanding of the multi-actor processes of value co-creation remains rather scarce. Hence, in this case study, we provide significant novel insight about innovation ecosystems as structures enabling multi-actor value co-creation in real-life innovation ecosystems. Based on our empirical findings, we identified two key principles: 1) in order to encourage the active participation of ecosystem actors in the value co-creation process, efforts must be made to ensure a clear vision and a shared value base on which the ecosystem activities can be built and 2) facilitation is needed to support the ecosystem actors to make new connections and to share their knowledge and resources in concrete ways. Most importantly, the more diversity there is among the ecosystem actors, the greater the support for innovativeness within the value co-creation process.

Introduction

In recent years, a more dynamic view of business and innovation has emerged (Whalen & Akaka, 2016). Instead of conceptualizing innovation as a firm-centric activity, the emphasis has now shifted towards both the service providers' and the customers' abilities to engage themselves in large, external networks for value creation (Romero & Molina, 2011). However, with a limited focus of analysis on interactions and value transactions, the understanding of innovation as a process that consists of multiple different actors and practices (Helkkula et al., 2018; Kartemo et al., 2018;) remains rather poor (Barile et al., 2016; Järvi & Kortelainen, 2017; Suominen et al., 2016).

Indeed, given the growing dynamism and complexity of modern business environments, companies are becoming more and more dependent on their external networks crossing many disciplines and industries. In order to maintain their competitiveness, network-specific innovation capabilities have become a lifeline for many companies (Valkokari et al., 2016). When building up these dynamic and more futures-oriented innovation capabilities, companies may well even double their economic growth (Rohrbeck et al., 2018). By thus highlighting the role of collaborative organizational structure and culture (Aarikka-Stenroos & Ritala, 2018; Smorodinskaya et al., 2017), the literature related to innovation management has been lately undergoing a significant transformation towards a more networked and systemic nature of value creation (Järvi & Kortelainen, 2017; Lee et al., 2012; Vargo & Lusch, 2016). This includes the increased focus on more collaborative practices of knowledge creation.

However, despite many years of active discussions on open innovation or other co-innovation models (Lee et al., 2012), understanding of the (inter)relationships between the different actors involved in the actual *value co-creation* processes has remained rather scarce (Barile et al., 2016; Järvi & Kortelainen, 2017). Besides the arising interest on remodelling the former solutions-based innovation policies and practices, more real-life examples are needed to challenge the theoretical approaches to and exuberantly positive discussion on

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value co-creation (Clarysse et al., 2014; Lintula et al., 2017). That is, greater effort and coordination are needed to engage researchers in different fields of science to empirically test and re-conceptualize the fit between the theoretical foundations and current discussions regarding value co-creation.

So far, academic studies have been primarily concerned with the strategic positioning of firms within ecosystems. In doing so, they have referred to ecosystems according to their various contextually or functionally changing roles (Akaka et al., 2017; Autio & Thomas, 2014; Spigel, 2017). Despite Adner's (2016) earlier work, calling for a structuralist approach to conceptualizing the ecosystem construct, the current understanding about the structures and practices supporting value co-creation in *innovation ecosystems* is still very limited. In particular, studies on value co-creation as a process, consisting of a high number of value transactions between the various loosely-coupled ecosystem actors, are practically non-existent. Therefore, in this study, we use a *two-part model approach for value co-creation* (Galbrun & Kijima, 2009; Kijima & Arai, 2016) to: i) understand how ecosystems could be developed as structures for value co-creation and ii) identify the key practices shaping these structures.

First, we provide a brief overview of the key concepts used in this study, as well as the chosen research approach and data collection method. Then, based on two empirical case studies, we identify and discuss the key prerequisites to support the ecosystem actors' abilities to first unfold and then either maintain or remodel the different structures and practices of value co-creation.

Key Concepts

Innovation ecosystems: The new dynamics of collaboration

Ever since the concept of business ecosystems (Moore, 1993) was first introduced, different concepts of ecosystems have emerged, disrupting the traditional boundaries between organizations and industry sectors. As for now, they all tend to encourage companies to widen their views and practices related to industry-specific partnerships (Aarikka-Stenroos & Ritala, 2018; Adner, 2016). Given that the concept of innovation ecosystems has been previously tied up around the creation of growth, local collaboration, and innovative startups in so-called knowledge hubs (Engel & Del-Palacio, 2011), a broader view of innovation ecosystems has been introduced.

Innovation ecosystems are "dynamic and co-productive spaces for research, development, and innovation (R&D&I) activities that are characterized by a high level of interdependence and co-evolution of value between the industry and research-based ecosystem actors" (Adner & Kapoor, 2010; Autio & Thomas, 2014; according to Schroth & Häußermann, 2018, p. 4). In other words, innovation ecosystems, just as entrepreneurial or knowledge ecosystems, are strongly connected with their ability to explore and adopt new knowledge (Valkokari, 2015). However, the motivations for knowledge sharing are different depending on the type of the ecosystem. Where innovation ecosystems are focused on interdisciplinary and cross-sectoral collaboration which results in new competencies and resources (Schroth & Häußermann, 2018), the entrepreneurial ecosystems are more directed towards coordinating and fostering social networks within particular geographical contexts (Stam & Spiegel, 2016). And, knowledge ecosystems are organized around a joint knowledge search on a particular context of study (Järvi & Almpanopoulou, 2018).

Value co-creation: A focus on innovation as a continuous process

Given the arising need for a more dynamic and practice-oriented view on innovation, the importance of a continuous interplay between the various ecosystem actors with many several overlapping purposes and different views on ecosystems has been strongly emphasized (Meynhardt et al., 2016; Parker et al., 2016). That is, there has been a growing interest in social cognition and connectivity (Knyazev et al., 2018) that underlies the socially constructed meanings (Adler, 2015) and the highly interactive, even symbiotic logic of value co-creation (Dattée et al., 2018; Meynhardt et al., 2016; Smorodinskaya et al., 2017). Instead of simply referring to innovation as the successful implementation of creative ideas within an organization, more attention has been given to *value co-creation as a collaborative process* (Edvardsson et al., 2011; Rajala et al., 2016).

For a long time, the term "value" was only used when referring to value that was created through the manufacture and distribution of tangible goods (Prahalad & Ramaswamy, 2004; Vargo et al., 2008). However, in recent years, a growing tendency towards a more systemic view on value co-creation has emerged. By embracing the concepts of *value-in-use* and *value-in-context,* rather than the concepts of *value-in-exchange* and *embedded-value,* the supplier-driven value chains have now been replaced with value networks that gather all stakeholders (Vargo & Lusch, 2008). According to

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this increasingly accepted, more systemic, and transdisciplinary view on value co-creation, value co-creation is defined as "the joint, collaborative, concurrent, peer-like process of producing new value, both materially and symbolically" (Calvagno & Dalli, 2014).

Hence, by shedding light on the interdependencies between the repetitive sequences of cooperation, conflict, and compromise (Pellikka & Ali-Vehmas, 2016), it is clear that the alignment of value is not always possible or even desirable (Pera et al., 2016). In other words, consisting of both intentional and emergent actions, contributions to value co-creation may be either positive or negative (Lintula et al., 2017) – or simply neutral. As a result, it seems that many of the existing theoretical frameworks and models now fail to provide suitable tools for adapting this more dynamic view on value co-creation in practice (Koskela-Huotari et al., 2016). For this reason, in this study, the understanding of both value co-creation and *value co-destruction* are included in the exploration and analysis of the value co-creation process.

Research Approach and Data

Considering innovation as a major challenge to practitioners in both the private and public sectors, in business and in research, a more systemic view is needed of innovation as a complex process of interactions between a dynamic configuration of people, organizations, and knowledge (Kijima, 2015). That is, whereas Adner (2016) has raised a discussion about ecosystems-as-structures, viewing ecosystems as configurations of activities that are defined by a shared value proposition, our aim is to explore innovation ecosystems as systems that focus on generating new knowledge. With this in mind, we see innovation ecosystems as more open and loosely-coupled systems that allow the ecosystem actors to use the acquired knowledge in their own particular ways, for example, in their firm-specific business ecosystems.

Hence, in order to examine the development of these desired, more dynamic, and futures-oriented innovation capabilities in the real-life ecosystems, a two-part model on value co-creation is applied (Kijima & Arai, 2016) as the framework of analysis. To do so, we refer to the service science's view on innovation as something that is always embedded in the value co-creation structures (Lusch & Nambisan, 2015). In this study, innovation is to be considered as the outcome of a gradually evolving process that unfolds the existing, both explicit and implicit perceptions of value co-creation.

A two-part model for value co-creation

First introduced in 2009, the two-part model for value co-creation consists of two separate yet partly overlapping concepts (see Figure 1): platforms and ecosystems. On the one hand, the concept of a *platform* refers to the first part, where different actors meet one another and become interested in value co-creation. On the other hand, the *ecosystem* concept refers to the second part, where the actual value co-creation takes place in four major phases of interaction (Kijima & Arai, 2016). By thus seeing platforms as venues where the ecosystem actors can connect with one another (i.e., as venues for

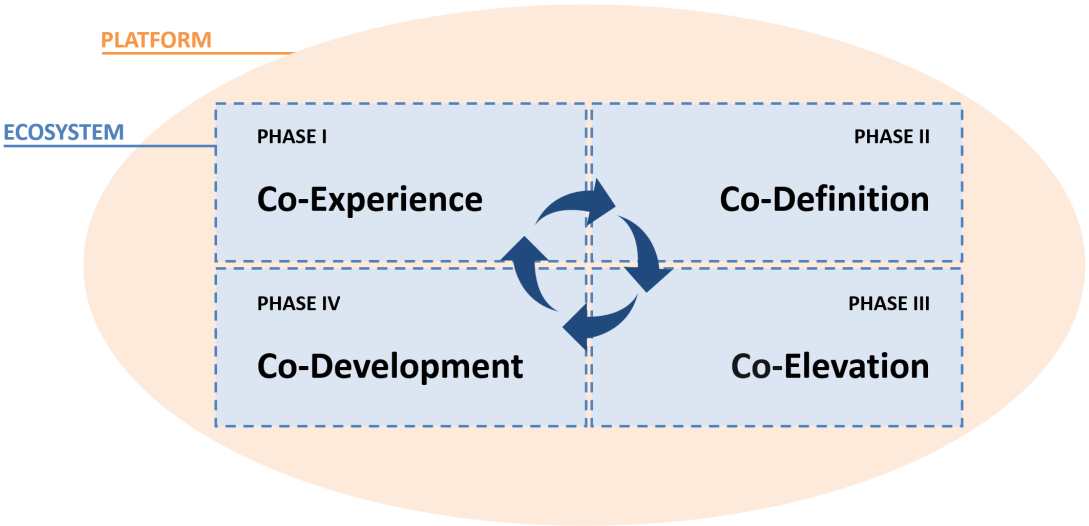

Figure 1. The process of value co-creation (see Galbrun & Kijima, 2009)

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innovation), the focus on platforms remains in facilitating and orchestrating actions that may eventually lead to value co-creation or co-destruction. Therefore, it is important to invite as many and as wide a variety of actors as possible to join the platforms. Then, with the support of the actual innovation process, consisting of four phases – co-experience, co-definition, co-evolution, and co-development – the systemic and progressive nature of the value co-creation process can be actualized.

In practice, the value co-creation process starts once the ecosystem actors come together in terms of mutually shared interests in innovation. During the first phase (co-experience) the ecosystem actors become aware of their needs and expectations, and gradually start to mirror them against the needs and expectations of other ecosystem actors representing a number of different individuals and organizations. Then, during the second phase (co-definition), the actors come across with each other's capabilities to share their internal models and perceptions of value co-creation. In the third phase (co-evolution), the focus finally turns to actual value propositions, strengthened by an active communication between the ecosystem actors. Last is at the fourth phase (co-development), where the concrete value co-creation – or co-destruction – is actualized and evaluated (Galbrun & Kijima, 2009; Kijima et al., 2014).

The overall purpose of these four phases is to emphasize the active, creative, and social nature of the value co-creation process. They also create a structure that supports the ways in which the value co-creating actors engage in the process of continuous interaction through knowledge creation and exchange. Considering the depth of collaboration during the process, objectives and goals must be clearly expressed and discussed. This process requires effort and commitment from all the value co-creators. By interacting with one another, the different actors learn about each other's expectations and needs, aiming at a shared internal model (i.e., shared practices and principles that feed the process). During these four phases, multiple approaches to addressing the mental and physical aspects of human beings are curated and empowered (Galbrun & Kijima, 2009; Kijima & Arai, 2016).

Case selection

The case selection of two different ecosystems was made in line with guidelines for case research (Eisenhardt, 1989). Based on the researchers' access to the underlying processes of value co-creation in the two different ecosystems, the selected cases were both comparable and complementary to one another. That is, both ecosystems were built around a physical platform as the core of the ecosystem, with a different number and variety of ecosystem actors, but they represented different fields of industry. In addition, both ecosystems were still under construction. Hence, special attention was given to maximizing the multidimensionality of the research approach and data collection, thus resulting in rich learning and exploration through the selected cases.

The first ecosystem (case A) was built around a multitude of ecosystem actors that aim at developing a leading centre for the actors in a sustainable bio-economy, both in Finland and globally. In doing so, it aims to create an open, dynamic, multi-actor ecosystem for business, research, and education within the field of cleantech innovation. Originally, the initiative for this ecosystem development was made by a large research institute who then decided to move its research laboratories to this hotspot. Eventually, the research laboratories formed the core of the innovation ecosystem.

The second ecosystem (case B) was purposefully designed to encourage and support productive collaboration between a technology university and its many stakeholder organizations. Situated at the centre of a university campus and co-managed by the owner of the ecosystem properties and the university, it offers a broad range of services and multipurpose facilities for learning and innovation.

Data collection

Based on a qualitative, multiple-case-study approach, the empirical data of this study consists of both interviews and focus group observations. All data was first collected and then analyzed by two independent researchers (i.e., the authors of this article). The informants (i.e., interviewees and focus group members) included a variety of ecosystem actors: (senior) corporate executives, managers, researchers, and university staff – a variety of people involved in the ecosystem development, management, and utilization. Altogether, over 40 people were interviewed in the studied ecosystems. The data sources are summarized in Table 1.

The collected data differs in form: the case A data consists of several focus group meetings where ecosystem actors are building shared understanding, whereas the case B data consists mostly of interview data. This is because the case A data focus more on the composing

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Table 1. Data sources

Case	Interviews	Focus Groups
A	Interviews 13 (representatives of 7 organizations)	12 focus group meetings (01/2017 – 11/2018)
B	Interviews 22 (representatives of 10 organizations)	1 focus group in August 2016, and 1 focus group in March 2018

phase of the ecosystem, while case B complements it with data on an already exiting interaction platform and the ecosystem around it. In reality, the value co-creation process is iterative, and the four phases of value co-creation are often overlapping one another. In order to place each of the identified structures and practices according to the here presented four phases, they are aligned with the specific focus of individual phases (such as raising awareness at the co-experience phase).

Case Findings

Platforms as the initial settings for value co-creation
In both cases, a physical place formed the core of the value co-creation (Table 2). In case B, one of the stakeholders stated that being present at a specific location for value co-creation was considered as an important benefit: "This place represents a no man's land, easily accessible to all kinds of actors." The importance of the diversity of actors was also highlighted by the co-managers: "It's strategically important that the campus welcomes different actors to work in the same premises."

In case A, not all actors were present at the same location and the research facilities were not open to all. Many parties were interested, but the development was strongly led by the research institute and the focus was on research infrastructure. Many separate subcomponents arose out of the common agenda during the value co-creation process, but the physical location could also hinder ecosystem building. It was important that the actors identified themselves with the ecosystem and were committed to joint collaboration and to opening up their own interests.

Understanding the process of value co-creation
In case A, the aim was to create a close development network with a common technology roadmap, referring to the "sustainability of society and growth of an industry sector". In case B, the ecosystem development started by creating a space where people can meet. At this first phase of value co-creation (see Table 3), the role of facilitation was seen as very important. As stated by the facilitator working in case B, "the role of facilitator is to be enthusiastic, to make people enthusiastic and to innovate". Similarly, in case A, the facilitator's role was in engaging different actors in value co-creation. This happened through formal or informal discussions, and by presenting the research facilities to hundreds of visitors during the year.

In both ecosystems the physical facilities were recognized as a valuable showcase of innovation activity and opportunity creation, or, as one of the university actors in case B expressed: "to enhance different forms of cross- and transdisciplinary collaboration". Again, one of the stakeholders, a city representative actively involved in the case A development said that: "These facilities and the research done here attract global forerunners to take part in networks of innovation. It's easy to invite new actors – this is an excellent example of our strengths in this technology sector."

In phase II (see Table 4), the role of facilitation was still rather important, as highlighted by the participants in case B: "If the aim is to really mix people and ideas, more support is needed to activate the co-creation process" and "Allocating more time for the platform activities would certainly be beneficial." As pointed out by the ecosystem developers from case B, "It takes time before

Table 2. Observations related to the core value of platform orchestration

Case	Core Value
A	Platform integrating different research facilities, enabling knowledge, and resource sharing
B	Platform enabling collaboration between diverse actors with different backgrounds, orientations, and interests

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Table 3. Observations related to the co-creation processes: Phase I

Case	Phase I: Co-Experience
A	• An ecosystem facilitator, employed by the research institute, boosted the evolution. • The shared vision was rather generic. • A jointly created ecosystem brand supported stronger commitment by the participating city. • Regular meetings supported networking and updates between the actors.
B	• It was well acknowledged that the ecosystems' learning process takes time. • The role of interactions was highly appreciated. • Diversity was regarded as an asset by some ecosystem actors, but not all.

Table 4. Observations related to the co-creation processes: Phase II

Case	Phase II: Co-Definition
A	• New connections and encounters were constantly being created, bringing together actors from different sub-assemblies (e.g., educational institutes). • Two other research institutes and one company also decided to locate some of their research facilities and personnel in the same building. • More diversity was needed, and this issue was being actively worked on.
B	• The role of facilitation was essential in enhancing value co-creation. The phase of co-definition was exponentially growing due to various meetings and events. • Many of the ecosystem actors were more or less observing the platform instead of actively participating. • Co-creation was understood in a rather generic way. • Some conflicts manifested as differences between the ecosystem actors' expectations, and their ability to act upon the shared visions varies greatly. • The focus of discussions were largely related to sharing one's own knowledge and understanding of issues that attract interest.

people get familiar with new concepts". Furthermore, as pointed out by the facilitator of case A, the ecosystem facilitator should not be tightly connected to the content creation, but "to be an enabler and connector and to support the substance experts so that they can focus on their research".

While the role of facilitator was highlighted during the first phases of value co-creation, in this co-elevation phase (see Table 5), the facilitator should take a back seat. This results in shared responsibilities and fosters multiple development perspectives. In addition, in both of the studied ecosystems, there was a lot of talk about and much interest in value co-creation, but the abilities to practice it varied considerably. However, if the objectives are not clear and efforts are not made to learn by doing, that is, if the discussions do not lead to a shared knowledge and understanding of the expected outputs, ecosystems may not evolve in the long run. Thus, in case A, the benefits of shared research infrastructures represented an important and concrete value for the ecosystem, as described by a research organization representative: "these shared facilities enable us to follow and benefit from the research progress of our partners".

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Table 5. Observations related to the co-creation processes: Phase III

Case	Phase III: Co-Elevation
A	• Ecosystem actors were more active in development and in suggesting new connections, initiatives, and partners (both national and international). • Investigations were made to locate new actors and their activities in the same physical location. • Ecosystem facilitation was shared among participants. A new leading actor emerged.
B	• Co-creation seemed not to turn into action but remains a topic of discussion. • Things were mainly run from a company-specific viewpoint. • Co-creation was first limited to some of the leading ecosystem actors but grew in active content or goal-specific networks. • Changes in the working cultures are slow; they did not merge. • Sharing was first limited due to trust and competitiveness issues, but more recently, a lot of product development and research has taken place within the ecosystem. • The ecosystem sheltered individual institutions and networks. • Understanding of the ecosystem started to develop in more profound ways.

Given the low maturity of case A, the actors have not yet had enough time to develop the goals and objectives needed to reach the co-development phase (see Table 6). As the four-phase model of value co-creation initially suggests, it seems to take a long time for some ecosystem actors to integrate into the value co-creation processes. As revealed in case B, it is only after several years that the shared vision of ecosystem functionalities reaches a phase where the unusual diversity of the actors becomes an asset rather than a limitation for a shared vision. Regarding the platform-specific innovation hub, limited to only some ecosystem actors, the vision is clear, and the role of the facilitation has developed accordingly.

Having observed the ecosystem actors' different perspectives and understanding of the concepts of platform and ecosystem, as well as how they operated according to alternative innovation management "theories of practice", significant impacts were detected on their mindsets and – eventually – on their value co-creation practices. The need for radical change was largely

Table 6. Observations related to the co-creation processes: Phase IV

Case	Phase IV: Co-Development
A	• There was a lack of a detailed roadmap for the entire ecosystem, with some more focused roadmaps for the sub-assemblies. • There was no common assessment framework (i.e., the clear and measurable objectives were missing).
B	• Co-creation mainly took place at the platform-specific innovation hub. • An increasing number of actors were joining the activities on a continuous basis. • Some ecosystem actors have a very limited, linear and mechanical view on innovation; some members considered ecosystems to be fully functioning only when systemic thinking was applied. • The use of a variety of different communication channels increased. • More disruption was needed to unfold the dominant practices of collaboration.

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acknowledged. Yet, due to uncertainties about the impacts of value co-creation on future business models and the roles within the future ecosystems, the business actors' willingness to engage in open discussion and collaboration were clearly diminished.

The development of value co-creation practices

The importance of understanding the differences between the four phases of value co-creation was highlighted in both case studies. Figures 2 and 3 summarize the thus identified value co-creation practices.

Conclusions

As the existing studies still tend to only focus on firm-specific viewpoints (Adner & Kapoor, 2010; Akaka et al., 2017) and certain types of ecosystems (Pellikka & Ali-Vehmas, 2016), the aim of this study was to shed light on the complex nature of innovation ecosystems as structures for value co-creation through new knowledge creation. Hence, based on two empirical case examples, this study offers important new insight into the co-existence of different value co-creation practices in

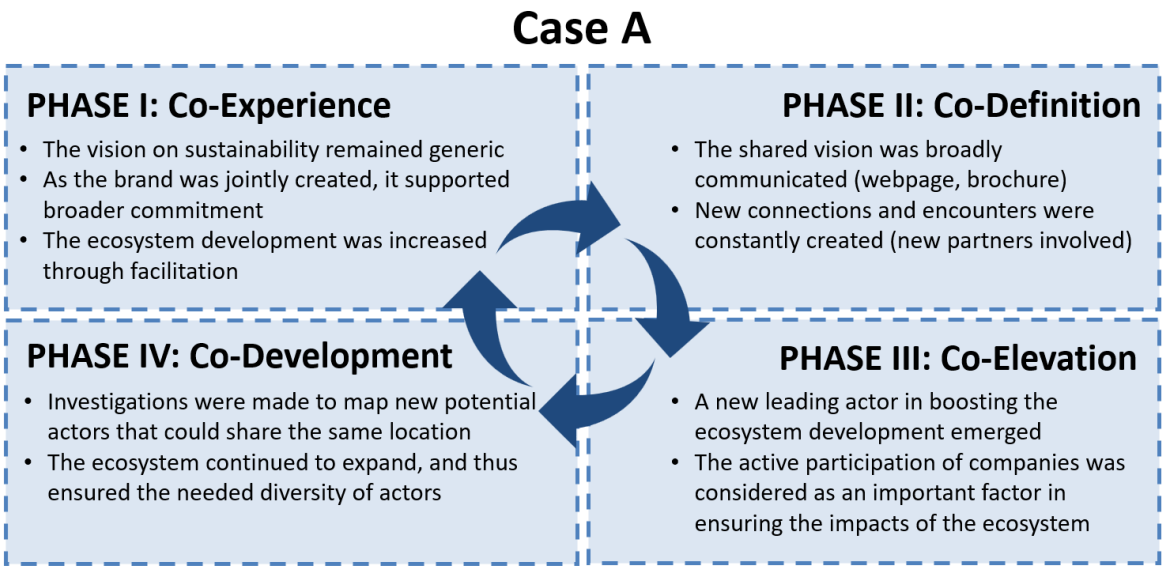

Figure 2. Practices enhancing value co-creation in case A

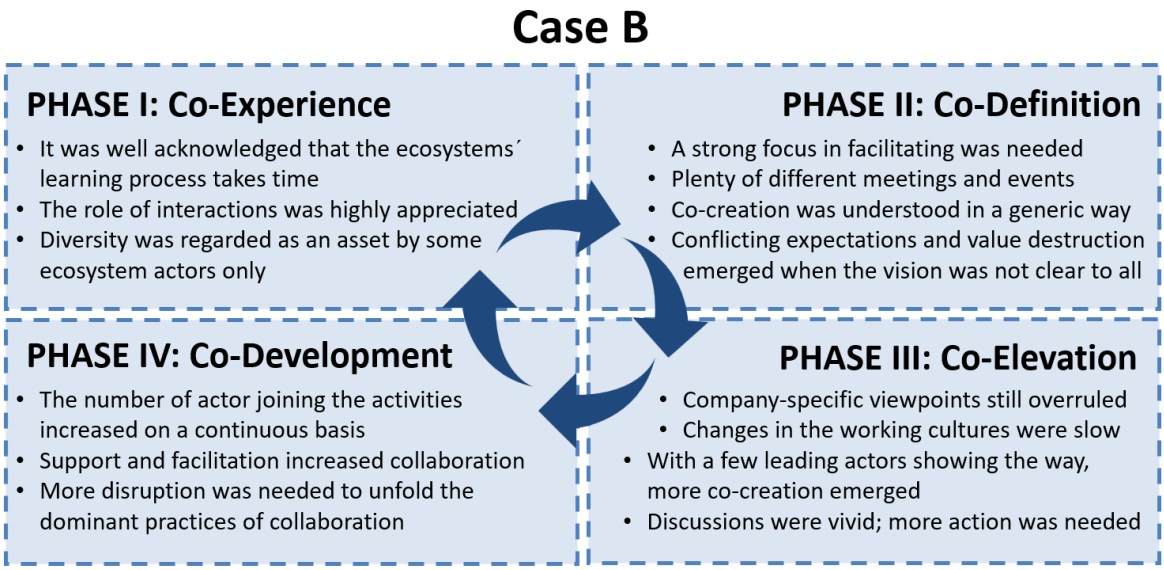

Figure 3. Practices enhancing value co-creation in case B

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the studied innovation ecosystems. In doing so, both theoretical and empirical understanding is provided regarding the value co-creation practices.

The results of this study are well in line with the two-part model approach to value co-creation (Kijima & Arai, 2015). First, the importance of understanding the differences between platforms and ecosystems was highlighted. In doing so, in both cases, the platforms were identified as important venues for the ecosystem actors to get introduced to one another and to share their ideas for collaboration. Second, the different phases of value co-creation were observed, including the forms of interactions between the ecosystem actors. According to these observations, the process of value co-creation took place in several sub-systems (i.e., in various independent development projects and programmes occurring at the innovation ecosystem). This is highly in accordance with the recent understanding of ecosystems as the contexts at which the continuous interplay between multiple actors and with a number of overlapping purposes and different views emerges (Meynhardt et al., 2016; Valkokari, 2015). In addition, this study complements the earlier perspective on ecosystems-as-structures (Adner, 2017) by introducing two practical case examples where the emergence of coevolution dynamics is used to create new knowledge within the innovation ecosystems.

In both cases, the ecosystem development was somewhat hindered by the rather generic aims of collaboration and the conflicting expectations regarding the ecosystem development. For this reason, attention was given to the role of facilitators as important connectors or enablers of value co-creation. Surprisingly, despite the increasingly global nature of their activities, both ecosystems were largely dependent on having a concrete physical platform as the "home base" for the value co-creating activities. That is, a place where different people and organizations can meet and create trust-building collaborative ties. In case A, the shared use of a research laboratory and other facilities for research were provided for this. In case B, many events and meetings were organized for researchers and company representatives with common interests to meet.

Finally, as presented in Figure 4, in order to enhance the ecosystems' value co-creating potential in practice, it is highly essential to invest in two key principles. First, in order to ensure a certain diversity among the ecosystem actors, and to encourage them to actively participate in the platform, seek shared values and invest time and energy into making a clear vision that is easy to identify with. Second, support the vision with structures and facilitation that help to match people and ideas in concrete ways.

It is also noted that certain ecosystem actors – or at least their current business models – may fall by the wayside during the evolution of the innovation ecosystem towards several future business ecosystems. This means that participating in and facilitating collaborative innovation in ecosystems calls for a new kind of agility that, in some cases, requires companies to be willing to even kill their current business model(s) to survive within the evolving ecosystem. These aspects of systemic change

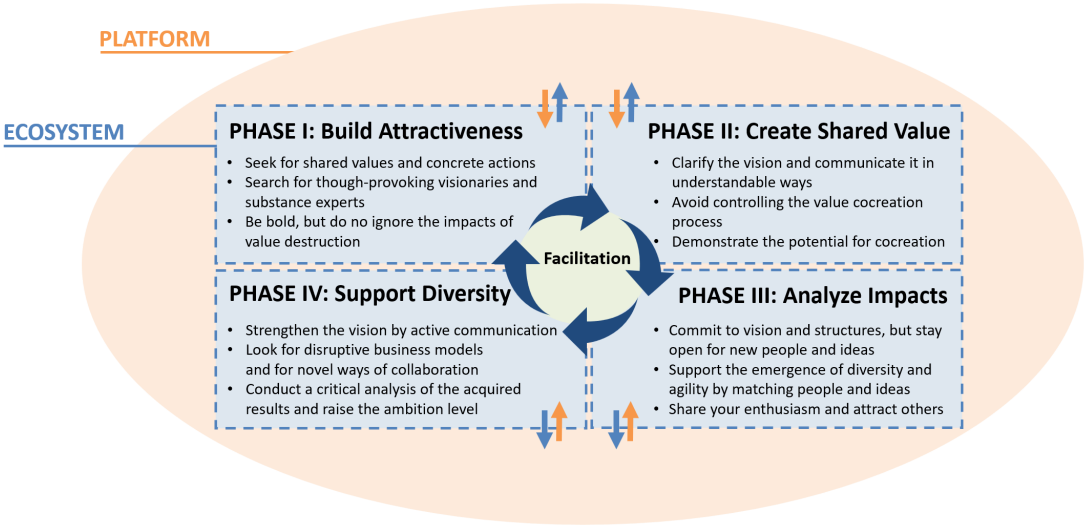

Figure 4. Summary of practices enhancing value co-creation in the studied innovation ecosystems

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are yet not sufficiently discussed by researchers or practitioners interested in value co-creation and collaborative innovation. As the complexity and multiplicity of actors participating in these innovation ecosystems increases, a more dynamic and open dialogue is required from all ecosystem actors to better understand and balance the interplay between value co-creation and value co-destruction.

About the Authors

Sanna Ketonen-Oksi works as a futurist-in-residence at Talent Vectia Oy (Espoo, Finland), a company offering strategic consulting and training services for organizations interested in renewal and new growth. With broad experience in EU-funded research, development, and innovation projects, often in university-industry collaboration, and based on her PhD studies on the service-dominant logical view on value co-creation and innovation, she sees that more understanding about innovation as a process of multi-actor collaboration is still needed. The growing complexity and dynamism of the innovation ecosystems is also an integral part of developing organizational futures orientation.

Katri Valkokari is a Research Manager working in the business, innovation, and foresight research area at VTT Technical Research Centre of Finland. She has over 15 years of experience in both research and practical development work on business networks, ecosystems, and networked business operations. She has, for example, held the post of programme manager in the large FIMECC (GP4V) and DIMECC (REBUS) research programmes, and worked for many industry companies, large and small. Katri has published several articles, managerial guidebooks and other publications related to collaboration models, innovation, and knowledge management as well as sustainability. When it comes to ecosystems and networks, Valkokari believes versatility is the key to creating true impact. When networks are formed openly, they can be a powerful tool for solving many of society's problems.

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Mastering the Digital Transformation Process: Business Practices and Lessons Learned

Lucija Ivančić, Vesna Bosilj Vukšić, and Mario Spremić

> *"The consumer society is so all-pervasive today that it is easy to assume it has always existed. Yet, in reality, it is one of the more recent innovations that propelled the West ahead of the Rest."*
>
> Niall Ferguson
> Economic historian, professor, and author
> In *Civilization: The West and the Rest*

Due to its unique features and accessibility, the focus of implementing digital technology is no longer just to improve internal operations, but to expand internal dimensions, reach customers and external partners, affect services, integrate processes, disrupt markets, and fundamentally change industries. It is no surprise that the notion of digital transformation has garnered much research interest, especially from the practitioners' point of view, but academic achievements are somehow lagging behind, possibly because frameworks for digital transformation are still evolving. In this article, we tried to address that gap by conducting holistic research of digital transformation in companies. We used a series of in-depth interviews to inform comprehensive case studies of three companies from different industries that are in different stages of digital transformation. We carefully investigated the companies' experiences in the process of digital transformation, which are discussed here to provide valid theoretical framing. We conclude that, in addition to technology adoption, important factors for successful digital transformation are the ability of an organization to change and operational excellence in the integration of external digital services with internal IT support. In that light, we summarize our findings in a form of discovered (sub)dimensions that are the basis for the proposed digital transformation framing, while the narratives and case experiences provide with examples of best practice.

Introduction

Digital transformation can be comprehended as a continuous process of climbing the scale of digital maturity by employing digital and other technologies along with organizational practices to create a digital culture. Ultimately, this maturity will enable the company to provide better services, gain competitive advantage, and effectively respond to actions in a complex environment. Companies that successfully employ digital transformation enjoy better returns on their assets and are generally more profitable (Westerman et al., 2012).

In response to the promise of these positive business outcomes, digital transformation and digitization have become common "buzzwords" in both the business world and the academic community. Studies on digital transformation date back as far as a dozen years ago (Kohli & Johnson, 2011; Zhu et al., 2006), but have only recently aroused greater scientific interest (Bosilj Vukšić et al., 2018). Digital transformation has been mostly investigated by prominent research centres in collaboration with professional experts from consulting companies (e.g., Gill & Van Boskirk, 2016; Kane et al., 2015; Westerman et al., 2011), whereas academic researchers are somewhat lagging behind. From the practitioners' point of view, there is a struggle in finding effective ways of conducting digital transformation (Lucas et al., 2013; World Economic Forum, 2018). Moreover, academic achievements offer little help given that digital transformation is an emerging field and the body of literature still provides limited value in terms of representative case study examples that practitioners can actually benefit from (Bosilj Vukšić et al., 2018; Henriette et al., 2015).

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Hence, there are opportunities for further scientific research that will yield both practical implications and better scholarly understanding of digital transformation. Our research aims to contribute to the field of digital transformation topic addressing the identified research gap. Therefore, in order to shed some light on the digital transformation concept, our study aims to achieve the following research objectives:

1. To conduct a holistic and comprehensive investigation of all aspects of digital transformation.

2. To propose empirically grounded directions for developing a framework for digital transformation and its business implementation.

This article is structured as follows. After the introduction, we briefly describe our methodology. Next, we present our findings by systematically describing our case companies' experiences in the digital transformation process, and we present the digital transformation sub-dimensions we identified through the analysis. The discussion that follows emphasizes recommendations and lessons that can be learned from the experience of the studied companies. Finally, we offer concluding remarks and identify future research directions.

Methodology

We adopted a qualitative approach by conducting three case studies to address the research objectives. Qualitative reasoning has been extensively used in information systems research since, according to Myers (1997), a shift of interest has been made in direction of organizational issues of information systems science. Consequently, a case study approach gives good justifications for questions of "what" (descriptive design), or "how" or "why" (explorative design) a certain phenomenon occurs, and for obtaining first-hand and in-depth understanding (Yin, 2006). In addition, case study investigations are considered appropriate when a topic needs to be explained in detail or in relation to the context, as well as for early research stages of defining the variables of research topic by employing a holistic vision (Benbasat et al., 1987; Matthews & Ross, 2010; Myers, 1997). Therefore, a case study design was chosen for fulfilling the objectives of this study given that its aim is to gain first-hand insights and clarify digital transformation practices in companies in a holistic manner. The adopted case study approach is well established and accepted in different information systems areas and in the related literature in general (Niehaves et al., 2014), including digital transformation (Kohli & Johnson, 2011; Sebastian et al., 2017), since it allows researchers to study practices and situations that are understudied and not yet completely described and comprehended, such as the topic of digital transformation.

Prior to conducting the case studies in companies, a case study protocol was made, including research objectives, data collection methods, and interview protocol with questions and prompts to ensure reliability. We followed the work of Kane and coauthors (Kane et al., 2016) and adapted it to match our research objectives, alongside the experience and knowledge of the authors related to organizational science, business process management, IT, and digital transformation, in order to convey a set of guiding questions utilized in semi-structured interviews (Appendix 1) with top-level managers. Interviews are typical source of data in case research (Myers & Newman, 2007; Sebastian et al., 2017; Vukšić et al., 2013) and were chosen as a data collection method because we wanted to obtain opinions and experiences of top-level managers on the digital transformation processes, efforts, and utilized practices in their companies. We decided not to use a completely free-form interview format because, although qualitative in nature, we wanted the results to be somewhat comparable in order to deliver more relevant results in a cross-sectional study. Hence, we opted for semi-structured interviews. The questionnaire tool option was discarded because our interest was not in the strict form and quantification of digital transformation in the case companies but, rather, we sought business practices and lessons learned in the process of digital transformation. According to Matthews and Ross (2010), semi-structured interviews are appropriate for this research objective because they enable free expression by interviewees and they yield more and specific information on the topic and explanation of occurring behaviours and practices.

We conducted three interviews in total with four C-level executives in charge of digital transformation in their companies. Each interview lasted for about an hour and was recorded with the informant's permission. A few interviews lacking information identified as relevant for subsequent analysis were supplemented with details acquired from the interviewees at a later date. We followed coding and analysis case study protocol outlined by Voss, Tsikriktsis, and Frohlich (2002) who suggest taking a three-step approach for case study data coding and analysis: data fragmentation

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(open coding); cross-case analysis; rearranging data for new insights (axial coding). First, the interviews were transcribed. The transcripts were afterwards used to summarize the findings in a coding procedure using Microsoft Word and Excel. A procedure for data analysis included coding of general information found in transcripts by marking the focal parts and important information of the interview. After that, a dimension notation that most precisely describes these parts was added in the transcript. In the end, a cross-case analysis was conducted in order to extract general dimensions from the text alongside with somewhat richer explanations that were used to identify sub-dimensions. This type of coding and data analysis protocol is common for studies using interviews as a data gathering method (e.g., Buh et al., 2015; Sebastian et al., 2017). On top of that, narratives and case-specific information were used to depict organizational practices and lessons learned from our case companies.

Case Selection

This research was conducted in three companies operating in Croatia, but which have strong ties to other markets. In addition, all of the companies had been in the market long enough to experience necessary changes from old ways of doing work to the modern requirements of the digital age, which makes them appropriate for research on digital transformation. Additionally, the country context is a relatively small European economy where awareness of the importance of digital transformation among established companies is not completely developed. Case selection therefore focused on companies that: i) have started digital transformation projects; ii) are advocates of digital transformation in the business community; and iii) have ties to other markets.

An overview of the three selected case companies is provided in Table 1. For privacy reasons, alias names for these companies have been used in the article. Case company A is a telecommunications provider, here named Teleop, with a parent company in Western Europe that has branches in more than 50 countries and has more than 200,000 employees. Case B, here named Manufact, operates in the manufacturing sector. It has export-oriented production and is a global market player in its niche. Case C company, here named Insurer, is a regional leader in the insurance industry that has branches in 6 regional countries and has more than 2,000 employees in Croatia only.

Findings

In our analysis, distinctive orientations taken in digital transformation directions can be observed among the three case companies, especially when viewed in light of their different industries. Manufact's digital transformation efforts are focused on gaining competitive advantage through production speed, Insurer appraises operational excellence, while Teleop focuses on building digital services infrastructure developed in cooperation with partners. Nonetheless, of the sector-specific differences, general conclusions about the setup of digital transformation can be drawn. The multiple case

Table 1. Overview of the three case companies

	Case A Teleop	Case B Manufact	Case C Insurer
Industry	Telecommunications	Heavy manufacturing	Insurance
Number of employees	3,550	315	2,100
Average revenues in the last three years	€820 million	€30 million	€345 million
Year of foundation	1998	1976	1964
Started digital transformation	6 years ago	1 year ago	2 years ago
Formal role of Chief Digital Officer (CDO)?	Yes	No	Yes
Part of an international subsidiary?	Yes	No	Yes
Head of subsidiaries?	No	N/A	Yes

study approach has enabled us to identify seven dimensions of digital transformation – strategy, people, organization, customer, ecosystem, technology, and innovation – and their corresponding sub-dimensions, as summarized in Table 2.

As shown in Table 2, most of the sub-dimensions apply to more than one case, if not all three. However, due to specific requirements of work arrangements and business in diverse sectors, our in-depth content analysis of the interview transcripts revealed certain company-specific features that are described in the forthcoming narratives and are more detailed explanations of findings presented in Table 2. In addition, narratives depicture miscellaneous practices employed by companies to foster digital transformation and accompanying organizational changes that can serve as good practice examples. Also, case practices in the following sub-sections are discussed in relation to and corroborated by findings from other existing studies on specific topics related to digital transformation.

Strategy

Sharing a common digital vision is comprehended as an important factor for the successful outcome of digital transformation endeavours in our cases. Still, every company develops its strategy according to its own needs and the stage of its digital transformation process. This diversity in defining a digital transformation strategy was also noticed in research on three companies by Hess and colleagues (2016). In Manufact, the corporate strategy incorporates a digital vision. On the other hand, Teleop and Insurer enacted their strategies as separate strategic documents carefully aligned with corporate strategic vision. However, according to Teleop, the company no longer relies on the strategy very much nowadays. This is due to entering a more mature stage of organizational digital transformation, to cite the Teleop respondents – the "organization for the digital era", which represents the company once a digital culture is incorporated into its organizational structures. Regardless of the differences in strategic approaches, two common notions are evident: i) defining a Chief Digital Officer (CDO) role in charge of digital transformation projects and efforts and ii) strong support of the board. Even though the official CDO role has not been established yet in Manufact, the company's CEO plays a partial role of a CDO by strongly reinforcing digital projects. Other authors also streses the significance of supporting the capacity and influence of a CDO in a process of digital transformation (Horlacher & Hess, 2016; Singh & Hess, 2017). Nevertheless, even with the top-level management vision and support, a battle for gaining resources (both human and financial) among competitive organizational projects remains, which holds repercussions for talent development, as discussed in the next subsection.

People

In order to develop a digital culture and also gain competitive advantage, organizations employ measures for acquiring employees with digital skills and encouraging a culture of knowledge-sharing in the workplace. For instance, Insurer recruited a new CDO from the telecommunications industry, which is acknowledged as a pioneering sector in digital transformation (e.g., Westerman et al., 2012; Kane et al., 2015). With years of relevant experience, Insurer's new CDO is expected to assist with the digital transformation process after the initial enactment of the digital strategy. Other employees with digital skills are also specifically recruited. These employees can then collaborate on digital projects, inside their original teams or outside them, depending on the sort of project or matrix organizational structure in the company.

They also advocate for a culture of knowledge-sharing and help their peers selflessly. Having in mind benefits for the company and work outcome, they do it without fear of someone else taking credit for their input. In the experience of all of the case companies, these qualities seem to be inherent to the younger demographic of employees. In Manufact, younger employees adjust faster to novelties and, hence, provide internal education and transfer their knowledge to the rest of the company, especially after returning from formal education. With such a practice, a number of employees that can participate in digital solutions development increases, thereby leveraging limited human resources in times of increased project activity.

Organization

A digital transformation unit cannot operate alone, nor can a digital project be run separately from the rest of the company. Hence, digital transformation requires the inclusion of staff from other departments besides the digital transformation unit. This phenomenon was previously noticed by Teleop, who had for this reason advisedly dissolved their digital transformation unit but retained the function of a CDO. Members of the digital transformation are now intentionally distributed over the company to foster a digital spirit and assist internally in digital projects. In the words of Teleops' current CDO: "We did this allocation specifically with the aim

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Table 2. Organizational resources and activities in the digital transformation process (continued on next page)

Dimensions	Sub-Dimensions	Case A: Teleop (Telecommunications)	Case B: Manufact (Heavy manufacturing)	Case C: Insurer (Insurance)
Strategy	Digital strategy has been enacted.	✔		✔
	Digital strategy is aligned with corporate strategic vision.	✔	✔	✔
	Subsequent transformation phases to help operationalize activities are designed.	✔		✔
	Board of directors supports digital transformation	✔	✔	✔
	Chief Digital Officer (CDO) role is acquired.	✔		✔
	Digital transformation includes business process enhancement, standardization, and IT integration that supports digitized solutions.	✔	✔	✔
People	Digital skills are developed through constant training and education (internal and external; formal and informal).	✔	✔	✔
	Talent development HR process is in place.	✔		✔
	Young people or those with proactive mindsets are specifically recruited.	✔	✔	✔
Organization	Digital transformation unit manages transformation efforts.		✔	✔
	Digital "evangelists" advocate digital spirit and cooperate in digital endeavours.	✔		
	Digital transformation unit or "evangelists" report directly to higher management.	✔	✔	✔
	Digital projects are run through the project organizational structure.	✔	✔	✔
	Organizational measures include digitally related key performance indicators (KPIs).	✔	✔	✔
	Common management practices from the fields of organization management and operations management are utilized.	✔	✔	✔

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Table 2. (continued) Organizational resources and activities in the digital transformation process

Dimensions	Sub-Dimensions	Case A: Teleop (Telecommunications)	Case B: Manufact (Heavy manufacturing)	Case C: Insurer (Insurance)
Customer	New products and services are offered to provide a better experience and new value for customers.	✔	✔	✔
	Solutions are (re)designed according to the end-to-end customer journey.	✔	✔	✔
	Customers participate in process delivery.		✔	✔
	An employee who knows the customers' needs is always included in (digital) project teams.	✔	✔	✔
	Customer satisfaction is regularly measured.	✔		✔
Ecosystem	Partners are connected to the main IT system creating a digital platform.		✔	✔
	New digital products and services are developed in cooperation with partners.	✔		
	Cooperation with the academic community enables knowledge harvesting.	✔	✔	✔
Technology	Processes are being digitized.	✔	✔	✔
	Robotic process automation is implemented.		✔	
	Internal IT system transformation is ongoing to better support digitized solutions.	✔	✔	✔
	Big data solutions are utilized.	✔	✔	✔
	Customer data is collected to improve services.	✔		✔
	Application interfaces are simplified and redesigned for greater interactivity.	✔		✔
Innovation	Top-level management encourages idea creation.	✔	✔	✔
	Employees can share their ideas directly with their superiors.	✔	✔	✔
	An innovation-evaluation process is established.	✔		✔

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that they [the members of the digital transformation unit] cultivate digital transformation, but this time from another direction, from the business units themselves or from IT."

The adoption of new technologies for: i) utilization purposes (e.g., handling robotic automation in Manufact or digitized processes and points of sales in Insurer) or ii) new solutions development (e.g., new infrastructure for services based on Big Data in Teleop or software technologies for robotic reprogramming in Manufact) requires constant training. Alongside with internal training, opportunities for external training are also offered to employees. These can include earning standardized certificates or somewhat less formal education such as partnering with Gartner for the provision of individual on-request consulting services, which is the case in Teleop. Also, in Teleop, a specific focus is put on agile education, such as acquiring Scrum certificates with the aim of creating an Agile project organization, which is reasonable since, according to Recker and colleagues (2017), projects to implement information systems depend on a company's capacity for agility.

Coping with constant changes that come along with a process of digital transformation can be difficult. As remarked by one of the respondents from Insurer: "We implement changes pretty fast, and just to change something isn't enough. People are overwhelmed by them and find it hard to adapt. A certain fatigue could have been detected lately." To overcome this issue, Insurer has implemented a change management process. A similar experience was reported by Manufact. They came to the conclusion that a more personal approach would be more suitable for their company. Individual employee conversations are held to communicate changes, alongside with 360-degree feedback for open evaluation of coworkers, regardless of the hierarchy. Other practices and methods from the field of organization management and operations management are also utilized, including methodologies related process management such as Business Process Management and Lean Management. These methods support digital transformation in companies from an organizational perspective, such as human resources or operational excellence.

Customer

Quality of service provision is a more prominent consideration in Insurer and Teleop, which due to nature of their business, consider operational outcomes as a combination of customer journey design with technologies implemented to speed-up end-to-end customer-related processes. The end-to-end customer journey is a key guide in designing digital solutions. In Insurer, it is also used as a decision-support tool for process changes. Products and services are (re)designed in order to provide better customer experience, advance service quality, and create new value for the customers, all while having in mind distinctive market characteristics and being guided by customer needs. For example, even though a social network and the online omnipresence of customer support is 24/7 available to the Teleops' customers, their buyers in one market are more inclined to prefer personal contact, meaning they are more like to visit a physical customer centre. In that light, Teleop has revised its centres' opening hours. The decision-support system for altering the opening hours was enriched with information from software analyzing people density and movement data, collected from telecommunications mobile network. Analysis of network traffic data enabled the detection of busy periods and informed decisions about the centres' optimal locations and opening hours.

Due to the manufacturing economic activity of Manufact, which by nature has a limited number of customer touch/engagement points, the end-to-end journey is achieved through an online ordering system and adapting the process outcomes and key performance indicators (KPIs) to customer needs. Besides reducing the product errors, automation provided Manufact with well-needed speed in delivering project deadlines with highly time-sensitive customers. Due to this competitive advantage, Manufact closes deals by virtue of being able to deliver the product faster than the other global competitors. Another customer-related aspect of digital transformation is greater involvement of customers in business processes. In Manufact, customers start sessions in the production system through an online sales portal, whereas the clients in Insurer are entitled and encouraged to use digital channels to make damage claims on their insurance policies – a process which once required the agent to go out on a field assessment.

Ecosystem

The highest goal of digital transformation in our cases is greater inclusion of customers in company processes, often through the digital platform, which creates a business atmosphere where customers are perceived as partners. On one hand, given that the main business activity of Teleop is the provision of core telecommunication infrastructure and services, partnering in network projects for the Internet of Things (IoT) creates

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new market and revenue opportunities for the company and other parties willing to connect to the network. On the other hand, sharing of the available mobile network traffic data raises the overall efficiency of partners involved in the ecosystem. Indeed, the greater need for knowledge, which is driven by current digitization, fosters collaboration with partners, including business-to-business (B2B) customers, public and government organizations, or even unknown actors in a process of value co-creation (Brust et al., 2017; Hossain & Heidemann Lassen, 2017; Pellikka & Ali-Vehmas, 2016). Also observable from our cases is a close connection with the academic community with the aim of soliciting knowledge, innovations, and human resources. The most eminent example of academic partnering is in the Silicon Valley where a circle of IT firms and firms from other sector, startups, and the academic community evolves for new value creation (Kane et al., 2017).

Technology

Incumbent digital technologies can be observed according to the strength of affiliation with the traditional corporate IT. Hence, we can classify digital technologies as primary (e.g., mobile, social, cloud, Big Data, and IoT and secondary or emerging (e.g., 3D printing, wearables, virtual and augmented reality, artificial intelligence, drones and robotics, and deep learning algorithms (Spremić, 2017). As such, organizations have the option to choose from a pool of abundant modern technologies, depending on the digitization areas they are focused on. As it turns out, companies do not excel in all implementation areas (Westerman et al., 2012), and as observable from our cases, neither do they have the urge to do so. Having its niche in manufacturing industry, Manufact focused its implementations on the production line, introducing robotic automation. Robots can observe and act in response to the observed environment, thereby minimizing the need for human involvement and reducing product errors. Insurers' digitization efforts are directed towards customer-oriented process digitization. Tablet PCs are used remotely, providing agents with access to quality information and allowing them to complete tasks even at a distance. Providing instant service in the customers' locations, mobile agents empower agility and better customer satisfaction with services.

As evident from Table 1, all three of the companies utilize Big Data and related technologies to gain additional insights and generate new value out of data. Some of the companies have used the existing data, which has previously not been exploited, whereas other ones noticed the opportunity to collect new data to infer conclusions or offer new services. Manufact introduced production-line cameras and an image-recognition algorithm for quality control and quality assurance, whereas Insurer uses open public geographical data in combination with drones in the process of environmental damage assessment. Teleop, on the other hand, used existing network data (anonymized and generalized) to provide diverse stakeholders with information about the network traffic. Such information enables the bank to optimize the locations of automated teller machine, for instance. Or, it can help tourism offices decide where to place tourist guides and multi-language signs.

Furthermore, alongside the adoption of digital technologies, our companies stressed the need for a quality enterprise resource planning (ERP) system in the background and undertaken efforts to standardize business processes. Process digitization calls for revision and standardization of the process, in terms of workflow, but also the terminology, especially in service industries, which, as also seen in the financial sector, have a diverse portfolio of products and many communication and sales channels. Likewise, Insurer put efforts into employee education and the harmonization of process nomenclature so that a certain product would be offered under the right name to the customer and therefore would launch the correct process instance in the digital platform. In addition to that, an efficient ERP system in the background joins utilized digital technologies into one IT system and empowers information flow.

Innovation

Innovation generation is strongly encouraged by the management of our case companies. Ideas are transferred to the supervisors through diverse channels, although in Manufact it is not uncommon to approach the general director directly with ideas, thereby bypassing the chain of command. By the narrative of Manufacts' CEO: "People say that they came because they have a great idea and worry it will be lost in the hierarchy. So, they approach me, and I support that kind of behaviour." They also explained that this practice is sufficient for handling incoming innovation ideas, for the time being. Interestingly, these initiatives regularly come from younger employees. Hence, a special effort is put into employing engineers with innovative, curious, and proactive mindsets. Teleop has adopted a somewhat more formal approach for idea evaluation by

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constituting a special board that is convened monthly in so called "idea pitch" sessions to assess large projects proposed by employees. However, in the experience of Teleop, and other cases around the globe (Kane et al., 2016), innovations do not have to be game-changing. They can be modest, such as Teleop starting to use Word documents along with digital signatures to digitize the administrative process of exchanging student contracts between three parties.

At Insurer, the top management team's openness to new ideas has resulted in a great and ever-increasing number of ideas that became hard to administer. They try to counteract this issue with an Innovation Committee along with an idea-management portal on the Intranet for employees to apply their ideas to the evaluation process. Insurers' CDO explains the reason behind this business move: "The volume of these ideas is enormous! Besides that, after idea submission, our employees expect first of all to get feedback, and afterwards, they expect someone to be dealing with the idea and [to know] who would, in the end, come with an implementation proposal addressing the underlying issue. Above all that, in order to keep employees content, we have to be able to repeat the process and make it sustainable. In other words, we need to have a team constantly employed on these activities."

Another common innovation management activity in companies is an annual "innovation competition" (Kane et al., 2018; Westerman et al., 2012). According to Westerman and colleagues (2012), competitions train employees to think of new ideas and help them identify gaps in business that could be innovated. Our case companies regularly finance these kinds of meetings, which also include external participants, or they take part in student case studies and business or technological idea competitions. Regardless of the adopted approach, evident from our research is that systematic efforts to encourage idea generation and maintenance should be undertaken in order to convey ideas to value-generating innovations and benefit from the company's innovation potential.

Discussion and Lessons Learned

The seven main dimensions of the digital transformation identified from our research are strategy, people, organization, customer, ecosystem, technology, and innovation (Table 2). The identification of these dimensions supports related works arguing that digital transformation is much more than simply employing digital technologies (Kane et al., 2015; Kohnke, 2017). The strategy dimension encompasses the enactment of digital strategy and other means for ensuring proper governance. Although some authors emphasize the importance of digital transformation strategy (Hess et al., 2016), we found that digital ambition is a more important factor for successful transformation, since the ultimate goal is to have "digital" institutionalized as an ordinary company setup. Nevertheless, for starters, digital strategy enactment can be a good start to a digital transformation process. The innovation dimension encompasses the means and resources that enable innovation generation and management, and it is connected with sub-dimensions related to organization and people dimensions, since innovation capacity is determined by human capital and can be developed through workshops and other educational methods. Other supporting evidence of "people" as an important category in digital transformation setting can be found in the literature (Kane et al., 2015; Kane et al., 2016). The case companies we investigated digitize processes and develop new digital services and solutions, which could not be possible without an efficient operational system in the background to ensure information flow between different digital solutions and applications. Our findings regarding the technology dimension are in good agreement with the works on the importance of the role of business-management systems in digital transformation (Asprion et al., 2018; Sebastian et al., 2017). For instance, Sebastian and co-authors (2017) argue that there are two technology assets that serve as enablers for digital transformation: operational backbone and digital services platform. Managing changes that come with digital transformation can be overwhelming, and all of our companies agree that employing a change-management process is perhaps more important than ever in this digital age. Employees get used to specific work patterns, and changing their habits without communicating and implementing such changes properly can undermine digital efforts. Change management, HR conversations with employees, and education help employees adapt to change and contribute to a digital culture in the company.

Through the process of digitally transforming, companies discover the most suitable means for themselves as the "learn by doing". Likewise, there are differences in stages of digital transformation among companies that can be explained by digital transformation start period, as shown in Table 3. Whereas Table 2 presents resources and practices in digital transformation, Table 3 envelops information that provides an overview of the state of digital transformation process by each case. Table 3 also points out each company's most important

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Table 3. Process characteristics and lessons learned in digital transformation

	Case A: Teleop (Telecommunications)	**Case B: Manufact** (Heavy manufacturing)	**Case C: Insurer** (Insurance)
Start of digital transformation process	6 years ago	1.5 years ago	2 years ago
Internally defined phase of digital transformation process	Phase 3	Phase 1	Phase 2
Description of internally defined phase of digital transformation process	Digital culture developed after three strategies; new business models adopted	Still in the beginning; no formal strategy defined but digital projects in place	Several projects finished; a second strategy is on its way
Main goal of digital transformation	Find new business models and monetization methods	Create a completely automated production process	Offer new services and keep or enlarge customer portfolio
Operational backbone characteristics Adapted from Sebastian et al. (2017)	Standardized key business processes and organizational management system (home grown)	Standardized key business processes and organizational management system (home grown)	Standardized key business processes and centralized customer database (home grown)
Digital services platform characteristics Adapted from Sebastian et al. (2017)	Personalized, flexible customer experience within a topic area (in progress)	Aggregation and analysis of different data from sensors, devices, other sources	Continually adjusted, personalized customer experience with analytics and behavioural economics (in progress)
Selected digital transformation success indicator	Launched customer application for integrative service management	20% export products segment yearly growth	23% premium online insurance policy growth in 2018
Lessons learned and recommendations As described in digital transformation framing (Table 2)	Ask the users if solution makes sense; maximize available data monetization potential; CDO is a bridge and a separator	Ally with universities and hire young people and those with proactive mindsets	Maintain or develop high service quality and employ change management
Priority dimension Following digital transformation framing (Table 2) and Lessons learned and recommendations (in previous row)	• Customer • Technology • Strategy	• Ecosystem • People	• Technology • Organization

lessons learned. Although companies address all of the dimensions in the process of digital transformation, linking these lessons with digital transformation framing from Table 2 unfolds some priority dimensions.

Additionally, we asked our companies to select one KPI or successful project that they are mostly proud of and that was facilitated due to activities of digital transformation. The selected success indicators are in good agreement with the main goals of digital transformation and can be correlated with industry and niche particularities.

Teleop has passed through several phases of digital transformation. Currently, its digital strategy does not coexist as a separate document; rather, it is a coherent part of other strategies and a way of doing business, with emphasis placed on customer orientation. In Teleop, they consider their company to have achieved a digital organizational culture. Since telecommunication companies are in a good position of having access to geolocation, customer, and other population data, a smart reflection would be to try to finding them a new, additional purpose. There are three recommendations emerging from the Teleop case. First, always ask the users, whether those are internal users (i.e., employees) or external users (i.e., customers) if the digitized process or solution makes sense – they are the company's best consultants. Second, companies should consider maximizing the available potential for data-monetization. Finally, make most out of the CDO role. Business units know the customer, and IT units should not be burdened by endless business meetings and discussions. Rather, they should have enough time for technology implementation set out by the CDO. The CDO is both a bridge and a separator between business units and IT that ensures smooth project development and implementation.

In 2018, Insurer reported 23% growth in premiums for online insurance policies, which is consistent with efforts to enlarge its customer portfolio while providing a high-quality service standard. Growth was facilitated by related operational steps and enablers in the digital transformation project: creating a digital insurance policy, simplifying the buying procedures, increasing the number of maximum periods for paying in installments from 10 to 12, removing 3D security in credit card payments with accompanying risk assessment, analyzing daily consumer visits, and conducting behavioural analytics in the customer journey coordinated with digital marketing. As far as Insurer is concerned, a key to successful digital transformation would be to ensure continuously high service quality for external customers (i.e., buyers) and employ change management so that internal customers (i.e., employees) are satisfied and efficient.

Being an export-oriented manufacturing company, Manufact seeks to create a completely automated production process including integration at the level of supply chain integration with partners. Although in the beginnings of formal digital transformation, Manufact already benefits from the digitization and innovation capacity of their employees. They are experiencing yearly growth of 20% in the export products segment. Robotic automation that uses sensors and Big Data in the production lines has enabled greater product quality in comparison to competitors, greater efficiency, and greater production capacity. Big foreign buyers considered these features as indicators of security and trust because they show that the company is ready to tackle the current market challenges (e.g., short timelines from order to delivery) that, in the end, lead to increased exports. According to Manufact, the main lessons learned in digital transformation relate to innovation capacity and generation: companies should not forget to ally with universities, and they should employ the best engineers that are willing to make a difference for the company.

Conclusion

Organizations struggle to employ effective combinations of best practices and available resources to make the most out of digital transformation, and the topic is still developing in academia. We tried to address this gap by performing a qualitative holistic investigation on digital transformation in three companies (Research Objective 1). Besides technologies adoption, we discovered that important co-factors of digital transformation are: i) the overall organizational setup supporting a digital culture and related changes ii) and operational process excellence with efficient integral information systems in the background. Special consideration in digital transformation needs to be made regarding change management, innovation management, and talent development. In the end, a digital mindset and digital skills have the potential of being an essential mediating capability in determining the success of digital transformation endeavours.

Inferring from the cross-sectional first-hand insights of our research, this article provided a systematic analysis of digital transformation in companies through univer-

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sal digital transformation resources and practices that are presented in a form of digital transformation dimensions and sub-dimensions (Research Objective 2). Taken together, the case companies addressed all of the identified dimensions, but we showed that certain dimensions can be prioritized depending on the main goals of digital transformation. In addition, particular focal areas, activities, and lessons learned related to certain company and sector are explained in the narratives.

Although this research contributes to the body of knowledge on digital transformation, the limitations of qualitative research need to be considered, such as the limited number of companies that originated from the same country. Nevertheless, we tried to counteract this limitation by selecting a diversified cross-sectional portfolio of distinguished companies, and hence, we believe that it is valid to generalize the findings. Future research attempts could evaluate our postulates in additional case studies or through a quantitative survey design.

We believe that a holistic investigation of the topic enriched with first-hand qualitative data provides many possibilities for further dissemination of the presented findings. The synthesis of our findings in the form of digital transformation framing with (sub)dimensions can be further utilized in digital transformation models and to construct hypotheses. Moreover, specific framing components reveal research topics that can be more thoroughly investigated in future studies.

Practitioners can benefit from business-related revelations presented in this article. Digital transformation framing alongside the recommendations from our case companies can be used to guide strategy. We encourage them to use our digital transformation framing and best practice examples to establish a well-defined digital transformation setting. As far as our own future research on the topic is concerned, we plan to continue investigating the digital transformation process in organizations and its underlying aspects in order to contribute to an ontology, as well as to provide the practitioner community with insights to guide the hands-on operation of their businesses.

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Appendix 1. Illustrative questions from the semi-structured interviews

- What does digital transformation mean for you? How do you understand it?
- When (what) would (or will) mean that your company is "digitized"? Do you see this as a project(s) or as a permanent process? Would you agree with the claim that digitization is the use of digital technology for changing business models and processes and creating new business opportunities?
- In your opinion, how will digitization disrupt your industry?
- When did you start systematically / formally with digitization your company and what was its development?
- In which area do you implement digitization projects? To what extent? Are they focused on customer engagement or on the digitization of products/services?
- In which area are you planning to start projects in one year or in the next two to five years? To what extent? Are they focused on customer engagement or on the digitization of products/services?
- Do you have a digitization strategy in your company? Is the digitization strategy independent or is it included in the IT strategy / business strategy? In what relation is the digitization strategy with other company strategies? Is it aligned with other strategies?
- What are the roles of different CxO (CDO, CEO, COO, CMO, CIO) in formulating the digitization strategy?
- How (would) you measure the progress in your company in the field of digital transformation?
- Does digitization have a significant impact on your business models?
- Do you pursue the following goals through digitization: increasing efficiency, increasing innovation, improving business decision-making, significantly transforming business processes?
- What is the role of CIO (or highly ranked employee responsible for IT)? Work role? Where in the hierarchy of the organization is he/she positioned?
- What is the role of CDO (or highly ranked employee responsible for digitization)? Work role? Where in the hierarchy of the organization is he/she positioned?
- To what extent do you digitize customer engagement?
- Are external stakeholders also involved in digitization? How do you connect with external actors? What role do they have?
- Are your processes digitized (IT implementation)? Are you using ERP / CRP / SCM / PLM... solutions? What is the level of their integration over the processes?

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- How do you ensure the connectivity and transparency of your processes? How do you provide crucial information in your company? In your opinion, is it always available on time? Is the information correct? Is there one version of the truth?

- To what extent do you digitize your products and services (digitized solutions)?

- Where do digitization initiatives come from? Who participates in digitization projects?

- What knowledge and skills are needed for participants digitizing projects?

- Do employees have adequate knowledge and skills? How do they obtain them? What knowledge and skills possess individual participants have (IT personnel, employees responsible for digitization)?

- What are the roles of individual stakeholders in digitization? Did the roles change? How? Do individual stakeholders cooperate with each other? How? How are they involved in defining, designing, and implementing digital transformation? How do you personally evaluate the cooperation between individual stakeholders?

- How do different stakeholders identify and co-create value in digitization? How are IT personnel included? Are they covering business or technical aspects (or both)?

- How is your company strengthening digital innovation capabilities? Developing the digital capabilities of existing employees; collaboration with contractors and consultants; cooperation with other organizations (e.g. partnerships and other forms of cooperation); recruiting employees with relevant knowledge in the field of digitization; recruiting leaders (managers) with relevant knowledge in the field of digitization; mergers and acquisitions?

- How do employees in the company accept digital transformation?

- Are employees keen on (support) the changes that are caused by digital transformation? Any differences between different groups? How do you encourage employees to adopt the changes caused by digital transformation?

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Keywords: digital transformation, digitization, digital business, digital transformation model, digital model, talent management, human capital, innovation management, change management, case study

Understanding Digital Innovation from a Layered Architectural Perspective

Jesper Lund and Esbjörn Ebbesson

> *"Good ideas may not want to be free, but they do want to connect, fuse, recombine. They want to reinvent themselves by crossing conceptual borders. They want to complete each other as much as they want to compete."*
>
> Steven Johnson
> Popular Science Author
> In *Where Good Ideas Come From (2010)*

Managing successful digital innovation processes is a challenging task, especially when it involves heterogeneous actors with different sets of knowledge. By gaining a better understanding of how different architectural layers of digital technology interplay with digital innovation, we can be better prepared for managing the complex and messy processes that often arise when working with digital innovation. In this article, we therefore ask: How does the layered architecture of digital technology interplay with digital innovation processes? A case study approach was selected to studied events involving multiple actors in an innovation and development project called the Smart Lock project. The theoretical basis for our study is digital innovation from the perspective of knowledge exchange and relationships. A temporal bracketing strategy was used to support a process analysis of the case data. The article primarily contributes to the body of research concerning digital innovation and provides an example to practitioners of how digital innovation processes can be coordinated and managed based on the innovation at hand.

Introduction

The already challenging task of managing successful innovation processes has become even more so today, when innovation processes are becoming increasingly messy (Fagerberg et al., 2006; Ollila & Yström, 2016; Van de Ven et al., 1999). This is particularly evident in the case of digital innovation, which refers to the process of creating new configurations of digital and physical components to produce novel products and services (Henfridsson et al., 2009; Lund, 2014; Yoo et al., 2010). Amazon Kindle, Spotify, and Netflix are all examples of digital products and services enabled by digital innovation and illustrate how digital reconfigurations can reshape even the most mundane artifacts.

Digital products and services are built around digital technology, which can be categorized by layers consisting of *devices, networks, services,* and *content* (Yoo et al., 2010). As different architectural layers of digital technology require different knowledge, competencies, and resources, organizations often need to either set up or join innovation networks to be able to succeed with digital innovation (Lund, 2017). As a result, digital innovation processes are becoming more and more open, networked, and complex with an increased need for heterogeneous resources (Boland et al., 2007; Baldwin & von Hippel, 2011; Yoo et al., 2010; Yoo et al., 2012). Many organizations are therefore shifting from vertically aligned thinking, where one organization can handle all research and development by itself, to horizontally aligned thinking, where the firm looks outside their own organizational borders to acquire knowledge from other actors in order to stay innovative and competitive (Bogers et al., 2017; Chesbrough et al., 2006; Yoffie, 1997).

Reviewing current literature about digital innovation illuminates several challenges that can be found regarding digital innovation processes. One challenge concerns collaboration between organizations. The increasing complexity of products and services requires heterogeneous knowledge sources and assets in order for those products and services to become marketable (Bogers et al., 2017; Lund, 2014; Lyytinen et al., 2016).

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In digital innovation processes, individual firms or other actors (e.g., researchers) seldom have the power, resources, or legitimacy to innovate and produce changes by themselves. Therefore, it is important to understand the relationships between actors to better understand the dynamics of these processes. Relationships also influence boundary-spanning exchanges between actors in an innovation process that are tangible (e.g., money, industrial resources) and intangible (e.g., knowledge, experiences) (Bogers et al., 2017; Powell & Grodal, 2005; Simard & West, 2006). Research has also investigated how to mobilize a range of innovators with conflicting interests and different knowledge bases, where no one has control over the final product architecture or the digital infrastructure that supports the innovation (Lyytinen et al., 2016).

Although efforts have been made towards understanding the dynamics of heterogeneous innovation actors in development (Boland et al., 2007; Ollila & Elmquist, 2011; Svensson & Ihlström Eriksson, 2012), little can be found about how the actual digital technology at hand relates to the dynamics of digital innovation processes. By gaining a better understanding of how different architectural layers of digital technology interplay with digital innovation, we could be better prepared for managing the complex and messy processes that often arise when working with digital innovation (Lund, 2017; Yoo et al., 2010; Yoo et al., 2012).

In this article, we present an interpretative case study approach in which we have studied events involving multiple actors in an innovation and development project called the Smart Lock project. The case study is used to investigate the research question: *How does the layered architecture of digital technology interplay with digital innovation processes?* The aim of this article is to describe and explain how the architectural layers of digital technology interplay with the relationships and boundary-spanning exchanges in digital innovation processes. This work therefore contributes to the body of research concerning digital innovation and provides an example to practitioners on how digital innovation processes can be coordinated and managed based on the innovation at hand.

Digital Innovation

As a process, innovation can be defined as the invention, development, and implementation of new ideas (Garud et al., 2013). Traditionally, innovation is based on internal research and development to either develop or generate new products and services (Chesbrough et al., 2006). However, in many consumer-oriented markets today, it has become important to involve external knowledge sources (Cohen & Levinthal, 1990; Westergren & Holmström, 2012). By opening up innovation processes, external firms start to play an increasingly important role for organizations to exploit new markets (Chesbrough, 2003). This is especially evident within technology development fields, such as digital innovation (Powell & Grodal, 2005).

Digital innovation refers to the embedding of digital computer and communication technology into a traditionally non-digital product (Henfridsson et al., 2009). Digital innovation also refers to the process of creating new combinations of digital and physical components that produce novel products or services (Yoo et al., 2010). As a process, digital innovation is often characterized as a networked achievement involving many actors, including user communities, often with different intentions (Kallinikos et al., 2013; Van de Ven, 2005; Yoo et al., 2005). As digital innovation becomes more networked, it also drives a need for collaboration spanning organizational realms (Yoo et al., 2010). Hence, there is a growing acknowledgment that digital innovation is a collective achievement by many actors and stakeholders from different fields with diverse knowledge bases (Van de Ven, 2005).

Digital innovations that are driven by the heterogeneity of actors and their knowledge bases tend to redefine digital products and services. This is illustrated by how digital innovation can lead to the re-organization of entire industries and the generation of new business logics, which changes business models (Lyytinen et al., 2016). Such reorganization is reflected in the innovation networks that are formed by firms and other actors to disperse knowledge necessary to innovate (Powell & Grodal, 2005).

Digital innovation processes

Digital innovation processes that occur in heterogeneous networks are complex and messy (Lyytinen et al., 2016). These processes also differ from other forms of innovation due to the complexities within, and the interactions between multiple actors' relationships and social changes. The complexity becomes even more apparent when working with digitization of services and products (Lyytinen et al., 2016). Especially in fields of technological uncertainty, firms are more likely to look for actors outside their organizational boundaries to involve an innovation network. One explanation for this is that firms can share the resources needed for developing innovative technology by forming networks and

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therefore also share risks. Innovation networks have been shown to provide access to diverse sources of capabilities and information, and the interaction between the actors increases the innovation level at the individual firms. This is especially evident in young and small organizations that benefit more from these relationships compared to larger firms (Powell & Grodal, 2005). Successful external relations, such as inter-organizational relationships, therefore fuel growth and innovation within a firm.

From the perspective of information and knowledge, the knowledge work in innovation processes with heterogeneous actors is not just a matter of processing more knowledge. Instead, it can be seen as a process of transforming knowledge between actors. The transformation of knowledge in the interface between different actors and their respective knowledge areas can be seen as both an opportunity for, as well as a barrier against, innovation (Carlile, 2002). The trading zones that can potentially occur in these innovation processes enable actors with different knowledge and agendas to negotiate, collaborate, and learn from each other (Boland et al., 2007).

Knowledge work in innovation processes requires the involved actors to have the ability to make a strong perspective within a community, while concurrently taking perspectives of other knowledge communities into account. Boland and Tenkasi (1995) describe perspective making as a process whereby a community strengthens its own knowledge domain and practices. Furthermore, the process of perspective taking is described as an exchange, evaluation, and integration of knowledge that others possess. In its essence, it is about making knowledge accessible, for example, through representations or narratives (specifications, prototypes, etc.), so that individuals can engage in a process where they explore, acknowledge, and appropriate the knowledge of others while also making their own knowledge accessible.

The layered architecture of digital technology

To illustrate the configurable nature of digital technology from the perspective of digital innovation, the notion of architectural layers can be used. These layers consist of *devices, networks, services,* and *content* (Yoo et al., 2010). The architectural layers enable two important separations: the separation between service and device due to re-programmability and the separation between contents and networks as a result of homogenization of data (Yoo et al., 2010). The re-programmability enables digital devices to support a wide set of functions and the homogenization of data allows digital content to be used on almost any digital device. As a result, the digital technology of today is malleable and dynamic. This generativity characteristic of the technology enables functionality that can be added after a product is launched onto a market (Yoo et al., 2012; Zittrain, 2006). This is often exemplified by smartphones acting as platforms for apps. These apps turn smartphones into adaptable and changeable digital tools supporting a multitude of different uses.

Layered digital technology is an example of a modular architecture that enables new innovations by combining components from different architectural layers (Tiwana et al., 2010). Design decisions for components in each of the layers can normally be made with small considerations of other architectural layers. As a result, the modularity increases flexibility in a design (Henfridsson et al., 2014; Yoo et al., 2010).

Although the architectural layers of the technology enable digital innovation, different actors from different fields are often required to cooperate. The different layers of technology require different resources, knowledge, and competencies. Therefore, organizations often need to collaborate in complex innovation processes involving heterogeneous actors in order to be able to succeed with digital innovation (Tilson et al., 2010; Yoo et al., 2012). As a result, digital innovation as a process often becomes complex and difficult to manage efficiently (Boland et al., 2007; Lund, 2014; Tiwana et al., 2010; Yoo et al., 2012).

Research Approach

Our research objective with this study is to describe and explain how the layered architecture of digital technology interplays with the digital innovation process. To achieve our objective, we used an interpretative case study approach (Walsham, 2006) in which we studied events involving multiple actors in an innovation and development project called the Smart Lock project.

Case background

The Smart Lock project ran for 13 months (Figure 1) and was an inter-organizational collaboration between four key partners that focused on improving wellbeing for senior citizens in a home care scenario in Halmstad, Sweden. The specific challenge that the project addressed was the uncertainty and feeling of insecurity that stems from not knowing if your door is closed and locked. The proposed solution to the problem was a digital lock and a monitoring system aimed to be used in

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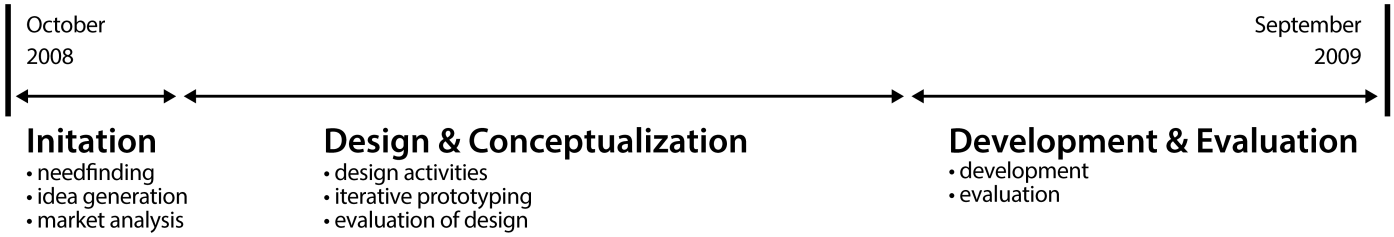

Figure 1. The three phases of the Smart Lock project

the senior citizens' homes. The four key partners in the project were a research group from Halmstad University (facilitation of co-design), the Alpha company (lock technology), the Beta company (wireless security), and a non-governmental organization (NGO) (expert domain knowledge). Furthermore, the municipality was seen as an important partner because they owned data concerning home visits to the seniors.

The digital innovation process consisted of three phases. The first phase included need finding, idea generation, and market analysis. Typical activities during this phase were workshops and focus groups involving seniors, NGO representatives, and representatives from Alpha and Beta. The NGO representatives and seniors were divided into two types of focus groups, representing the users:

1. A primary focus group of next of kin worked closely with the IT developers to generate ideas.

2. Two secondary focus groups, one with seniors and one with next of kin, acted as reference groups to evaluate ideas.

During the second phase, the primary focus group designed the actual device through mock-ups, scenarios, and iterative prototyping. Continuous evaluation of the design was done by the secondary focus groups. The researchers facilitated these activities and Alpha and Beta acted as advisors and "guests" in these sessions during which they answered questions and provided technical feedback to the focus groups. During the third phase, Alpha and Beta developed hardware and software based on requirements and prototypes delivered from the second phase. The high-fi prototype that was developed by Alpha and Beta were then evaluated through real-life testing. During the test, seniors and next of kin were able to test the prototype in their own homes for two weeks.

Data collection and analysis

A temporal bracketing strategy (Langley, 1999) was used to support a process analysis of the case data. This strategy specifically permits the creation of comparative units of analysis for the exploration of theoretical ideas. The approach can be especially useful if there is mutual shaping between concepts or multidirectional causality that will be incorporated into the theorization (Langley, 1999). Given that mutual influences (in this case, the influences of digital technology and innovation process dynamics) are difficult to study at the same time, it is easier to analyze data in a sequential process by temporarily "bracketing" one of the data streams. By decomposing data into successive periods, this strategy enables studies of how actions of one period lead to changes in the context that will influence actions in subsequent periods (Langley, 1999). The model of layered digital technology (Yoo et al., 2010) was used as a lens to structure data from the case. Changes in the architectural layers of the digital technology were used as key events to identify possible points of interest. These were then used as starting points for a temporal bracket that could encompass interesting and critical events in the digital innovation process, for example, changes in relationships or boundary-spanning exchanges between actors in the process. This analytical lens, together with the literature about digital innovation, was used to analyze the empirical findings.

The data concerning the case used for the analysis was collected over a period of two years, although the project only ran for 13 months. The extended period enabled us to gather data covering both the actors' everyday practices regarding their efforts to innovate IT products, as well as their practices after being involved within the innovation process. We discerned two types of data that were gathered during the project: process data and complementary data. The complementary data provided a contextual perspective of the gathered process data. The process data consisted of recordings of workshops, notes, and transcripts from meetings,

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mail conversations, project diaries, and notes taken by researchers during and after workshops with the users, the NGO, and the companies (Table 1).

In addition to the process data that was gathered, interviews were held to collect additional perspectives on the process data. The interviews were carried out with the users, the representatives from the companies, and the NGO to provide guidance and support to the process data. The interviews were conducted before, during, and after the project was finalized. Interviews took place both at Halmstad University in Sweden and at the companies' facilities. The interviews were recorded on digital media for transcription. Table 1 presents an overview of the data collection activities during the Smart Lock project.

Table 1. Data collection activities

	Type of Data / Activity	Number of Participants
Process Data	Workshop notes and recordings from 20 workshops	20
	Project documentation	–
	Notes from formal project meetings	–
Complementary Data	4 formal interviews with Alpha and Beta	2
	1 questionnaire	60
	2 group interviews with focus groups	8
	3 interviews with the NGO representative	1
	2 questionnaires regarding the week-long "real life" tests	16
	1 interview regarding the week-long "real life" tests	16

Furthermore, notes from meetings between actors in the process, field notes covering observations, archival documents, and reflections by researchers involved in the ongoing activities (such as workshops) in the innovation process were included in the analysis of the data.

The Smart Lock Case

This section describes key events from the Smart Lock case identified by examining the Smart Lock system based on changes in the layered architecture of the digital technology. Changes in architectural layers were then traced to the different concepts that were developed as well as events leading up to them. Figure 2 details the relationship between the main concepts that were developed during the innovation process and the timeline of the project.

Start up and initial concept

The project was initiated with a series of workshops where all three focus groups together with researchers and Alpha and Beta participated. The aim of the focus groups was to identify and prioritize problems relating to the everyday life of seniors and the next of kin from the perspective of secure living. The problematic areas that were identified through the workshops were then evaluated and ranked by a larger group of seniors and next of kin through a questionnaire, which also attempted to identify further needs and problems. The NGO

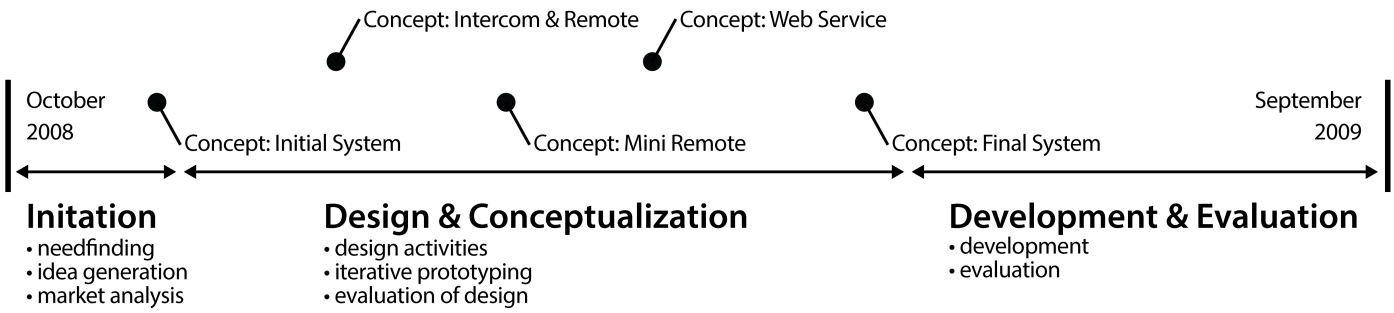

Figure 2. Key events from the Smart Lock case

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played an important role during these initial activities, not only by contributing to the workshops, but also by enabling access to other user groups, such as other senior citizen interest groups and the church. These user groups were then involved when it was time to validate the results from the start-up workshops through the questionnaire.

The feedback from the questionnaire was used as input for the selection and development of ideas and concepts in the upcoming workshops within the Smart Lock innovation process. One primary area of concern, identified during the initial workshops and through the questionnaire, was the feeling of insecurity that a door might be unlocked. This insecurity was shared between the seniors and the next of kin. The seniors expressed concern about their own ability to get to the door to check it, while the next of kin worried about whether or not the door was indeed locked or not. This uncertainty resulted in the next of kin sometimes having to double-check that a door was locked. Taking both scenarios together, it was clear that the status of the lock was something that led to quite extensive travelling back and forth in the households. As an initial attempt to mitigate the problem areas, Alpha and Beta started planning the creation of a remote control.

The initial concept presented by Alpha and Beta, when viewed through the lens of Layered Digital Technology, is illustrated in Table 2. The idea was based around Alpha's existing "smart" lock solution, an engine-driven lock that could be opened or locked via a digital code transferred over Bluetooth. This enabled care personnel to use their cellphones instead of physical keys to open locks. The Smart Lock, combined with cameras and sensors, provided an opportunity for monitoring an apartment for, for example, movement, while also providing logs to see who had opened a door and when. Lock logs required GPRS to communicate updates from the lock to a server. This data was, in turn, accessible from a PC via TCP/IP.

Already during the first meetings with the senior and next-of-kin user groups, it became evident that the groups had quite different perspectives. For example, the groups wanted different features and had different visions of the primary use of the system. The next of kin wanted rich data regarding, for example, movements in an apartment, potential uses of cameras, and to know who visited and when. The seniors regarded many of these features as a breach of privacy. Also, a conflict of interest between the companies was identified. Beta was looking for more video and image features in the system due to possible synergistic effects with existing products, whereas Alpha was focusing on their own product features focusing on Smart Lock solutions.

In the first phase, the actors both informally and formally started to build relationships with each other. As the problem space of the project was quite uncertain, the user groups were essential for obtaining domain knowledge needed to guide the innovation process towards actual needs. However, the companies, which had a quite technology-driven approach towards what could be developed, highly influenced the initial features of the Smart Lock system. The innovation process was initially based on the ideas and components presented in Table 2. The actors involved were therefore the ones who could actually realize the ideas of a "smart" remote lock with features based on Alpha's and Beta's existing resources.

Design and conceptualization of the Smart Lock system

In total, 18 workshops with focus groups were conducted within the project. In these workshops, the primary focus group worked with the companies to refine ideas and conceptualize them. Techniques such as brainstorming, future scenarios, persona descriptions, design sketches, low-fi prototyping, and mock-ups were used.

Continuous evaluation of the design work was conducted by involving the two secondary focus groups. The outcomes from the needfinding workshops, the design,

Table 2. Initial Smart Lock system components

Content	Service	Network	Device
• Lock logs • Lock status	• Remote lock • Surveillance	• GPRS • Bluetooth • TCP/IP	• Remote control • Smart Lock • Cellphone • Cameras • Sensors • Server • PC

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iterative prototyping, and evaluation workshops, were used as input for Alpha and Beta in the development phase of the project.

As different features and design solutions were discussed and materialized into conceptualizations, the components involved in the different architectural layers of the digital technology were changed. Different concepts utilized different components in different architectural layers of the digital technology. When one concept changed some components, this had a ripple effect throughout the layers.

During the second phase of the Smart Lock case, the relationships between Alpha and Beta were deepened and formalized. As described by one of the development managers, the relationships between the firms were strengthened as they started to share each other's competences:

> *"…we have become better and better at sharing and it has become so much easier to utilize each other's competences and we have started to share knowledge about technologies back and forth between the firms. Even though we worked at the same facility, we have been isolated from each other in the past. Now we have opened up and also started to use each other's components in our product lines…"*

The managers also elaborated on the importance of actually formalizing informal relationships:

> *"A co-operation between the firms seemed to be bound to happen, but it never did before we both joined this project. This was the starting point that made it all happen."*

During development meetings between Alpha and Beta, discussions of how to solve technical problems were increasingly common when engineers from the two companies met. According to the companies, these discussions led to potential problem solving for other development projects within both companies. Positive knowledge exchanges were therefore identified between the companies with spillover effects on other projects within the organizations.

The collaboration between the companies also led to synergetic effects, exemplified by the developing manager from Alpha stating that:

> *"We have opened up to each other and started to use each other's competence in other areas as well, such as when ordering components."*

This finding was in contrast to the next-of-kin focus group that wanted the possibility of buying both the services and the hardware directly from Alpha. The main reason for Alpha's stance regarding the business model was that they did not want to build up a sales and support organization targeted towards end consumers. Instead, they wanted to sell to municipalities that leased hardware and paid for the services. As no representatives were officially involved from the municipality, one important actor was missing to be able to realize the Smart Lock system.

The remote and intercom concept

During the design and conceptualization phase, several alternate concepts were developed by the focus group together with Alpha and Beta. The two main concepts designed were the remote and intercom and the web interface. When viewing the final remote and intercom concept from a layered digital technology perspective, it is evident that many of the core components stayed the same throughout the project (Table 3). Both the hardware and software were fully developed within the Smart Lock project. However, the remote control was mainly developed by Beta and was designed to be able to interact with the Smart Lock. The remote control could allow a user to lock and unlock the door, as well as seeing the current lock status. In a display on the remote control, a user could see and talk to the person at the door via an intercom mounted outside the door. The intercom was also developed by Beta using their proprietary technology for wireless audio and visual

Table 3. The components of the remote and intercom

Content	Service	Network	Device
• Photos of visitors • Video feeds • Lock status	• Remote lock • Video call	• Bluetooth • WiFi	• Remote control • Smart Lock • Intercom • Cameras

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communication. The intercom sent a signal and a video feed to the user's remote control.

Both Alpha and Beta reported that they gained a deeper understanding of their respective target groups by working with the focus groups. The development manager of Alpha said:

> *"I feel that we have a much clearer picture of the use context and how the system, in this case, will be used."*

This knowledge could be traced both to how the Smart Lock solution was designed, but also to modifications in Alpha's current line of products and upcoming products. One representative from Beta said:

> *"We have some ideas from the workshops that we really find interesting and have specified for our next revision of our product."*

During the workshops, the companies and the primary user group changed their understanding of the problem by, for example, taking the perspective of caretakers situations, but also regarding what possibilities technology either offered. One representative from Beta said:

> *"We have gained a greater understanding regarding how they (the users) think and how they want things to work and function."*

When the companies gained knowledge and better understood the user groups' needs, the concepts changed as a result. This created a better outcome according to the development manager of Alpha:

> *"Due to the number of people and the thoroughness of the process working with the problem situation, this is so much better than if only developers had worked with it the same amount of time. The prototype will be much better than what it normally would have been."*

The web service concept

The web service concept complemented the Smart Lock intercom and lock. This concept was designed as a web portal for next of kin. The concept utilized all components of the intercom and lock, which spanned all architectural layers of the technology (Table 4). The web service also added additional features to the Smart Lock system, which had ripple effects on the requirements of the hardware. The web portal presented logs and history of when the door was locked or unlocked. It also showed if the lock interaction was initiated by the remote or by home care personnel. Furthermore, the system could present photos from the video intercom as well as handling alarm functionality where an alarm could be sent via SMS or email.

Different kind of sensors was used in the initial design to enable surveillance of a senior's movements. This was especially sought after from the next of kin. However, due to privacy issues identified by the secondary focus groups, the project excluded healthcare monitoring features via camera and sensor technology. Also, several alarm functions were removed for the same reason. When surveillance services were removed from the concept, sensor components were also excluded. Even so, to build the system based on the smart lock, remote and intercom, and web system, included a multitude of components that spanned over four architectural layers of digital technology.

When sensors and surveillance were excluded from the Smart Lock system, the core competence of Beta was no longer sought after. Also, their business incentive to participate was weakened. Therefore, they became a supplier of basic technology such as video and audio. A change in the innovation process dynamic was imminent when Beta took on this subcontractor role to Alpha.

Table 4. The components of the conceptualized Smart Lock web service

Content	Service	Network	Device
• Photos of visitors • Personnel logs • Visitor logs • Lock logs • Lock status	• Activity alarm • Inactivity alarm • Remote lock • Video call • Surveillance	• GPRS • Bluetooth • TCP/IP • WiFi	• Remote control • Smart Lock • Cellphone • Intercom • Cameras • Sensors • Server • PC

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The mini remote concept
During the development of the intercom and the remote, a spinoff product from the project was initiated by Alpha. A mini remote was conceptualized that consisted of only the remote lock service, somewhat similar to a remote car lock device. Few components were needed, which mitigated complexity issues (Table 5). This enabled Alpha to develop the mini remote product without involving any other actors.

Development and evaluation of the final system
In the development phase of the digital innovation process, Alpha and Beta designed the hardware and software for the Smart Lock system with only a few interactions with other actors in the process. One new actor had to be brought in informally to the innovation process before the start of the field trials. As the municipality had caregiving personnel visiting the test subjects, data that they were in control of had to be incorporated into the test. The system registered when a caregiver arrived to visit a senior, and the data was also visible through the Smart Lock web solution. As the Smart Lock system was dependent on the data controlled by the municipality, they had to be involved as an actor. This meant that Alpha in particular became dependent on resources owned by the municipality (the data about personnel).

A field trial of the entire Smart Lock system (Table 6) was conducted over the course of two weeks. Two questionnaires, one for each week, were used to gather data. In addition, interviews with seniors and next of kin were conducted at the end of the trial. The Smart Lock system was deemed successful in the evaluation. For example, seniors with physical disabilities who had trouble moving around in their apartment found the remote control very helpful. Another example concerned the relief of stress that next of kin felt by always being able to see who had been at their parents' home and when. This information also helped in their communication with the caregiving organization. Finally, there was a high degree of willingness to pay for the innovation from next of kin, which showed great commercial potential.

Discussion

The Smart Lock case shows an example of a heterogeneous set of actors with different agendas, perspectives, and conflicting interests working together innovating digital products and services. This case illuminates the need for cross-organizational collaboration in digital innovation, something that earlier research also indicates (Bogers et al., 2017; Boland et al., 2007; Power & Grodal, 2005; Yoo et al., 2010). While viewing the Smart Lock system from a layered digital technology perspective, the complexity becomes apparent. The complexity is also mirrored in the innovation process itself. Even though complexity in digital innovation has been showcased before (e.g., Lyytinen et al., 2016), this article aims to describe the nature of the complexity to enable ways to address it. Furthermore, this article provides new insights regarding the interplay between layered digital technology and digital innovation dynamics.

Table 5. The components of the mini remote

Content	Service	Network	Device
• Lock status	• Remote lock	• Bluetooth	• Remote control • Smart Lock

Table 6. The components of the finalized Smart Lock system including all products

Content	Service	Network	Device
• Photos of visitors • Personnel logs • Visitor logs • Lock logs • Lock status	• Activity alarm • Inactivity alarm • Remote lock • Video call • ~~Surveillance~~	• GPRS • Bluetooth • TCP/IP • WiFi	• Remote control • Smart Lock • Cellphone • Intercom • Cameras • ~~Sensors~~ • Server • PC

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When studying the innovation process from a layered digital technology perspective, five major changes in the conceptual representations could be discerned. The changes towards more stable concepts in the innovation process were all superseded by a flux of diverging designs, and in some cases actors, in what could be interpreted as a malleable initial phase of the digital innovation process. During this phase, new actors were connected to the process that opened up additional opportunities for trading zones. This phase also opened up new perspectives to Alpha, Beta, and the focus groups, which was already part of the process. This initial phase was followed by a concept development phase, where several concepts were created. Following this initial phase, where a concept development phase was several concepts were created. The formalization of concepts enabled the representatives from Alpha and Beta to bring these back to their own developers. It also opened up discussions about what additional resources that were needed or made obsolete based on the concepts. These discussions on how to realize the stable concepts put the innovation process back into a malleable state by inviting, strengthening, or diminishing the roles of the different actors. This is illustrated by the previous example of connected interest groups, as well as the municipality, but also by how Beta took the role of a subcontractor after sensor and surveillance technologies were removed based on user feedback.

The empirical findings illustrate how the process changed back and forth from a formalized and malleable phase during the Smart Lock case. The dynamic movement between malleable and formalized phases started from the initial stable concept. It then continued throughout the design work during the conceptualizations phase, until the stable concept of the finished smart lock system was formalized. In the malleable phase, heterogeneous external actors might be beneficial in order to bring in innovative ideas and designs. The heterogeneous actors' role in innovation is beneficial for innovation and firm growth, especially for young and small firms (Powell & Grodal, 2005). Arguably, this was the case in the Smart Lock project. All actors involved contributed with insights and resources that shaped the Smart Lock concepts. In the Smart Lock case, the malleable phases consisted of a wide design perspective to explore the innovative potential in ideas and concepts generated by the focus groups along with developers. In the formalized phase, ideas were materialized into concepts, mock-ups, and prototypes. The materializations were then discussed from both a business and user perspective. The business perspective included discussions about business models and opportunities to launch the concepts as products on a market. The user perspective concerned design and usability issues, as well as handling the conflicting interests between the different user groups.

When analyzing the empirical insights based on a layered architectural perspective of digital technology, the following insights can be discerned. A specific set of actors is needed to provide different perspectives and insights important for a digital innovation at hand. In the Smart Lock case, different user groups, together with researchers and the companies, provided a heterogeneous mix of competences and perspectives that highly influenced the concepts developed during the innovation process. The different actors all contributed with expertise to different architectural layers of the digital technology. Researchers together with the user groups primarily contributed to the content and service layers, whereas the firms primarily had knowledge and competence on the device and network layer. Even if all actors were involved in discussions concerning all architectural layers, the firms specifically wanted domain knowledge from the users to be able to develop relevant Smart Lock concepts. At the same time, their own expert knowledge was founded in the device and network layers. Based on these insights, we deem it important to identify, mobilize, and actively involve actors with knowledge and expertise in relation to all the architectural layers of digital technology. These insights can help innovators to plan for and mobilize a set of relevant actors for digital innovation.

After the formalization of a concept, the firms started to discuss possible ways of launching the future digital innovation on the market. The role that the firm played in bringing the Smart Lock concepts to market differed with every concept. In the initial Smart Lock concept, both firms utilized already existing products and services into the concept. This meant that, for example, Beta had the opportunity to reach new markets with their alarm and surveillance products and services. Further down the road, Alpha took the role of owner of some of the concepts that included the use of their existing business model. This changed the role of Beta to a supplier of components instead of a partner to Alpha. A similar phenomenon was identified when the municipality had to be incorporated into the process to enable the launch of feature that incorporated data owned by the municipality. Based on these insights, we argue that digital innovation processes need to be managed in ways that enable a fluent movement between malleable and formalized phases.

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In the initiation of both malleable and formalized phases, there was a stronger need for relationship facilitation. In the malleable phase, new actors were involved in the Smart Lock case that had to find their place and role in the innovation process. This was especially evident with the user groups. To enable successful ideation and concept creation, heterogeneous users are beneficial for innovativeness (Bogers et al., 2017; Ollila & Yström, 2016; Powell & Grodal, 2005), which could also be observed in this case. However, to reap the benefits of heterogeneity in the innovation process, facilitation between actors had to be done by the researchers. A similar phenomenon has been identified in other cases of digital innovation as well. In these cases, heterogeneous actors required relationship facilitation to provide trading zones to support the exchange of ideas and perspectives (Ebbesson & Ihlström-Eriksson, 2013; Svensson et al., 2010). In the formalized phases, new actors had to be involved, and in some instances, the actors' role changed. An example of relationship facilitation in the Smart Lock case was when Beta shifted role to a subcontractor instead of a partner during the formalization of the web service concept. This facilitation was needed to mitigate problems with the innovation process and support the successful development of the Smart Lock system. The facilitation was also needed when new user groups, with no prior connection to Alpha or Beta, was connected to the innovation process. Furthermore, there was a need for facilitation to create an interface, or an arena, where the actors could meet. Similar findings are reported by Ollila and Elmquist (2011).

Based on these findings, we argue for the importance of relationship facilitation in the initiation of malleable and formalized phases to support digital innovation. Furthermore, perspective making and perspective taking can enable trading zones where actors can negotiate, collaborate, and learn from each other (Boland et al., 2007). As innovation processes require involved actors to make a strong perspective within a community, while concurrently taking perspectives of other communities into account, the empirical findings illustrate the importance of perspective making and taking during the malleable phases of digital innovation. As described by Boland and Tenkasi (1995), perspective making is a process whereby a community strengthens its own knowledge practices and domain. The process of perspective taking is essential to making knowledge accessible, for example, through representations and concepts. These representations allow actors to engage in a process where they can explore, acknowledge, and appropriate other's knowledge while also making their own knowledge accessible.

Conclusion

As shown in this article, a layered architectural perspective can be used to gain insights about how digital technology interplays with digital innovation. Actors, resources, and knowledge related to the different layers influence the digital innovation process, not only in the initial phases but throughout the whole process. Furthermore, as highlighted in the empirical findings, changes in the architectural layers affect the dynamics of the digital innovation process by creating a need for malleable and formalized innovation phases.

This article adds to earlier research about the complexity of digital innovation and suggests that a layered architectural perspective can provide valuable insights concerning how innovation processes within this domain can be coordinated and managed. Based on the insights presented in the discussion, we argue that it is important to identify, mobilize, and actively involve actors with knowledge and expertise in relation to all the architectural layers of digital technology. These insights can help innovators to plan for and mobilize a set of relevant actors for digital innovation. By analyzing ideas for new digital innovations based on a layered architectural perspective, firms can assess the viability of initiating actors and stakeholders that can support a successful digital innovation process. Furthermore, the interplay between the layered architecture of digital technology and digital innovation processes suggests a need for boundary-spanning exchanges in malleable phases and a need for formalized relationships in formalized phases of the innovation process.

Based on these findings, future studies are suggested to investigate in greater detail how digital innovation can be managed successfully. Questions such as what innovation activities are needed to enable digital innovation could be interrogated to further explore the phenomena and address the complexity of digital innovation.

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