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Platforms and Ecosystems

Welcome to the September 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.

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Editorial: Platforms and Ecosystems

Chris McPhee, Editor-in-Chief
Ozgur Dedehayir and Marko Seppänen, Guest Editors

From the Editor-in-Chief

Welcome to the September 2017 issue of the *Technology Innovation Management Review*. This month's editorial theme is **Platforms and Ecosystems**, and it is my pleasure to introduce our Guest Editors, **Ozgur Dedehayir**, the Vice-Chancellor's Research Fellow at the Queensland University of Technology (QUT), Australia, and **Marko Seppänen**, a Full Professor in the field of Industrial Management at Tampere University of Technology, Finland.

This issue arose out of the newly created ISPIM special interest group on Platforms and Ecosystems (ispim-innovation.com/platforms-ecosystems). Each article was developed from a paper presented at the ISPIM Innovation Conference in Vienna, Austria, June 18–21, 2017. ISPIM (ispim-innovation.com) – the International Society for Professional Innovation Management – is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management.

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.

Chris McPhee
Editor-in-Chief

From the Guest Editors

It gives us great pleasure to introduce this special issue on Platforms and Ecosystems. The past several years have seen growing interest in platforms, which refer to loosely coupled activity systems that facilitate the exchange of products (Choudary, 2015; Mäkinen et al., 2014; Parker et al., 2016; van Alstyne et al., 2016). Platforms, specifically digital ones, bring together an ecosystem of producers, users, and complementary service providers, thereby making it easy for them to co-create value embedded in new ideas, technologies, and knowledge (e.g., Afuah & Tucci, 2012; Autio et al., 2016; Dushnitsky & Klueter, 2011; Frey et al., 2011; Thomas et al., 2014).

The combination of platforms and ecosystems has been referred to as the platform economy (Kenney & Zysman, 2016), a phenomenon that encapsulates a growing number of digitally enabled activities in business, politics, and social interaction. In this platform economy, incumbents as well as startups face challenges as they strive for a platform strategy, requiring them to develop new business models (Eloranta & Turunen, 2016; Parker et al., 2016). Regulators are not exempt from new challenges brought about by the platform economy either (Acquier et al., 2017; Murillo et al., 2017). For example, cross-industry or convergent innovation that accompanies ecosystem creation can result in higher levels of uncertainty and risk for all stakeholders concerned (Enkel & Heil, 2014; Mason et al., 2013). Meanwhile, the overall function of the platform ecosystem requires an orchestrator – a central figure that secures valuable resources and mitigates arising problems (Dhanaraj & Parkhe, 2006). The present special issue subsequently focuses on such challenges inherent to platforms and ecosystems, with insights on how organizations can deal with them.

The first article, by **Mikko Dufva**, **Raija Koivisto**, **Leena Ilmola-Sheppard**, and **Seija Junno**, addresses platform economy development and the drivers anticipated to define its future trajectories. The authors suggest that the development of the platform economy is influenced by a range of uncertainties sourced from technologies, geopolitical power structures, public and private actors,

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and the regulatory environment, among others. From an examination of the heavy engineering industry, the article arrives at a list of key uncertainties and scenarios (i.e., alternative descriptions of platform economy futures) based on these uncertainties, together with strategies to cope with these scenarios.

The second article, by **Heidi Korhonen**, **Kaisa Still**, **Marko Seppänen**, **Miika Kumpulainen**, **Arho Suominen**, and **Katri Valkokari**, focuses on startups, which are often burdened by limited resources and network positions in ecosystems. The article explores how startups connect producers and users in their endeavour to create and capture value through digital platforms. Through interviews with 29 platform startups at SLUSH, a leading European startup event, the authors show that many of these startups had big ambitions, targeting millions of users of their platforms. And while they aimed to deliver new and better services to users, and new markets for producers, many startups determined these needs on their own rather than letting users and producers identify the needs and create new solutions.

The third article, by **Minna Pikkarainen**, **Mari Ervasti**, **Pia Hurmelinna-Laukkanen**, and **Satu Nätti**, examines the roles of innovation network orchestrators and their actions to facilitate networked activities in different phases of the innovation process. The empirical focus of the article is a healthcare ecosystem that co-creates technological innovations to support the pediatric surgery journey. Interviews, workshops, and online discussions involving various stakeholders suggest that an orchestrator can take different roles over time to create a democratic and collegial atmosphere for the ecosystem. However, it appears that contextual factors such as rules and regulations can restrict orchestration activities.

The fourth article, by **Mark Phillips**, **Tomás Harrington**, and **Jagjit Singh Srai**, addresses the integration challenges facing organizations in nascent and convergent ecosystems. In their study of five longitudinal cases in the precision medicine and digital health contexts, the authors identify a need for organizations to embrace complexity by adopting approaches that balance credibility-seeking and advantage-seeking behaviours. The study underlines various kinds of risk that emerge from integration, as well as strategies to negotiate these risks through analytic approaches that address anticipated or perceived issues (i.e., actions to sustain, seek credibility, and reduce risk), and synthetic approaches that aim to position the innovation in light of future options (i.e., value creation, advantage-seeking, and shaping activities).

Finally, **Mokter Hossain** and **Astrid Heidemann Lassen** address the question: "How do digital platforms for ideas, technologies, and knowledge transfer act as enablers for digital transformation?" The authors suggest that, although digital platforms enable organizations to bring external knowledge to solve internal problems, they also bring new challenges. For example, knowledge sharing via digital platforms often entails a high degree of interaction between different sides of the platform, requiring new skills, tools, and management structures. To negotiate these challenges and optimize the potential of digital platforms, the authors provide a list of seven platform categories that organizations can select from to best suit their needs.

It seems inevitable that the platform economy is going to greatly affect how businesses are run in every industry. Even though this digital transformation can be seen as a threat, we would like to emphasize the opportunities that are opening up at every level – for society, for businesses, and for individuals. We hope that you enjoy this special issue and these pieces of research that provide some fruitful seeds of thought.

Ozgur Dedehayir and Marko Seppänen
Guest Editors

Editorial: Platforms and Ecosystems

Chris McPhee, Ozgur Dedehayir, and Marko Seppänen

About the Editors

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. He 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. Chris has nearly 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.

Ozgur Dedehayir is the Vice-Chancellor's Research Fellow at the Queensland University of Technology (QUT), Australia. Dr. Dedehayir received his PhD in Technology Strategy from the Tampere University of Technology (TUT), Finland. His research focuses on the creation and the dynamics of change in innovation ecosystems. He has published in various journals in the technology and innovation management field, including Technology Analysis and Strategic Management, Technological Forecasting and Social Change, and Technovation.

Marko Seppänen, PhD, is a Full Professor in the field of Industrial Management at Tampere University of Technology, Finland. Prof. Seppänen is an expert in managing value creation in business ecosystems, business concept development, and innovation management. In his latest research, he has examined, for example, platform-based competition in business ecosystems and innovation management in business networks. His research has appeared in high-quality peer-reviewed journals such as the Journal of Product Innovation Management, Technological Forecasting and Social Change, the Journal of Systems and Software, and the International Journal of Physical Distribution & Logistics Management.

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Keywords: platforms, ecosystems, platform economy, startups, orchestrators, stakeholders, technology, innovation, strategy, value creation, digital transformation

Anticipating Alternative Futures for the Platform Economy

Mikko Dufva, Raija Koivisto, Leena Ilmola-Sheppard, and Seija Junno

> "*Platforms are online environments that take advantage of the economics of free, perfect, and instant.*"
>
> Andrew McAfee and Erik Brynjolfsson
> Authors of *Machine, Platform, Crowd*
> and *The Second Machine Age*

Despite the considerable hype around platforms, our understanding of what the platform economy means and what drivers will define future development trajectories is limited. Companies and policy makers have a great need to investigate what potential opportunities will arise from the platform economy. A shared perception of uncertainties and a strong vision are prerequisites for the development of the platform economy. In this article, we describe a systematic way to develop a resilient vision for a new platform ecosystem, both from the viewpoint of national policy makers and corporate strategy makers in the heavy engineering industry. The process uses morphological analysis for scenario development and robust portfolio modelling for creating resilient strategies. The results include a list of key uncertainties, three general scenarios (sustainable development by Europe; polarization driven by China and the United States; US-driven fast, unreliable growth) as well as steel-industry specific scenarios based on these uncertainties, elements of a resilient vision, and strategies for coping with the uncertainties described by the scenarios.

Introduction

There are signs of a major transformation taking place in the structure of the global economy. The quickly emerging developments lead towards a networked, digital-platform-based mode of operating: the platform economy (see e.g., Parker et al., 2016; van Alstyne et al., 2016). Although there are many definitions of what a platform is, in this article, we adopt the platform-as-ecosystem view, which emphasizes the transactions between actors (see e.g., Thomas et al., 2014). By platform, we refer to a digital ecosystem that is a loosely coupled activity system organized around a digital platform, within which different actors (producers, users, related supporting service providers) flexibly create and combine offerings (modified from Autio et al., 2016). Consequently, we define the platform economy as the value creation system consisting of platforms.

Widely known examples of platforms include Uber and AirBnB – or IBM Watson and John Deere in the B2B domain – but the platform economy goes beyond just connecting users and producers. Platforms have production, innovation, and transaction leverage, meaning they can use resources more efficiently and generate value through network effects (Thomas et al., 2014). Platforms necessitate the rethinking of strategies and business models (Eloranta & Turunen, 2016; Evans, 2003; Parker et al., 2016), and they pose new challenges for regulators (Acquier et al., 2017; Edelman & Geradin, 2015; Murillo et al., 2017).

In the platform economy, the value depends on the extensiveness and functioning of the network (Evans et al., 2011; Parker et al., 2016, Thomas et al., 2014). Companies provide services for connecting actors around an activity or need, and they enable them to collaborate, allocate and use resources more efficiently, and co-create value for each other. Parker, Van Alstyne, and Choudary (2016) argue that companies must embrace platform thinking to ensure their future survival: "practically any industry in which information is an import-

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ant ingredient is a candidate for the platform revolution". According to a study by Accenture, 88% of the Fortune 500 companies are investing in platforms (Lacy et al., 2016). Their motivation emerges from the finding that digital platform businesses are growing faster than other companies in the market. The platform economy both threatens to disrupt industries and promises new and rapidly growing markets (Acquier et al., 2017).

Nonetheless, companies that are initiating a platform ecosystem are facing a major challenge. The development of the platform economy is clouded by major uncertainties regarding not only technology development but also geopolitical power structures, the role of public and private actors, developments in regulatory environment, and the structure and development of the global financial system. These uncertainties have not been systematically taken into account when thinking about future developments in the platform economy. Furthermore, a company-specific analysis is able to reveal only a narrow part of the phenomenon. The true transformative capacity is in the nature of the ecosystem of this new economic structure, and this ecosystem consists of and is impacted by many actors, not just the (incumbent) companies. For example, open platforms (Gawer & Cusumano, 2014) are generating fast, co-evolving ecosystems that are able to challenge dominant players in global markets. In addition to companies, also governments (e.g., the United States, Japan, the United Kingdom, South Korea, and the European Union; OECD, 2017) are eager to capture a share of the global platform business and are building their own platform policy strategies.

We argue that the resilience requirements of platform ecosystem vision, structure, and strategy deserve greater attention both on the general level as well as from the viewpoint of a company. Strategic planning can meet the challenges related to uncertainty with anticipation and resilience building (Ilmola & Rovenskaya, 2015). Given that the line of development is highly uncertain, strategic planning requires ways to manage uncertainties and build resilience (Daft & Weick, 1984; Folke, 2006; Taleb, 2007). The key to more resilient operations is to define what the strategy should be resilient to. Scenarios are a way to define alternatives if they cover a sufficiently comprehensive range of potential futures.

The main research question in this article is "What are platform ecosystem options within different global platform economy scenarios?" By global platform economy scenarios, we mean alternative descriptions of futures of the platform economy as a whole. On this general level, the goal is to improve our understanding of the drivers of the emerging phenomena of the platform economy and its related uncertainties, and to support industry and society in deriving benefits from it. In addition to describing these global development scenarios, we translate them into industry-specific narratives based on a case study in the Finnish steel industry. The case study was a very specific example of platform ecosystem development. There are thus two levels of analysis: the general scenarios and their implications, and industry-specific developments and options.

Methods

Our research question requires a method that captures the main uncertainties and – in order to secure and improve resilience – produces alternative, mutually exclusive scenarios that cover a wide range of possibilities. We thus decided to use a morphological analysis (Ritchey, 2011), which is a systematic method for considering multiple uncertain factors. In morphological analysis, key factors of uncertainties are identified, possible alternative exclusive states for each factor are developed, the pairwise compatibility of each state is assessed (i.e., determining whether two states are in conflict with each other), and finally, alternative coherent scenario structures are produced. In addition, we used expert workshops, scenario writing, and portfolio modelling to refine the scenarios and assess alternative options for responding to the challenges posed by the scenarios. In parallel to the development of global platform economy scenarios, we interpreted them in the context of the steel industry with a company interested in initiating a platform ecosystem around their products and services. Below, we describe in detail both the development of the global platform economy scenarios and the case study.

Scenario development

The scenarios were developed during 2016 in a multisector participatory foresight process together with 20 experts from universities, corporations, and government. Eleven members of the expert group were researchers that represented two cross-disciplinary research projects funded by Finland's Strategic Research Council: one focused on platform business models and management and the other on the technical aspects of the Internet of things (IoT) and the platform economy. In addition to the researchers, the expert

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group included corporate strategy planners (5) and senior policy and strategy planners (4) from the Ministry of Economic Affairs and Employment and the Finnish Funding Agency for Technology and Innovation (TEKES). The process used both online surveys and face-to-face workshops (Figure 1).

Key uncertainties related to the development of the platform economy were identified via a web-based questionnaire, which the expert group answered prior to the first workshop. The questionnaire included three open-ended questions, such as "Think about industrial internet and platform ecosystems in global services and industries. What drivers are shaping their development?" (by driver we mean a description of factors and issues that influence the development of platform economy) and "Can you think of something unclear but potentially important that is going on in the development?" The question format is specially developed for scanning early signs of change (Ilmola & Kuusi, 2013). For each question, the respondents could input as many drivers as they wanted, in the format of title and description. The questionnaire then asked respondents to assess the importance of drivers others had provided by placing them closer or further to the centre of an evaluation board (Figure 2).

Altogether, 153 drivers of digital platform development were collected and assessed. The assessment process produced a group of drivers that the respondents agreed to be either very important or not important at all (representing the dominating mental model of the development; see Ilmola & Kuusi, 2013), and two groups of drivers where opinions differed between experts. The importance of each driver was calculated by measuring its distance from the centre of the evaluation board. (Further details of the method are described in Ilmola and Kuusi, 2013). The first group of differing opinions – called emergent drivers – were those that had a high standard deviation (assessments varied substantially) as well as relatively high importance (measured as the mean of answers). The second group – called weak or early drivers – were those whose importance was perceived to be high only by a few experts. This assessment helped to identify key drivers as well as sources of disagreement among the experts, which can be an indication that the driver should be further explored.

The results were further developed into scenarios in the first expert workshop. The key drivers and related uncertainties were clustered into dimensions for a morphological analysis (Ritchey, 2011) by the core research

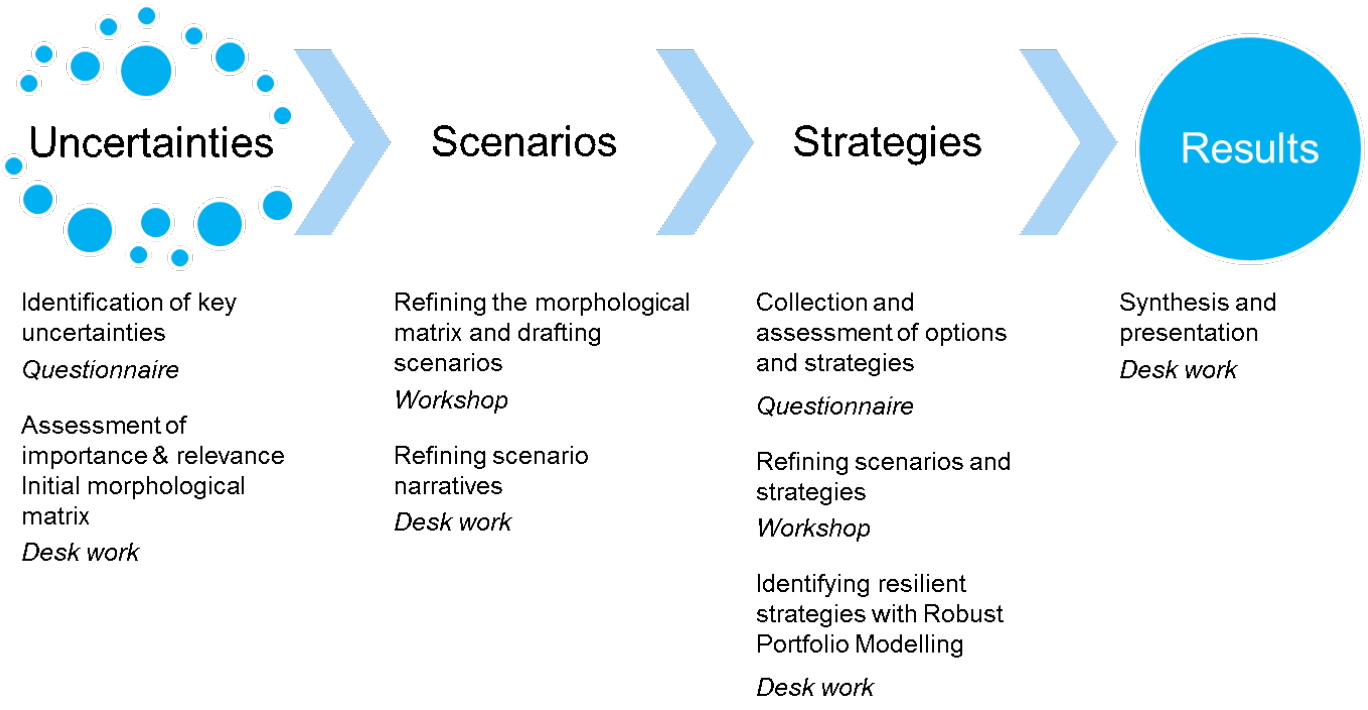

Figure 1. Scenario development process

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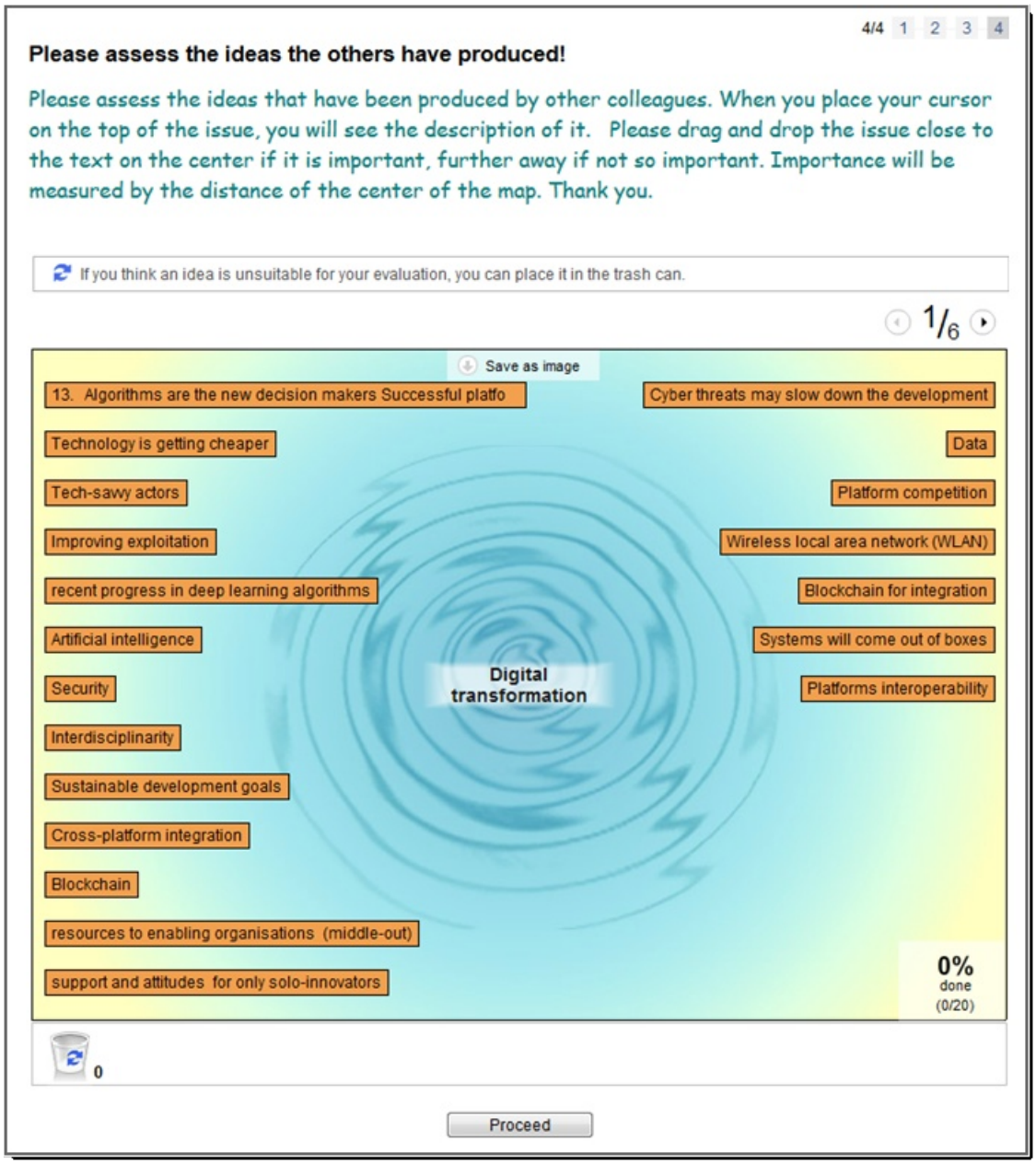

Figure 2. Assessing the answers of other experts

group, who used the STEEP framework (social, technological, economic, environmental, and political drivers) to produce an initial grouping according to key dimensions. Each of the dimensions was described with mutually exclusive alternative states and was collected to form the morphological matrix (Figure 3). Special attention was paid to the independence of the drivers, to the coherence of the driver state combinations, and to the diversity and novelty of resulting scenarios. Thus, the morphological matrix was discussed and refined iteratively during the workshop. The experts also created initial scenario drafts based on different combinations of the driver states, which were produced with the help of the Parmenidos EIDOS software to ensure coherence and diversity. After the workshop, the scenario drafts were written out as narratives by the core research group.

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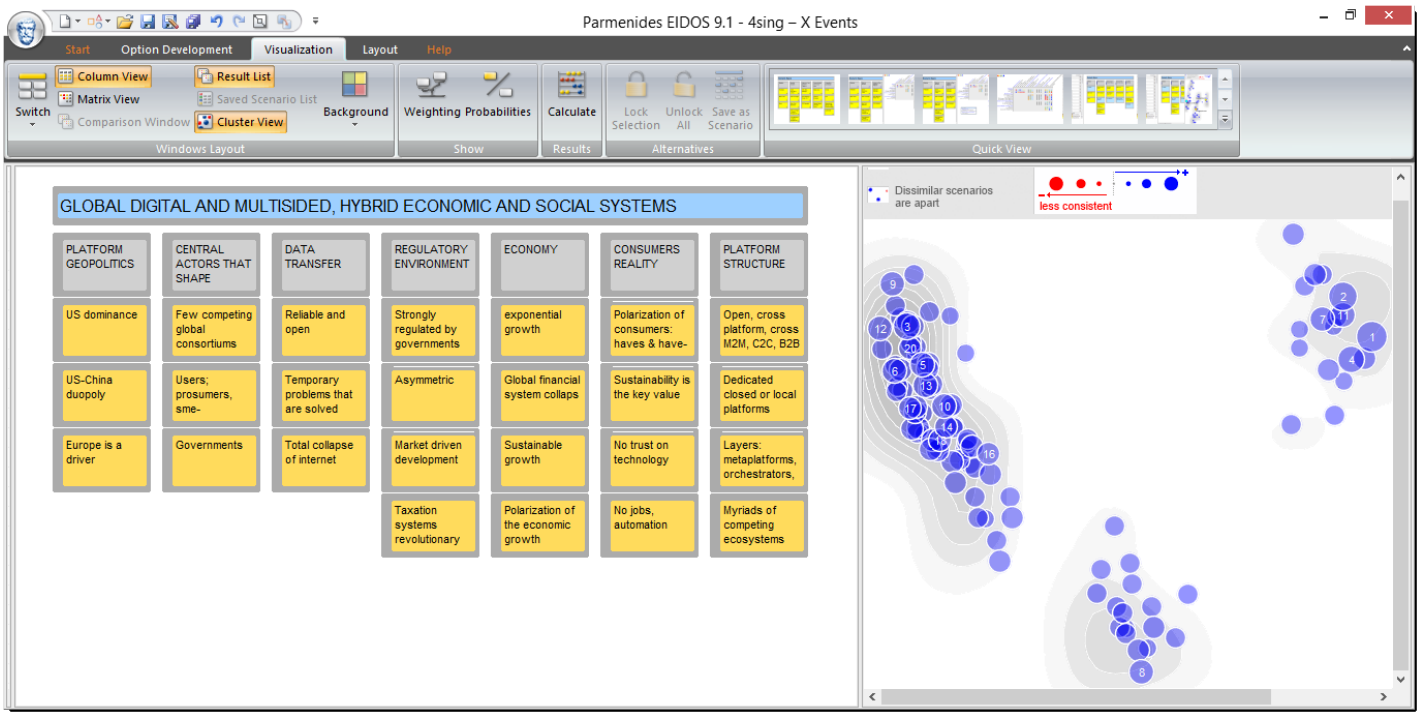

Figure 3. Key uncertainties in the platform economy and their alternative developments

A second web-based questionnaire was used to gather different strategic and policy actions for succeeding in the platform economy and to assess them in the different scenarios. These actions as well as the scenarios were discussed and further developed in a second expert workshop. In addition to refining the scenario stories, the workshop participants generated success strategies consisting of various actions for each of the scenarios from various industrial perspectives. After the workshop, the actions were prioritized and their resilience analysed using robust portfolio modelling (RPM) (see e.g., Liesiö et al., 2008). RPM is a decision-support methodology used for analyzing multi-criteria portfolio problems (Ilmola & Rovenskaya, 2016; Lourenço et al., 2012). It uses standard decision-analysis models to capture the benefits of different options and option portfolios (i.e., option combinations), but also admits incomplete information about the parameters. Based on combinatorial optimization techniques, the RPM identifies feasible and efficient option portfolios (i.e., those that satisfy relevant portfolio constraints regarding limited resources). RPM supported the identification of actions that are successful across the scenarios. Thus, we were able to define a set of resilient actions that would be useful in all of the scenarios analyzed. That outcome we call a resilient strategy.

Case study: Scenarios for the SmartSteel platform

The generic platform economy scenarios were customized by applying the morphological analysis presented above for a sector-specific case context, focusing on heavy engineering value chain. The project team had an opportunity to work in close collaboration with a consortium that had an ambition to develop a platform that covers the whole value chain and lifecycle of a steel product. In practice, this could mean, for example, all the phases from steel production to building a luxury cruise ship, and further to the phase where the ship is wrecked and the material is recycled.

The consortium participants had a strong business focus, and the main objective of the scenario exercise was to generate and compare different business models needed in scenario environments. Thus, the final market-specific scenarios had different titles that reflected technology development instead of geopolitics, such as “Internet Havens”, “Fast Transitions”, and “Technology Stuck in Tar”. Whereas the global platform economy scenarios focused on global and general developments and national level policy options, the industry-specific ecosystem scenario work focused on analyzing different business models that would produce success in each of the scenarios. The outcome was a vision and

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strategy for a SmartSteel platform. It consisted of elements that were assessed to be resilient both in the long term and in the short term, that is during the ecosystem business development phases.

Results

This section describes the three main outcomes of the process: the identified uncertainties, scenarios based on these uncertainties, and strategies for coping in the world described by the scenarios. We first describe results related to the general developments in the platform economy and then the case-specific results.

Key global uncertainties and possible development paths for platform ecosystems

The development of the platform economy is shrouded by major drivers that have many potential states. These represent key uncertainties that have a major impact on platform ecosystem development and to the choice of technology and ecosystem-level coordination. The participatory process described earlier identified seven main uncertainties that characterize the development of the platform economy, and alternatives for each of them were defined (Figure 3). The seven uncertainties cover key changes in the political, economic, social, and technological environments:

1. **Platform geopolitics:** The United States has dominated the platform business globally and especially in the Western countries. China is another big player driven by its fast platform development. Europe is lagging behind, but is taking a slightly different approach with emphasis on privacy and developing practices for the fair ownership of data. There are signs of the European Union challenging the practices of US-based platforms through regulation. How these geopolitical tensions play out is crucial in determining the future nature of the platform economy. For the scenarios, three alternatives were defined: *US Dominance; US–China duopoly; Europe is a driver.*

2. **Central actors:** The platform economy is currently largely driven by companies that have been able to scale up quickly and thus enjoy network effects. There is a tendency towards greater integration and platforms taking on new functionalities. There is also a countertrend with a focus on user-owned platforms or platform cooperatives as well as more local platforms. Governments are also taking more active roles in the development of the platform economy. Thus, the key question is: who is the key player in determining the development of the platform economy? Three alternatives were defined: *Few competing consortiums; Users, prosumers, SMEs enabled by blockchain; Governments.*

3. **Data transfer:** The platform economy is being built upon ubiquitous, accessible, reliable, and global data transfer. However, there are many developments that challenge the reliability of Internet and digital data transfer. There have been increasing numbers of attacks on domain name servers. There is also increasing volumes of traffic and numbers of devices, which both strain the infrastructure. The debate on net neutrality is also ongoing, with some service providers wanting to favour more lucrative traffic. Three alternatives were defined for how data transfer develops: *Reliable and open; Temporary problems that are solved; Total collapse of the Internet.*

4. **Regulatory environment:** Platforms disrupt existing industries and challenge the conventional notion of an employee. They also raise new questions about privacy and the ownership of data. Governments and communities have taken different approaches towards disruptive platforms. In the scenario process, four alternative pathways for the development of regulatory environment were defined: *Strong regulation by governments; Asymmetry where the strictness of regulations varies between sectors and regions; Market-driven development; New forms of taxation.*

5. **Economy:** The general development of the economy of course influences the future of the platform economy. The big question, especially in Europe, is stagnation or even the collapse of the whole economic system. On the global level, the polarization of growth is a key uncertainty: where will growth continue and where will it not? In the scenario process, four alternative developments for the economy were defined: *Exponential growth; Global financial system collapse; Sustainable growth; Polarization of economic growth.*

6. **Consumers' reality:** The values and attitudes of consumers or users of the platforms are key in defining how the platform economy develops. Platforms have the potential to connect and empower people as well as disconnect them from "filter bubbles". So far, the platforms have probably increased inequality more than they have reduced it because of the dominance of "winner takes all" dynamics. Four alternatives

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were defined related to consumers' reality: *Polarization of consumers; Sustainability is the key value; No trust on technology; No jobs.*

7. **Platform structure:** Currently, the dominant platform structure is rather closed with few application program interfaces (APIs) for interaction with other services. Data is usually owned by the platform and is often difficult to extract. There are also signs of open and distributed platforms as well as metaplatforms, which act as a "platform of platforms". Four possible structures were defined for the scenarios: *Open; Dedicated closed or local; Layers and metaplatforms; Myriad of competing ecosystems.*

Scenarios

Based on the key uncertainties, three scenarios were elaborated in the workshops. The selection of the development paths for each scenario was assisted with software to ensure the internal coherence and diversity of the scenarios (Figure 4). A sketch of each scenario is provided below:

- **Scenario I: Polarization driven by China and the US.** Chinese and American companies are ruling the global economy. They have built gigantic consortiums that have a portfolio of various platforms that they play with. Regulation is weak and the markets are leading development. Automation is well advanced and applied widely, and that has a strong impact on employment. Many have lost their jobs, but the minority of specialists that are still needed are doing very well. All seems to be fine, until the Internet has an increasing number of failures. Large companies are building their own closed worldwide networks. Those consumers that are not potential customers for global companies are dropping off.

- **Scenario II: Sustainable development by Europe.** The impacts of climate change and global warming are visible everywhere. Consumers and political decision makers are ready for behavioural change, and sustainability is dominating decision making at all levels. The climate is warming, but at the same time, the geopolitical atmosphere is freezing. Countries, especially the US, are using large companies' data against international codes of conduct. In the scenario, users have lost their confidence in American companies after several scandals, and they highly appreciate European platforms, which they perceive as trustworthy. Even if the growth of the economy is still modest, the interoperability of open platforms based on European standards generates a high economic potential.

- **Scenario III: US-driven, fast, unreliable growth.** The US is still the engine of the global economy, especially when Chinese and African economies are struggling with the side effects of the recent superfast growth periods. With President Trump, the US political context is refocusing and anti-trust regulation – and especially the financial support for the digital infrastructures – favour networks of small and medium-sized companies. Unlike in 2016, the markets now consist of fast-growing and fiercely competing platforms. Global infrastructure is not receiving investment, and overheated Internet traffic leads to collapse. Secure, closed network providers are collecting platforms under their wings.

Case-specific market-focused scenarios

The value-chain-specific scenarios included the same dimensions, but in a simplified way. Key dimensions of the market-specific scenarios were technology development, globalization, Internet development, politics, and consumer values. Based on these dimensions, three case-specific market scenarios were developed: "Internet Havens", "Technology Stuck in Tar", and "Fast Transitions" (Figure 5).

The group generated visions for each of the scenarios. These visions consisted of scenario-specific choices of structure of the ecosystem, its governance model, and

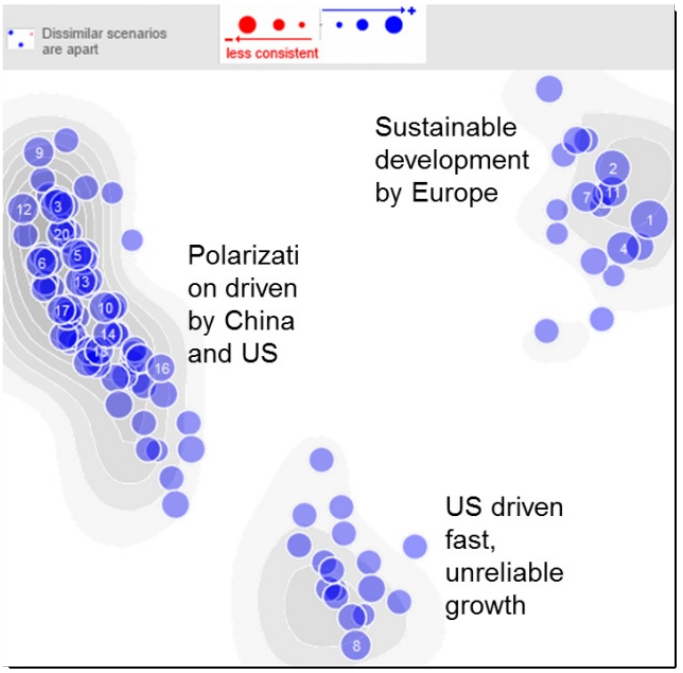

Figure 4. The alternative combinations of dimension states produced a large set of alternative scenarios

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Figure 5. Three market-specific scenarios

the focus market. The vision described the growth pattern as well. Visions were operationalized into a set of actions that consisted of technology development, regulatory lobbying, and acquisition of specific knowledge needed.

Resilient strategies and key recommendations

The robust portfolio analysis (RPM) produced a proposition of actions that would be useful across all of the scenarios defined. The results are presented in Figure 6. The resilience testing for the SmartSteel platform case study included 23 actions from certification to early investments. Typical for resilient actions was a low investment requirement and close relatedness of the current customer needs. Full details are not disclosed due to confidentiality.

Actions' impacts on scenario probabilities taken into account	
EU steel legislation	1.00
Platform investment	1.00
Information security	0.92
Certification	0.92
Speed and agility	0.92
Service business	0.77
New sources of income	0.77
Open interfaces	0.62
Traceability requirements	0.38
Partnering	0.38
Central corporation / foundation	0.31
Early investments	0.00
Cost savings	0.00
Sustainability requirements	0.00
Sector-focused development	0.00
Institutional actors	0.00
Technology business	0.00
No novel technologies	0.00
Passive location tag	0.00
Active tag	0.00
Energy storage tag	0.00
Antenna capability	0.00
Sensor layer for IoT	0.00

Actions' impacts on scenario probabilities neglected	
EU steel legislation	1.00
Platform investment	1.00
Information security	1.00
Partnering	1.00
New sources of income	0.68
Traceability requirements	0.56
Open interfaces	0.52
Central corporation / foundation	0.52
Certification	0.48
Service business	0.48
Sector-focused development	0.30
Speed and agility	0.30
Institutional actors	0.14
Sustainability requirements	0.02
Technology business	0.00
No novel technologies	0.00
Passive location tag	0.00
Active tag	0.00
Energy storage tag	0.00
Antenna capability	0.00
Sensor layer for IoT	0.00
Early investments	0.00
Cost savings	0.00

Figure 6. Computation results from the robust portfolio model

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Discussion and Conclusion

The research question guiding our work has been "What are platform ecosystem options within different global platform economy scenarios?" The results describe a comprehensive set of uncertainties around the development of the platform economy. We have looked at the possible development paths, both on the global level with a focus on national policies and on the industry level from the viewpoint of a consortium of companies. The scenarios and the further robust portfolio analysis help to define actions and strategies that are resilient towards different possibilities. The process described thus produces a set of possible actions, both for policy makers and corporate strategy makers interested in developing platform ecosystems. The results also highlight the need for the resilience of the key actions companies in a platform ecosystem can take to ensure a favourable development in this uncertain environment.

On the methodological side, our article presents a concrete, systematic process to build a vision and strategy options for a new platform ecosystem. The approach is a good example of combining more qualitative results, such as the scenario narratives and key uncertainties, with more quantified methods, such as choosing a robust portfolio of actions.

A shared understanding of the operating environment of an ecosystem and attractive vision are prerequisites for a birth of a new platform ecosystem. The vision should be strong enough that it will motivate ecosystem members with different priorities to overcome the risks generated by the uncertainty of the outcomes. We believe that the systematic process described in this article will help in attaining the shared understanding and create resilient visions. The scenarios and strategies developed in the project are also being used in a set of virtual tools. We are developing a workbook on platform ecosystem development and a web-based game that helps the initiators of the ecosystem in assessing different strategy options.

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The Core Interaction of Platforms: How Startups Connect Users and Producers

Heidi M. E. Korhonen, Kaisa Still, Marko Seppänen,
Miika Kumpulainen, Arho Suominen, and Katri Valkokari

> *"Our management team strongly believes that the key opportunity of our business does not only come from just the increase in terms of number of users but also how we continue to enhance the value of our platform for our users."*
>
> Victor Koo
> Founder and CEO of the Youku online video platform

The platform economy is disrupting innovation while presenting both opportunities and challenges for startups. Platforms support value creation between multiple participant groups, and this operationalization of an ecosystem's value co-creation represents the "core interaction" of a platform. This article focuses on that core interaction and studies how startups connect producers and users in value-creating core interaction through digital platforms. The study is based on an analysis of 29 cases of platform startups interviewed at a leading European startup event. The studied startups were envisioning even millions of users and hundreds or thousands of producers co-creating value on their platforms. In such platform businesses, our results highlight the importance of attracting a large user pool, providing novel services to those users, offering a new market for producers, supporting the core interaction in various ways, and utilizing elements of the platform canvas – an adaptation of the business model canvas, which we have accommodated for platform-based business models – to accomplish these goals.

Introduction

In the age of non-linear innovation and digital technologies, innovation can be better nurtured within a special, innovation-conducive environment, which may be seen as an ecosystem meant for co-creation of value through collaboration (Smorodinskaya et al., 2017). Additionally, today's global business setting requires actors to be involved in value co-creation that is beneficial to all participants (Ramaswamy & Ozcan, 2014). Multi-sided platforms are seen as business models that enable external producers and users to create value together by interacting with each other (Choudary, 2015), hence operationalizing some of the co-creation of an ecosystem.

Platforms oftentimes disrupt companies' existing capabilities, networks, and business models, paving the way for new entrants capable of leveraging new capabilities. In addition, established companies manage innovation by building innovation externally, buying it, or partnering with resources outside of the company (Blank, 2014). Accordingly, information technology (IT) startups are aware of possibilities for multi-sided marketplaces and resulting platform-based business models. However, startups have limited resources and network position, meaning they have little or limited connections to existing ecosystems (Valkokari et al., 2017).

In this article, we concentrate on producers and users and the value-creating interaction between them because creating and capturing value is the "core interaction" of platforms (Parker et al., 2016). We explore the core interaction in the context of growth-seeking startups and their platform solutions. We view startups as organizations formed to search for repeatable and scalable business models (Blank, 2013).

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In our research, we are interested in the ways startups are connecting producers and users in value-creating interaction through digital platforms, but also in their ability to capture value from this core interaction of the platform. Hence, our research question is: How do platform startups connect producers and users through value-creating core interactions?

We approach this research question by first looking at the existing theoretical literature on digital two-sided platform businesses. We further illustrate a platform business with a canvas to clarify some of the main concepts of our empirical research. We then describe our method for studying 29 cases of platform startups that we interviewed at a leading European startup event. Thereafter, we present our findings, including a general presentation of our case startups and their financial performance, an analysis of the number of users and producers connected, the value created for them, and a deeper analysis of the core interaction, the participants, and the support for core interaction. Finally, we discuss our results, identify the managerial implications, and take a look at opportunities for future research.

Background

Platforms beyond matchmaking

The purpose of a platform is to facilitate the exchange of products, which can be goods, services, or even social currency (Choudary, 2015). In management research, the fastest-growing stream related to platforms is the market intermediary stream, in which a "platform" represents a link or a facilitator between two or more markets or groups of producers and users (Thomas et al., 2014).

Simply put, platforms have been described as digital matchmakers that connect a variety of users and producers, making it easy for them to get together and do business. It is essential but challenging for platforms to simultaneously attract users and producers (Parker et al., 2016), as both participants are needed in order for value to be created (Evans & Schmalensee, 2016). However, true platform innovators do more than use data-driven algorithms to drive better buyer–seller matches: they also empower participants to create value with each other, which leads to multi-sided surplus and more value (Van Alstyne & Schrage, 2016), hence network effects play a key role.

Focus on interaction

Platforms give companies new opportunities by changing the nature of their interactions with each other and by circumventing traditional business rules (Vazquez Sampere, 2016). In the digital platform ecosystem, technology mediates connections between actors – such as people, organizations, and resources – making it easy and efficient for participants to connect and exchange value (Evans & Schmalensee, 2016).

To make this core interaction inevitable, the platform must attract users (often with a heterogeneous value proposition), create infrastructure, and set the interaction governance principles. Hence, with an elaborate governance system of laws, enforcement, and penalties (Evans & Schmalensee, 2016), the platform can facilitate value co-creation and match the most compatible users with each other.

Instead of single or one-time interactions (though valuable ones), the key to platform success is explained with sustainable and repeatable interactions (Choudary, 2015) that breed ecosystem growth or emergence. Such opportunities for digital platforms often emerge when the market has friction that hinders the different user groups from doing business with each other (Evans & Schmalensee, 2016). Removal of such friction allows for more interaction – and therefore digital platforms often challenge the existing business ecosystems with disruptive business models. Increasing the number of platform participants and the level of their interaction further increases the value of participation. Once a critical mass of participants is reached, the phenomenon becomes self-reinforcing. Such network effects are the source of competitive advantage, which can lead to market dominance (Parker et al., 2016) and platform ecosystem sustainability.

In other words, when platform ecosystem members seek sustainable growth, it is not enough for them to simply invest in greater capacity and greater efficiency: platforms should strategically invest in the capabilities, competence, and creativity of users (Van Alstyne & Schrage, 2016). Such empowerment attracts customers, and empowered customers strengthen the platform. Also, studies suggest that the biggest profits are gained when platforms are opened to third parties – their technologies, products, and services. These complementary offerings increase customer value (Ailisto et al., 2016).

Exploring the core interaction with the platform canvas

The platform canvas (Sorri et al., 2016) operates with eight key elements describing critical characteristics of platform business: users, producers, value, value capture, network effects, resilience, governance, and filtering (Figure 1). The platform canvas helps to guide the

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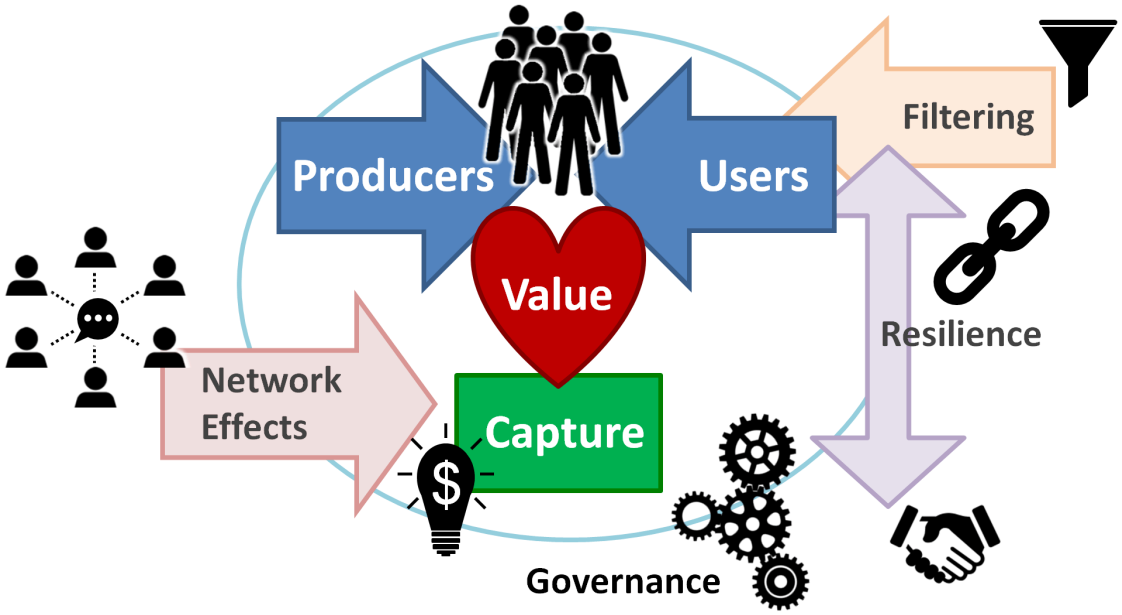

Figure 1. The platform canvas emphasizes the central role of core interaction towards value capturing and monetization

platform ecosystem participants – platform owners, complementors, infrastructure, and service providers – through key elements, ensuring reviews of all critical perspectives.

The platform canvas presents, in a visual way, the most important activity of the platform: *the core interaction* (Choudary, 2015; Parker et al., 2016). For the purposes of this study, we focus on four core elements. These include participants, both *users* and *producers* (Evans & Schmalensee, 2016), who are depicted in the canvas with blue arrows. The value created for them (Van Alstyne & Schrage, 2016) is explored with *value proposition,* depicted in the canvas with a red heart. The *value capture* needed toward creating a sustainable business, and attractive motivation for all participants, is depicted in the platform canvas with a green box.

Method

Our study is based on a qualitative case study research strategy (Yin, 2003) supported by quantitative data on the financial performance of the case startups. To investigate the phenomenon of platform innovations and the core interaction within them, we collected data in November and December, 2016, at the leading technology startup event in the European Union, SLUSH (slush.org), held in Helsinki, Finland. According to the organizer's press material, there were 2,336 startups, 1,146 investors, and 17,500 attendees in this event.

We pre-selected some of the case companies based on keywords they provided to the event organizers, selecting only those companies that used keywords such as "platform" or "marketplace". We then approached and interviewed representatives of those pre-selected companies that had booths at the two-day event. We added further case companies opportunistically by visiting booths and examining the companies' marketing materials; this approach enabled us to identify additional interviewees of companies that self-identified as representing platform companies. The most typical roles of the interviewees included Founder, Co-Founder, CEO, and other C-level executives. Other interviewee roles were related to business development, marketing, sales, public relations, finance, product management, community management, and web development.

In total, 55 short (10–20 minute) interviews were conducted among those companies that were available for interview. After the event, we gathered secondary information about these companies from their websites and Facebook pages as well as other openly available information on the companies and their offerings on the Internet. From the sample, we removed duplicates, companies that we later decided were not platform companies based on additional information, as well as companies that had been established for more than four years (i.e., they were no longer startups). Our final sample contained 29 cases of platform startups for further analysis.

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Our interview guide was based on the platform canvas. Hence, it included questions about platform participation, business models, and support needed for success. However, only the results of the first part of the survey, which explored the core interaction, are considered in the current article. Survey results related to the business model innovation of the startups were previously reported by Still and colleagues (2017).

The interview guide questions addressed in this study relate to the number of platform participants on the *user* and *producer* side, and what kind of *value* is offered for them by the core interaction within the platform.

The choices for the value offered for the users were:

1 = Service entities
2 = Better, faster services
3 = New services
4 = Tailored solutions
5 = Opportunities for sharing of profits or new earnings

The choices for the value offered for the producers were:

1 = New business through coupling of services
2 = New markets/new customers
3 = New tools for customer interfaces
4 = Novel usages of data for business

The respondents could choose more than one of the choices. As to the number of participants on the platform, the respondents were asked if there were ones, tens, hundreds, thousands, or millions of users and producers on the platform.

In addition to the qualitative data gathered through interviews, quantitative financial information for the companies was collected from the Orbis database (tinyurl.com/yaho3dyb), one of the world's largest databases for company information. Of the 29 interviewed companies included in the analysis, 21 could be identified from the Orbis corporate database: 16 of them had profit/loss data and 18 of them had turnover data. The first part of this study is based on the interview questions and Orbis data.

As a second part of this study, the core interaction was studied in greater depth based on qualitative information about the companies and their offerings that was freely available online. We first looked at the startups' own websites and Facebook pages. Thereafter, we searched for the companies on Google, and given that these startups are still in their infancy, the amount of information found through search was quite manageable. In our Google searches, we typically arrived at websites connecting together startups and investors, such as CrunchBase or AngelList. However, the information freely available on these sites is typically very limited and does not give a full picture of the platforms. Many of the startups had LinkedIn pages, YouTube videos, or they were presented on the websites of startup communities, and this information was often very helpful for the analysis.

The startups were typically described in different ways in the various contexts. Therefore, our interpretation of their platforms is not based on any single source but represents an integrated view of the different sources and our interviews. Based on our interpretations, we wrote a condensed description of the platform for each startup. We further focused on who are the different groups participating on the platforms (i.e., users and producers) and what kind of support the platform company offers for their core interaction, trying to find different types of support. We then looked at the groups participating on the platforms, whether there was one group of users and one group of producers on the platform (representing a two-sided market) or whether there were multiple groups of participants on the platform (representing a multi-sided market).

Findings

The 29 cases of startups developing digital platforms and our analysis of the platform participants and support for their interaction are presented in Table 1. This analysis is based on the data openly available on the Internet. The company-specific interview data is not presented here for reasons of confidentiality, but it is described at an aggregate level in the next subsection.

The startups were mostly Finnish, which reflects the origins of the majority of companies at the SLUSH event, which was held in Helsinki. However, there were also startups from countries near the event site (e.g., Sweden, Estonia), a bit further away (e.g., France, Hungary, Italy, Turkey), and even further away (e.g., Singapore, South Korea). The platform ideas varied extensively: from health, pet, and travel-related to open innovation, travel network optimization, and cryptocurrency exchanges. Hence, it can be seen that, in addition

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Table 1. An overview of the 29 platform startup cases in this study

#	Year Founded	Country	Platform Idea of Core Interaction	Participants Involved in Core Interaction	Support for Core Interaction
1	2014	Finland	People getting to know new people	People	Bring together matching parties and aid their communication
2	n.a.	n.a.	Weather community interaction	Wind sports enthusiasts and weather forecast provider	Bring together matching parties and aid their communication
3	2015	Finland	Service experience personalization	Service providers and their customers	Analysis of customers and aid communication between participants
4	2015	Finland	Combining vacancy rental services	Rental hosts and providers of vacancy rental services	Easier-to-use interface
5	2015	Italy	Sports equipment rental	Equipment owners and users	Marketplace
6	2012	Singapore	Location-based customer intelligence and marketing	Brand owners and their customers	Analysis of customers and aid communication between participants
7	2016	Finland	Gamification	Companies and their customers	Bring participants together and aid their communication
8	n.a.	Finland	Finding clothes manufacturers	Brand owners and manufacturers	Easier-to-use interface
9	2013	Finland	Chat	Companies and their customers	Aid communication between participants
10	2015	France	Market for data	Data providers and buyers	Marketplace
11	2016	Finland	Sharing of health data	Patients and health service providers	Analysis of customers and aid communication between participants
12	2016	Estonia	Health services market	Health service providers and their customers	Marketplace
13	2013	Finland	Near-location messages	Those sending and receiving messages	Bring matching parties together and aid their communication
14	2016	Finland	Pet caring	Pet owners and care takers	Marketplace
15	2014	Finland	Market for local shopping	Nearby stores and consumers	Marketplace
16	2015	Finland	Open innovation	Companies and developers	Bring participants together and aid their communication

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Table 1 ***(continued).*** An overview of the 29 platform startup cases in this study

#	Year Founded	Country	Platform Idea of Core Interaction	Participants Involved in Core Interaction	Support for Core Interaction
17	2014	Finland	Real-time data-based micro-services	People and machines trading data; developers	Marketplace
18	2015	Finland	Business applications	Users and cloud services providers for enterprise resource planning (ERP)	Easier-to-use interface
19	n.a.	Hungary	Community of shoe enthusiasts	Shoe wearers and key industry players	Analysis of customers, bring matching parties together, and aid their communication
20	2016	Finland	Travel optimization	Travel providers, their customers, and airlines	Optimization
21	2014	France	Travel network optimization	Different kinds of travel and transport operators	Optimization
22	2014	Sweden	Different payment methods	E-tailers, their customers, and payment companies	Easier-to-use interface
23	2016	Finland	Design clothes market	Designers, brand owners, and consumers	Marketplace
24	2012	Finland	Cryptocurrency transactions	Users of cryptocurrencies in different roles	Easier-to-use interface
25	2014	Singapore	Gaming	Players, game developers, and licensing partners	Bring matching parties together and marketplace
26	n.a.	Turkey	Travel experiences	Experience seekers, providers, and experts	Marketplace
27	2014	Finland	Positioning for location-aware apps	App developers, end users, and different location-technologies providers	Easier-to-use interface
28	2015	South Korea	App development	Beginner app developers, services providers, and operating system providers	Easier-to-use interface
29	2016	Finland	Media	Digital publishers, readers, and media providers	Analysis of customers and aid communication between participants

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to consumer markets, the startups were also aiming for business-to-business (B2B) markets. All of the companies had been established within the past three years (2014–2016), except for four companies for which we could not determine a date of establishment. We assume that these four startups are so new that they had not been formally established as companies at the time of data collection.

Most of the studied startups had turnover and, from this point of view, they were making money with their platform businesses. The median turnover was €100,000 (s=90, N=18). The largest turnover was more than €300,000. One of the companies had zero turnover; others, for which turnover was known, had a positive turnover. In particular, turnover below €50,000 and turnover between €100,000 and €150,000 were common in our case startups.

Still, the majority of the case startups were making losses, three of the companies had profits below €10,000, and one was making €42,000 profit. The profit and loss (P/L) values before taxes had a median value of -€143,000 (s=179, N=16). Four of the 16 companies that had data on profit and loss had a positive P/L value, whereas others had a negative value. This shows that the companies selected for the analysis are in a development stage where significant development costs and low revenues reduce the P/L value. On the asset side, the companies' total assets median value was €157,000 (s=249, N=16) and shareholder funds €52,000 (s=104, N=16).

Value creation through connecting users and producers

The first part of the study based on the interview data explores the numbers of users and producers on the platform and what kind of value is created for each of these participant groups as the platform connects them. The analysis of the 29 interviews shows that the startups were comfortable with analyzing the platform as a marketplace. Using the sliding scales of the survey (Ones-Tens-Hundreds-Thousands-Millions), most of the companies were able to estimate the number of participants on both sides. However, some discussed the current levels of participation, whereas some discussed the future expected levels of participation.

Among the 29 startup cases, the most common answer for the number of users was millions, which was stated by 45% of the respondents. The second most common answer was thousands (28%), which some elaborated as "hundreds of thousands". Still, two startups (7%) stated tens of users, which they explained reflects their B2B market.

The startups seemed to have fewer producers in their platforms than users. Only two of the startups reported having more producers than users on the platform. These were both B2B platforms that connected a larger pool of business services providers with a smaller pool of user companies. Further, only two (7%) of the 29 case startups mentioned millions of producers, whereas more than half of the start-ups mentioned either hundreds (24%) or thousands (31%). The platforms with millions of producers also had millions of users. Many (24%) of the startups mentioned only tens of producers and four of the startups (14%) counted the number of producers on their platforms as "ones". Figure 2 shows a comparison of how the 29 startups viewed the number of users and producers on their platforms.

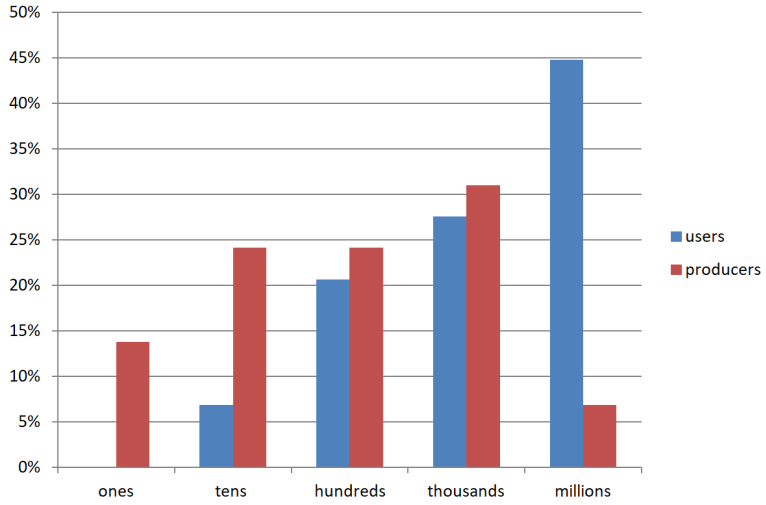

Figure 2. Number of users and producers on the case company platforms (N=29)

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For the types of value offered to the users, most of the respondents saw that it is a combination of multiple choices. The majority of the respondents chose more than one option. Thirteen of them (45%) emphasized the importance of one, 11 (38%) chose two options, two (7%) chose three options, another two (7%) four options, and one respondent even chose all five options.

The most often-mentioned value choices were better, faster services (59%) and new services (55%). Tailored solutions were chosen by 34%, service entities by 24%, and opportunities for sharing of profits or new earnings by 21% of the respondents. The distribution of the respondents' choices is shown in Figure 3.

When addressing the types of value offered to the producers, two startups did not mark anything. The majority, 14 out of 27 responses (52%), chose only one option. Two values were chosen by nine respondents (33%), while one chose three options, and three (11%) chose all four options given to them.

The most common producer value was new markets / new customers (56%), followed by new business through coupling of services (44%) and new tools (44%). Novel usage of data for business was chosen by 28% of the respondents.The distribution of these choices is shown in Figure 4.

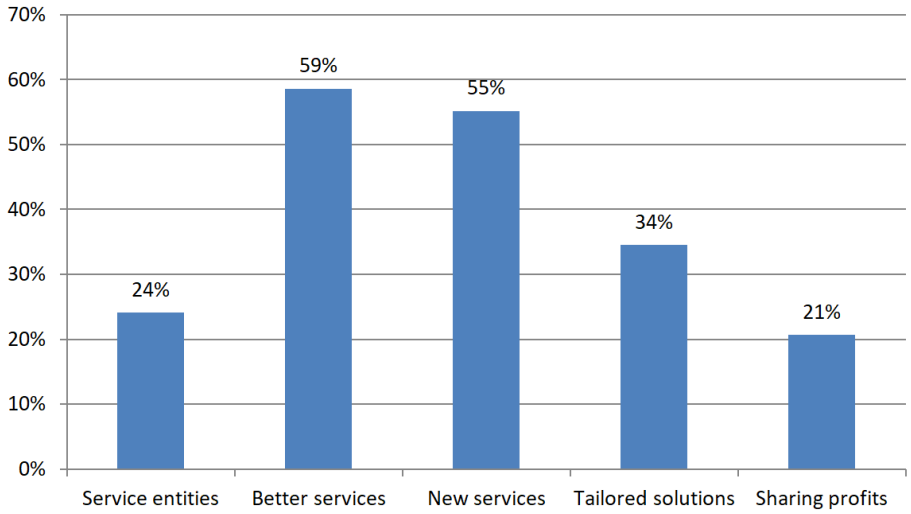

Figure 3. Distribution of the respondents' choices for the types of value offered to users (N=29)

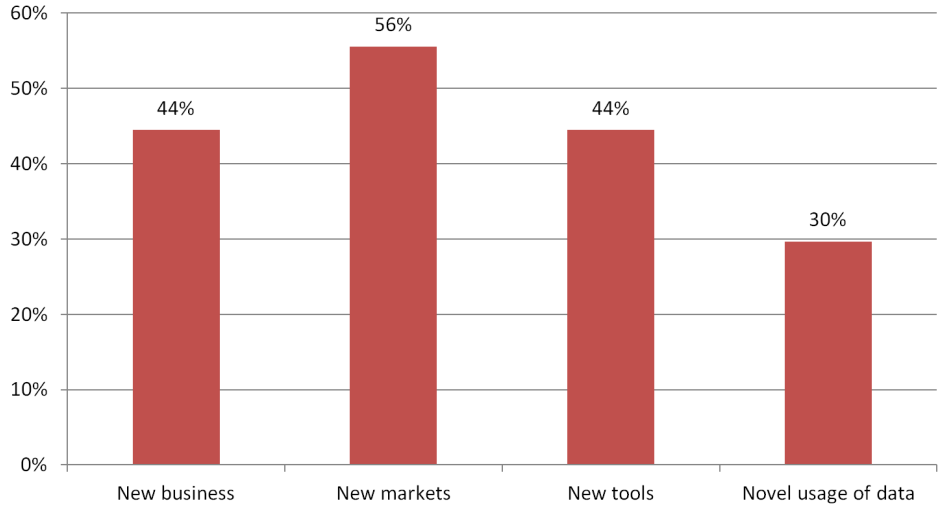

Figure 4. Distribution of the respondents choices for the types of value offered to producers (N=27)

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The core interaction and how platforms support it

The second part of the study goes beyond the number of users and producers connected and the value created when connecting them. We studied each case in greater depth based on the data found online. The main results of the case-by-case analysis were presented earlier (Table 1).

Our in-depth examination of each platform and the participants involved revealed the actual core interaction – how the parties co-create value on the platform. When looking at the parties involved, our first notion was that in roughly one-third of the platforms (9 of the 29 studied platform startups: cases #20–#29), there are clearly more than two groups of participants involved in the core interaction in addition to the platform startup. There may be more than one user group or more than one producer group participating in the platform. In roughly two-thirds of the cases, there is a clearer two-sided market with one user group and one producer group. However, it is difficult to define an exact number for the user and producer groups on a platform because these roles may be blurred and because the level of activity required from a participating group varies. The blurring of roles is especially emphasized in cases with millions of people interacting with each other in both the user and producer roles.

Some examples, such as machines trading data (case #17), also made us ponder whether robots, machines, or artificial intelligence in some situations should be counted as participants in the core interaction. Machines do not experience value in the same way as people, and usually there should be some sort of owner or user of the machine that can be considered as the actual party involved in the value co-creation.

After studying the participants involved and how they co-create value on the platform, it was possible to take the next step: to study how the platform supports this core interaction. The platforms typically seem to combine different logics for support. All the platforms provide the basic function of connecting the parties for the core interaction. They may connect parties that have not been connected before or they may somehow improve existing connections. Most of them provide something more than just a marketplace. They bring together the right kind of users and producers that match together, and they aid the information exchange and communication between the groups. They often analyze one group on behalf of the other: customer intelligence (analysis of users) seems to be particularly popular, but they also analyze the services of producers and help users find the right services or even optimize their usage. Also, in many cases, the services of producers were technical and difficult to use (especially when there was a need to combine together many different services from various technology providers), and the platform supported the core interaction by providing an easier and unified interface for these services.

Discussion and Conclusion

This study sheds light on the expectations startups have in relation to their platform-based business models and their abilities to both support the core interaction and capture value from it. The most apparent outcome of our study is that many startups do think of themselves as connecting producers and users. Platform thinking and looking at platforms as marketplaces has proliferated in the startup scene. Startups are experimenting with platform businesses, but the general level of articulating these business models is not yet very high. This result may also be affected by the issue that startups may not wish to fully reveal their business plans.

The previous literature highlights the core-interaction between the users and producers (Choudary, 2015; Evans & Schmalensee, 2016; Sorri et al., 2016). It is important to look at the scale of connecting users and producers given that, in a platform business, it is essential to reach a critical mass, and the value, or win-win, needs to be understood. This exploration was conducted based on the visualization of the core interaction using the platform canvas, which then guided the interviews of 29 startups.

"Millions" was the most common number of users, and those startups that only had a small number of users on their platforms were B2B companies. For the types of value offered to users, better services and new services were the two most common answers. For the types of value offered to producers, the differences between the answers were less pronounced but new markets was the most common answer. Making loss is typical for companies in their infancy, and based on our data, it seems that platform startups are no different on this aspect.

When looking at the core interaction in more depth, it became clear that most platforms not only bring the different users and producers to the marketplace but also support their core interaction in various ways. The value and strength of the platform and the ability of the platform company itself to capture value often seems to stem from the way the platform supports the different

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parties in their respective value creation and capture. It has been suggested that the perspective on innovation should be widened from value created for customers to value that is co-created, and that this approach will first be adopted by the companies in the forefront of development and in industries facing rapid technological change (Korhonen, 2014). Our study suggests that such thinking has already been adopted by many technology startups.

However, many startups have business ideas that seem to be based on their self-identified customer needs and their efforts in providing technical solutions to them rather than empowering users and producers to identify the needs themselves and create new solutions. Although we did not have financial data on all the case startups and the majority of them were making losses (as young companies usually do), the fact that most of the cases did have turnover signals – in line with previous studies (Ailisto et al., 2016) – that profits can be gained when platforms are opened to complementing producers in order to offer users value through novel services. Such development by complementing parties creates scale and momentum for the offering (Korhonen & Kaarela, 2015).

Managerial implications

Acknowledging that established companies are also part of the platform economy, we see that startups can provide good, clear, and novel examples of platform core interaction as they work towards finding a sustainable business model within their respective platform. Also, startups are not bound by current business models of the ecosystem and, as such, can provide valuable and useful insights into novel digital platforms.

We started our research by focusing on four key elements of core interaction: users, producers, value creation, and value capture. Through our research, we learned that the issue of platform participants may be more complex than just one group of users and one group of producers. Further, we learned that platform support for the core interaction is an essential element that glues together the users, the producers, the value creation, and the value capture. The platform, with all of its participants, needs to concentrate on supporting the interaction, both toward value co-creation as well as toward value capturing. Therefore, based on the study, as a managerial implication, we propose four key questions about the core interaction that managers need to consider:

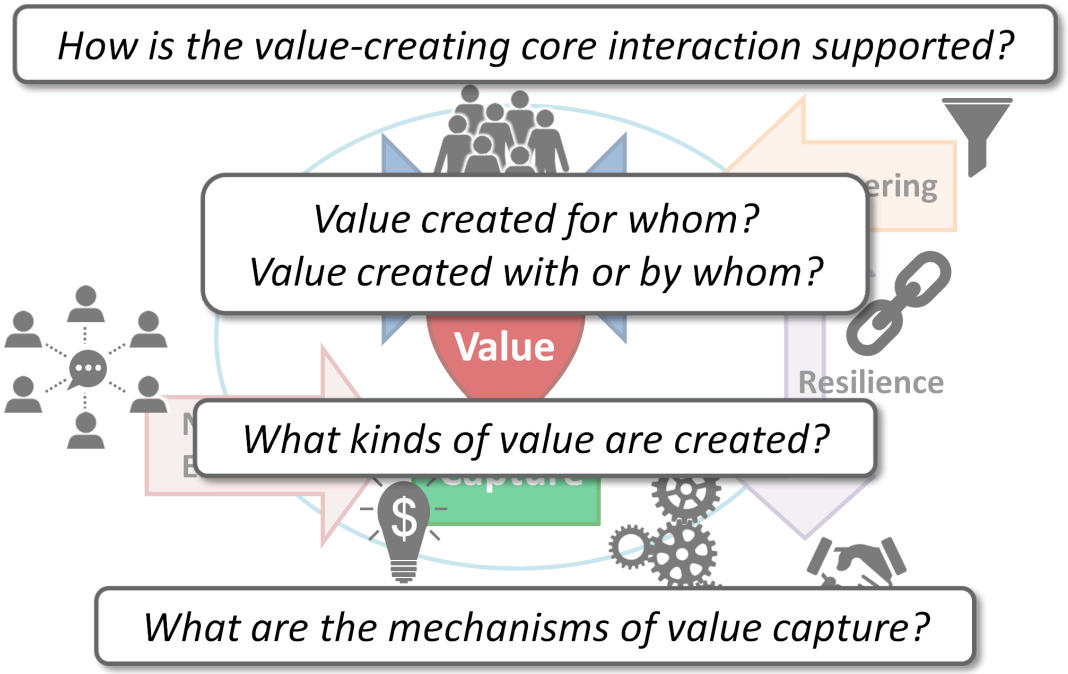

Figure 5. Four key elements of core interaction for managers to consider

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1. Who are the platform participants for whom, with whom, or by whom value is created?

2. What kinds of value are created?

3. What are the mechanisms of value capture for the different parties?

4. Finally, as an overarching element, how is this core interaction supported in the platform?

We see that addressing the issues underlying these four questions can be conducted using the other elements of the platform canvas. Figure 5 reflects the key questions of core interaction overlaid on the platform canvas.

Our study confirmed the importance of ecosystem thinking in a platform-based business (Parker et al., 2016), meaning the focus should be on understanding multi-sided ecosystem value co-creation instead of focusing solely on user value (Korhonen, 2016, 2014). Platform-creating startups should have several partners with complementing offerings as producers in order to increase customer value and solve the chicken-and-egg problem related to their network position. On the other hand, changing customer behaviour towards novel services may raise new possibilities as the well-known disruptive business models of Airbnb and Uber show.

Limitations

Startups are clearly developing platform business, but the language and understanding of this type of business are still developing. In the absence of prior longitudinal experience of the platform, respondents' answers were based on impressions and assumptions of their future business models and the impact of network effects. Although assistance was provided at the time of answering the interview questions, in several cases the respondents seemed to lump together the two participant groups – users and producers – with each other. The blurring of the concepts of users and producers may be related to platforms having more than two participating groups and to all the groups being simultaneously creators and receivers of value. Still, the short, structured interviews enabled us to discuss the terms and key concepts with interviewees, which would not be possible within a traditional survey. The information on the platforms gathered through Google searches was particularly limited because there typically is not that much information available on startups relative to established companies. The analyses of the platform idea, the participating groups, as well as the support provided for the core interaction are to a large extent based on our interpretation of this limited information and not on clear statements of the startups themselves. On the other hand, the information available on startups often is focused on expressing the basic business idea of the startup.

As in any empirical research, the results of the present study cannot be interpreted without taking into account its limitations. Future research directions could include, for example, revenue and incentive models of platform-based business models or further analysis of the different logics of supporting the core interaction. We also need to better understand how existing ecosystems might adopt new platform-based business models faster, with one possibility being to more actively facilitate collaboration between startups and established companies.

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Keywords: platform business, digital platforms, startups, value creation, core interaction, multisided markets, platform canvas, slush event

Orchestration Roles to Facilitate Networked Innovation in a Healthcare Ecosystem

Minna Pikkarainen, Mari Ervasti,
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> *"I'm so excited, we have needs and you have found solutions to them. There is nothing better than that."*
>
> Medical Doctor at the Nordic Hospital
> (Interviewed for this study)

This study examines orchestration roles in a networked innovation context characterized by significant transformation. In particular, an exploratory case study approach is taken to study the roles of innovation network orchestrators and their actions to facilitate networked activities in different phases of the innovation process. The context of the case study, a healthcare ecosystem that aims to co-create technological innovations to support the pediatric surgery journey, provides valuable insights about orchestration and adds knowledge on specific limitations set by the orchestrator-specific and context-related issues in a professional context. The findings of this study highlight the need for careful coordination that allows shared understanding of the goals of the orchestration process and achievable innovation implementations. It is shown that parallel, evolving, and even changing orchestrator roles are needed in complex networked innovation settings.

Introduction

The healthcare sector is currently facing a dramatic change brought about by the digitalization of services, more effective and cost-efficient care models, and self-care promoting personalized healthcare (Caulfield & Donnelly, 2013). Increased costs and the promise of connected health technologies have created a need for innovations that increase patient satisfaction. This need for new technological innovations has also created new business opportunities for companies that target the medical market. A company's success often depends on collaboration with other actors that influence the creation and delivery of their innovative technology solution (Valkokari et al., 2012). This dependency is particularly relevant in the healthcare context, where knowledge and resources need to be continuously distributed between different actors – such as doctors, nurses, patients, and companies – who have their specific features and motivations that need to be acknowledged. Networked innovation (i.e., negotiation in an ongoing purposeful communication and communicative process that relies on either a market or hierarchical mechanism of control; Swan & Scarbrough, 2005) is needed. Then, it is not always the central stakeholders that can do the best job in combining all the different elements and managing the context-related complexities, but different intermediaries may be needed for the coordination task.

There is an ongoing debate in the literature about the best collaboration models and their management in network and ecosystem contexts (see Andersson et al., 2007; Möller & Rajala, 2007; Tsujimoto et al., 2017; Valkokari, 2009; Wilkinson & Young, 2002). Although valuable new research insights have been introduced (see Dhanaraj & Parkhe, 2006; Järvensivu & Moller, 2009; Möller & Rajala, 2007; Valkokari, 2009), conceptual confusion still exists. Particularly, more detailed analysis is required on how to facilitate the innovation process in mutually beneficial collaboration, and how the collaboration practices evolve in different phases of the innovation process (e.g., Valkokari, 2012).

Innovation network orchestration can be characterized as a purposeful action or practice by an orchestrator (an actor such as a hub firm) to initiate and manage knowledge in the innovation process in networks and ecosystems (Nambisan & Sawhney, 2011). Orchestration comprises a set of activities, and when an orchestrator

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conducts (some of) these activities in a specific manner (e.g., by exerting more or less power on other network or ecosystem members), it can be considered that the orchestrator takes a specific role. Over time, in a complex network or ecosystem, there can be multiple orchestrators taking a variety of roles.

In the existing literature, there are plenty of studies that focus on different innovation environments and orchestration activities (e.g., Dhanaraj & Parkhe, 2006; Nambisan & Sawhney, 2011). Some of them have focused on innovation management, whereas others place greater emphasis on network orchestration. Most of the literature on network orchestration is developed for large networks with a dominant hub firm (Gausdal & Nilsen, 2011). Also, research (e.g., Gausdal & Nilsen, 2011) has emerged on orchestration in smaller, innovative networks small and medium-sized enterprises (SMEs). Relatedly, a stream of literature has emerged on co-creation practices (Frow et al., 2016), including studies in the field of healthcare or service ecosystems specifically. Additionally, various marketing and business perspectives on customer-dominant logic and customer participation in value co-creation have been introduced (Grönroos & Ravald, 2011; Vargo & Lusch, 2004). However, research addressing the roles of the orchestrator, and the ways their practices evolve over the time in innovation processes, is still limited. Furthermore, contextual issues influencing orchestration in ecosystems are not yet completely understood. The empirical setting of this article, a healthcare ecosystem comprising hospital management, doctors, patients, and companies, for example, offers a great opportunity to gain deeper understanding of orchestration.

In practice, there are a number of activities in innovation networks that need to be carried out in order to facilitate innovation. This is particularly true in the healthcare domain (Black & Gallan, 2015). Some advanced hospitals have already realized that joint innovation activity with companies could be the way to boost rapid advancements for the novel digital hospitals and home care solutions. Some of them have even started to create support facilities to help firms to take their places in innovation ecosystems. Similarly, firms can see value in accessing knowledge residing within a hospital environment. However, contextual issues may create challenges starting from the question of which actor(s) can act as orchestrator(s) to the issue of what kind of roles can and should be taken to achieve the best results.

In this article, an examination of the existing literature and empirical evidence from a healthcare ecosystem forms the basis for finding out: i) what kind of roles the orchestrator can have to facilitate collaboration and knowledge utilization in different phases of innovation process and ii) how the high-level professionalism as a contextual issue within healthcare ecosystems influences facilitative orchestration. We consider this issue through an exploratory approach, starting from existing research and then examining a specific network that aims to create technological innovations to support the pediatric patient journey from home to hospital and back home: the Nordic Hospital in Finland is one example of advanced hospitals promoting ecosystem thinking. It has a test lab and a specific model for innovation management in its own premises. The test lab, together with the contribution of healthcare professionals, is used to support continuous innovation among health professionals, large companies, and SMEs. Considering the variety of involved actors, we begin the empirical examination by identifying the orchestrators in the innovation ecosystem. We then proceed to examine the roles and their adoption. Finally, we discuss the results and offer concluding remarks.

Roles and Practices in Innovation Network Orchestration

Managing any innovation process is a multifaceted task. In the environment in which there is a high diversity of partners and their contributions, that is, in innovation networks and ecosystems, an orchestrator is needed who will secure valuable inputs and mitigate concerns from network actors (Dhanaraj & Parkhe, 2006). Different network roles – which refer to the orchestrator doing specific orchestration activities in a specific way – can be found in the existing research. Network-orchestration activities include ensuring knowledge mobility, network stability, and innovation appropriability, as well as coordination, agenda setting, and mobilization (see, e.g., Dhanaraj & Parkhe, 2006; Hurmelinna-Laukkanen et al., 2014; Nambisan & Sawhney, 2011; Roijakkers et al., 2013). In different roles, these activities can be emphasized to different extents (e.g., highlighting knowledge mobility over appropriability or vice versa) and can be carried out in quite different ways (e.g., by exerting control over others or by simply facilitating different activities). Multiple network members may participate in these activities, but the responsibility lies with orchestrators. In many cases, the type of the orchestrator and the innovation

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network or ecosystem are decisive for the emergence of specific roles. Acknowledging the orchestrator roles is therefore relevant.

Different types of orchestrators

Earlier research suggests that the so-called player orchestrators and non-players (Roijakkers et al., 2013) have different approaches toward orchestration activities, and different means to conduct them. A player orchestrator typically is an actor that has relatively strong individual incentives within the networks and ecosystems that it aims to influence, such as a company that competes with other actors in the end markets. Correspondingly, a non-player orchestrator influences and supports the network without being an active competitor in the end market (Leten et al., 2013; Roijakkers et al., 2013). These non-players can be further divided into facilitators and sponsors. The latter type of orchestrators have their individual goals coupled with collective goals (consider, for example, venture capitalists and business incubators; Comacchio et al., 2012; Napier et al., 2012), whereas the facilitators' main concern is the wellbeing and functioning of the network: they are not as interested in utilizing the innovation outcomes themselves, nor are they orchestrating the networks for financial gain (see Fichter, 2009; Hurmelinna-Laukkanen & Nätti, 2012; Metcalfe, 2010).

All of these types could well emerge in health ecosystems. However, when individual professionals are in a central role – such as doctors in a health ecosystem – it could be assumed that large companies might not be the first ones to become orchestrators. Player-orchestrators of this kind might not be able to incorporate the strong professionalism from the side of doctors and other healthcare experts. On the other hand, smaller firms might lack resources, and health care professionals might neglect the business aspects. A neutral intermediary might be able to step in as a facilitator-orchestrator, and bring the diverging actors together. Thus, the focus of this study stays with facilitative orchestration and the related roles.

Variety in orchestration roles

The mentioned orchestrator types resonate with the ways in which they conduct orchestration activities. Players, for example, likely take more control and use their resources to persuade other actors (Hurmelinna-Laukkanen et al., 2014). Furthermore, different activities may become differently emphasized depending on, for example, the phase of the joint activities. Aspects related to network formation, such as mobilization, become highlighted at times, while network management issues, such as ensuring knowledge mobility, are more pronounced at others (Brown & Duguid, 2001; Ritala et al., 2012), for example. Accordingly, orchestrators adopt different roles.

The existing literature provides some specific examples, as shown in Table 1. For instance, the architect role emphasizes relatively strict agenda setting and coordination activities, run mainly by player-orchestrators (Hurmelinna-Laukkanen et al., 2014; see also Nambisan & Sawhney, 2011). A similar, relatively controlling approach is present in the roles of gatekeeper (Czakon & Klimas, 2014; Howells, 2006), conductor (Nambisan & Sawhney, 2011) and judge (Hinterhuber, 2002; Howells, 2006), where the benefit of a player-orchestrator trying to strengthen its own competence is highlighted even if the individual orchestration activities are emphasized to different extents (see Table 1).

Table 1. Orchestration roles and their key activities

Role	Key Activities	References
Architect	Engage in strict agenda-setting and coordination activities	Hurmelinna-Laukkanen et al., 2014; Nambisan & Sawhney, 2011
Gatekeeper	Support the knowledge extraction and dissemination of the information	Czakon & Klimas, 2014; Howells, 2006
Conductor	Take care of information acquisition, transmission, and task sharing	Nambisan & Sawhney, 2011
Developer	Create concrete assets for the network based on knowledge mobility	Hinterhuber, 2002
Auctioneer	Set the agenda and joint vision for the innovation network	Wallin, 2006
Leader	Motivate and foster the voluntary collaboration and identifying roles of network members	Dawson et al., 2014
Promoter	Support ecosystem members to work towards the same goal	Dawson et al., 2014
Facilitator	Bring together quite different, even competing, parties to work together	Hurmelinna-Laukkanen et al., 2014

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Requiring a somewhat more relaxed approach (and therefore quite suitable and natural for sponsor-orchestrators) in representative roles, orchestrators share knowledge of the network with "outsiders". This is quite similar to a liaison role. In these roles, the activities are more supportive, even if network formation and management activities are in the focus such as in the roles taken by players. Sponsor-orchestrators are also the most likely ones to take coordinator and developer roles (Hinterhuber, 2002) or an auctioneer role (Wallin, 2006).

In the least controlling group of roles, a leader role is characterized by a goal of motivating and fostering the voluntary collaboration. A good leader (typically a facilitator-orchestrator) is knowledgeable and passionate about the topic. The primary role is to link people, skills, and needs together (see Gausdal & Nilsen, 2011). A promoter role (see, e.g., Dawson et al., 2014) falls quite naturally to facilitators that should be able to bring together quite different, even competing, parties (Hurmelinna-Laukkanen et al., 2014). Discussions on the community leadership and leadership processes that cover, for example, informally linking community members, and fostering development of community members (see, e.g., Gusdal & Nilsen, 2011; Keeble & Wikinson, 2000; Wenger et al., 2002) reflect this.

Although earlier literature indicates that these different roles are relevant from an orchestration point of view, there is relatively little written on what happens over time, and what kind of constraints and enabling determinants (also beyond the orchestrator type, see Hurmelinna-Laukkanen et al., 2014) may be related to having specific roles in different contexts. Therefore, in this study, we set out to empirically examine an ecosystem in the healthcare sector that aims to co-create technological innovations with various stakeholders.

Research Design

The method chosen for this study is an explorative, in-depth single case study (e.g., Lazar et al., 2010). We suggest that this approach is appropriate because more in-depth understanding of orchestration itself – and understanding of multi-sided contextual influences – are needed (Yin, 2003). Abductive research logic is used, where theoretical and empirical material is considered side by side (Kovács & Spens, 2005).

Research context

Our case study builds on data collection from an 18-month period at the Nordic Hospital. The case study was conducted as a part of a larger research project, where various actors came together with an aim to create technological innovations to support the pediatric surgery journey from a patient's home to hospital and back home. Such a project forms an excellent context to study orchestration, as the hospital environment represents a high-level expert context where orchestration can be extremely challenging due to strong professionalism, diverging priorities of actors, strict regulations, and ethical constraints. Furthermore, agendas and motivations may change at different stages of the innovation process, with the involvement level of different actors fluctuating as the innovation activities proceed.

This study was conducted within a research project that aimed to support network orchestration to create new solutions for future hospital programs and was a part of the Nordic innovation ecosystem. The studied ecosystem aims for efficient returns on investment and, most importantly, for the creation of jobs in the healthcare sector. This healthcare ecosystem comprises several stakeholders from academia, the public sector, and the private sector. In this context, the Nordic healthcare innovation environment, the hospital's test lab environment, and the research project's representatives became natural targets of analysis as orchestrators. At the premises of the Nordic hospital's testing and innovation environment, new services can be demonstrated and evaluated in an authentic hospital environment together with genuine end users: citizens and health professionals.

Thus, in this study, the unit of analysis is the network orchestrator within the context of the Nordic ecosystem, specifically in the case of the pediatric surgery journey. The target of the orchestrator in this context was to facilitate the co-creation of innovations that support patients and health professionals in future hospital environments. In particular, the focus in the examined case was to gain deep understanding of the care-taking process and real end-user needs, as well as to ideate new solutions for pediatric surgery patients, including children who require surgical treatment with anesthesia provided by secondary healthcare. The other aim was to ideate new innovations to support the work of doctors and nurses that work in the pediatrics surgery department and to ease working with the day surgeries that represent 40% of the acute emergency operations. Furthermore, we investigated differences in willingness and motivation among end users in relation to their participation in the co-creation innovation process.

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The research project also resulted in a digital co-creation platform to help startup companies and SMEs integrate easily into the hospital systems. The goal was to speed up the co-design of future hospital services together with doctors, nurses, patients, and large companies, and thereby facilitate the adoption of innovations in hospitals. Figure 1 below illustrates the innovation ecosystem in the examined healthcare sector.

The project revolved around the co-creation of innovative products and services built together with SMEs, large companies, and end users (i.e., doctors, nurses, and parents of child patients). This innovation process was aided by the network orchestrators (i.e., the research and business incubator organizations and the test lab personnel). Pediatric specialists, nurses, parents of child patients, innovation orchestration management, large companies, and startups were involved in the data collection activities detailed in next Section. As a result, a comprehensive view of the case was obtained.

Data collection and analysis

In our case, an extensive user study was conducted in the form of interviews with healthcare professionals, the parents of child patients, companies; workshops; online discussions; and research meetings in which the representatives from the research and business incubator organizations in the project participated both as organizers and external observers (Table 2).

Experience-based design (EBD) (cf. Bate & Robert, 2006) was used as a method for co-designing novel hospital services together with patients and healthcare professionals based on their actual experiences of health services. The use of the EBD approach ensured that ideated children hospital services truly reflected the needs of patients, carers, and healthcare professionals based on their specific experience. Flowcharts of patient journey maps were used as a platform upon which experiences could be collected. Patient journey maps helped to define the pediatric surgery process as a chronological entity (i.e., what happens in each phase of the process) and view it from the family's perspective, as well as to identify and understand the roles and tasks of the health professionals in different phases along the surgery process, and how the different stakeholders communicate with each other.

In the workshops, current actions and challenges were identified in each surgery process phase from the perspectives of all three end-user groups by systematically going through the transcripts. Accordingly, improvement ideas and technological solutions were mapped throughout the process. Through the interviews, online discussions, and workshops, we gained a thorough understanding of the current practices and challenges from various points of view and how technology innovations could be utilized in future pediatric care journeys.

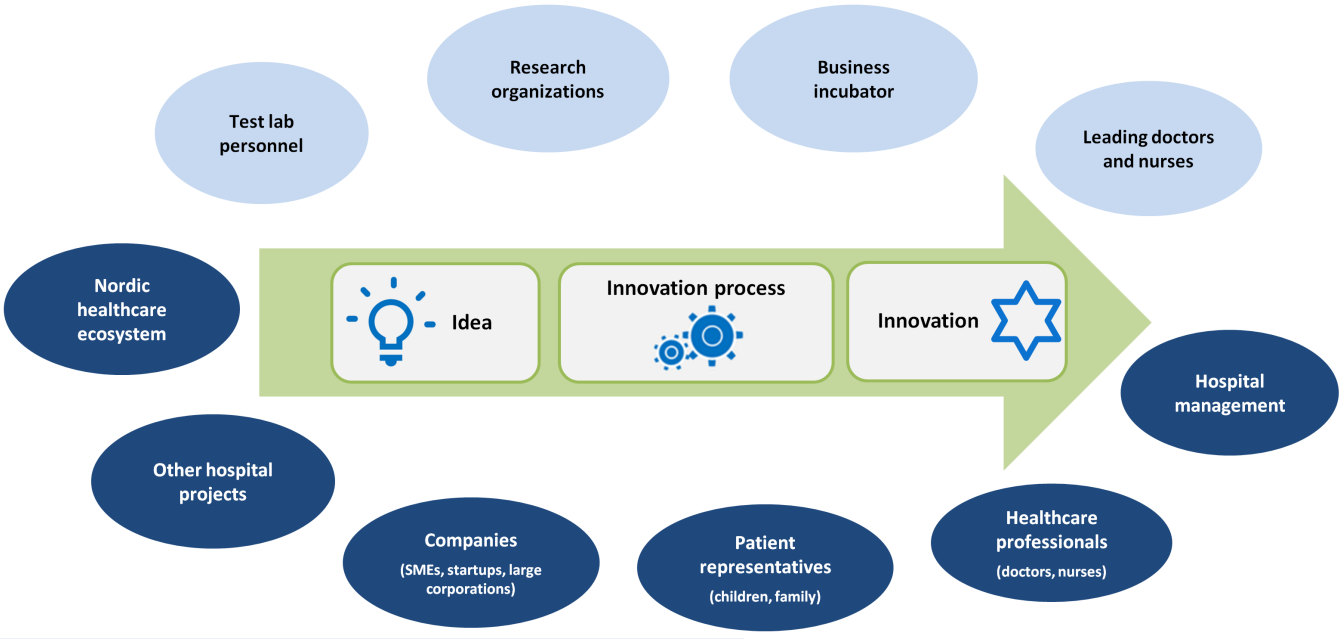

Figure 1. Healthcare innovation ecosystem related to the pediatric surgery case

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Table 2. Summary of innovation orchestration activities with parents of child patients as well as doctors, nurses, and companies

Innovation Orchestration Activity	Participants	Organizations
Interviews with pediatric specialists	7 doctors	Nordic Hospital
1st workshop with pediatric nurses	2 nurses	Nordic Hospital
2nd workshop with pediatric nurses	3 nurses	Nordic Hospital
3nd workshop with pediatric nurses	4 nurses	Nordic Hospital
Online discussion with parents of child patients	6 parents	Nationwide
Workshop with parents of child patients	6 parents	Nordic Hospital
10 interviews with companies	13 companies	7 SMEs and 6 large corporations

Results

The healthcare innovation ecosystem as a context for orchestration

As suggested above, there are some specific issues in the healthcare ecosystem context that make it different from many other networked innovation ecosystems. In this study, the collected information soon revealed that there are tradition-based, implicitly and explicitly accepted strong professional hierarchies that cannot be overridden. In addition, in this context, there seems to be a need for awareness of various and often conflicting interests among core actors. These competing interests create the need for open and planned innovation network orchestration procedures through which they can be satisfactorily reconciled.

The examined orchestrator roles in the ecosystem were organized taking these features into account. The target, vision, and goal setting for the innovation activity in the pediatric surgery journey were first determined together with the hospital management, leading experts, and research organizations, and the business incubator organization of the project. Naturally, all these actors approached collaboration from different angles. The hospital representatives' aim and motivation to participate in the collaboration were to save costs and improve the overall patient experience through technological innovations. Thus, they invested considerable amounts of the health professionals' time and resources in the innovation co-creation: *"This co-creation costs quite a lot for hospitals if we think about the work time of doctors and nurses; this demands quite a commitment from hospital management"* (CEO of a company). Through this remarkable investment, hospital representatives wanted to build better technological innovations to improve their own efficiency and end-user satisfaction.

From the company perspective, cooperation with the hospital was something they had been looking for: the hospital can be seen as a potential customer. However, the innovation project setting presumed cooperation with other companies as well – even competitors, which was a surprise for many participating firms. The link to the innovation ecosystem that the hospital was offering also meant collaboration with other industrial players such as hospital system providers who are targeting their solutions to the same market. Additionally, the project included meetings and common occasions in which the participating companies had to show the solutions to the doctors, nurses, and parents of child patients in the presence of their competitors. These issues generated tensions in the innovation network. The companies considered the new role of the hospital in the innovation process both as beneficial and challenging from their own perspectives. For example, *"I'm so excited, we have needs and you have found solutions to them. There is nothing better than that."*, *"we are in a better position with our solution compared to our competitors"*, and *"we have received customer references that have a significant role when we are selling our solutions"*. The references gained from these aforementioned innovation activities were helpful later on, as the participating startup companies could get real sponsors such as venture capitalists to support their future innovation work.

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Orchestrators in the healthcare ecosystem

In our case, multiple parallel actors took part in forming and managing the networked innovation activity. Namely, the actors adopting the orchestrator roles in our case could be identified as: i) the test lab personnel at the hospital, ii) the project's research organizations, iii) the project's business incubator organization, and iv) leading experts at the hospital (e.g., doctors and nurses). The hospital assumed an important role and part of the responsibility for promoting the ecosystem. The hospital had, as mentioned above, a test lab organization where commercial actors could test their solutions in an authentic environment. The test lab personnel were initially hired by hospital management. In the test lab, there was one person who was leading the innovation activities with different companies and taking care of the agenda setting, information sharing, and end-user involvement from a resource perspective. This person was also keeping up continuous discussions with hospital management.

However, since the hospital did not have resources to carry out these activities alone, the other orchestrators of this project eventually came from research institutes and a business incubator organization, and we chose to examine their roles in particular. The research institutes provided to the project multidisciplinary research groups with expertise in several research areas, such as service co-creation, business models, and connected health services. Responsibilities and information sharing between these facilitator-orchestrators turned out to form a barrier for information sharing in the overall setting. Although regular meetings were organized, the teams were overloaded with their own tasks and worked too much in isolation, which created challenges. It was difficult to find orchestrators for innovation networks that would have the capabilities to take care of many perspectives, such as those of the experts (healthcare professionals), patient representatives (parents of child patients), and commercially oriented companies. Nevertheless, what eased the situation was that much of the network orchestration responsibility was divided between actors that indeed could be considered facilitator-orchestrators and did not have their own financial goals to guard, but who were rather concerned about making the network work more efficiently as an entity. These facilitators took on notable orchestration activities in specific ways.

Adopting leader and gatekeeper roles

The research organization assumed a leader role. In this role, they were motivating high-level experts and patient representatives to engage in voluntary cooperation at the hospital settings. Whereas the project coordinators were the orchestrators for the whole co-creation network – influencing knowledge transfer for their part –the leading doctors and nurses in the organization had a similar position at a smaller scale: they led their own innovation units. They also adopted a role that could be considered as a gatekeeper in the innovation process. In our case, the leading doctors and nurses were important orchestrators given that they were also fostering the collaboration and allocating tasks for network members. They acted as gatekeepers of the sub-units of the network and made concrete actions to help ecosystem coordinators. For instance, they participated in the generation and definition of the innovation orchestration goal, which was the co-creation of technological innovations for the pediatric surgery journey. They also informed other doctors and nurses about the plans and asked them to participate in the innovation work (i.e., the workshops and interviews) during their working time. According to one doctor, *"it is important that the knowledge is shared and everyone could see what has been done in different phases of the innovation process"*.

The support provided by the leading doctors and nurses and the adoption of the above-mentioned roles allowed the orchestrators to reach one important step: that of proving that something is really proceeding in the innovation process. The leading doctors, in particular, stated that it is important to show concrete results for the health professionals in order to keep them committed. In addition, the professionals being able to influence the end result was found highly important: *"It is good to involve doctors when there is something ready to show to them, but not too ready so that it would not be possible to change it"*. Stemming from this specific context, maintaining motivation and giving enough room for professionals to influence seem to be two important empirical notions here. The leading doctors considered it important that the innovation work would be integrated with the other established processes at the hospitals. Likewise, doctors and nurses need to have resources allocated to the innovation work as a part of their clinical work. Both these notions stem from the scarce resources and time that the healthcare professionals could allocate tor the innovation process.

These roles were not enough, however. The facilitator orchestrators (i.e., the business incubator, research organizations, and test lab personnel) felt, especially, that the concrete collaboration between companies and end users could be even more efficient. It seemed that the academic orchestrator in this case did not have enough

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authority in the leader role and thereby was not able to keep every organization thoroughly involved in the meetings. A dual-core formed by different orchestrators (i.e the test lab orchestrators, business incubator, and academic orchestrators, likewise professionals in their own subunits) could provide the solution to this challenge. In fact, the orchestrators retrospectively considered that one possible approach would have been to enforce closer integration with the hospital, which would have increased the power for the orchestrator (who needed to orchestrate high-level experts, such as doctors) to ask all the stakeholders to join the relevant innovation activities and prioritize the innovation orchestration work in their agendas.

Emergence of coordinator, auctioneer, and promoter roles

In our case, the research organizations and business incubator formed a facilitator-orchestrator entity that first worked in an auctioneer role. They took action in agreeing and setting a joint agenda and vision for the project together with the test lab representatives, hospital management, and leading doctors. Research organizations also adopted a coordinator role through organizing regular meetings between different players. The purpose was to support knowledge extraction and information sharing. This did not work very well because the core players seemed to emphasize different aspects, they prioritized their own track first, and the information was not shared as planned between the actors. This finding highlights the importance of diligent orchestration in this specific context, more specifically agreeing on collaboration approaches, common goals, as well as roles and responsibilities among the orchestrators.

The research organizations and the business incubator had to step into a promoter role with a purposeful action to make these ecosystem actors work towards the same goals. One example of the promoter results is a narrative in which the future pediatric surgery process was described from home to hospital and back home including the core needs and innovation ideas collected from experts and patient representatives. The company assets were mapped into the narrative and described in such a way that it was easily understood by medical doctors and parents of the sick children who were involved in the innovation network and it was easy to give continuous feedback about the company ideas in different events and online system. Due to the communication structure, both the companies and end users reported their satisfaction with the results achieved by the innovation activities *"When we know the needs of health professionals, we can prioritize what is important"* (Company representative involved in innovation orchestration).

Taking a representative role

One more role emerging in our case was that of a representative. Because the innovation process in the project was carried out as a part of the Nordic ecosystem, the ecosystem actors together engaged in many activities to share the results through different seminars, publications, and forums. This type of information sharing of the innovation network ecosystem to outsiders was continuously done by research and business incubator organizations, but these tasks were allocated also to the test lab personnel. Such activities were considered important because the publicity and feedback also affected the legitimacy of the activities that were carried out.

Contextual determinants of role adoption

Our case indicates that the roles taken by innovation orchestrators can be parallel and changing over time (Figure 2). The key finding of our study is that, in an innovation network involving expert organizations, multiple organizations can take even parallel orchestrator roles in a networked innovation context, and there might be different kinds of orchestration activities performed and roles taken by different actors in different phases of the innovation process. For instance, from the hospital perspective, the research organizations and the test lab organization together with hospital management worked in auctioneer, coordinator, and leader roles by setting the goals, hiring new people, and getting leading doctors and nurses involved as gatekeepers. The academic orchestrators took the promoter role by helping network actors establish ways to show the ideated technological innovations and concepts to the end users with the purpose of gaining valuable feedback and informing them about the success cases in which the innovations were co-created based on the needs of health professionals. Academic orchestrators together with business incubator orchestrators also worked as promoters by helping the hospital and companies identify the needs, set common goals, and organize the ways for companies to show the concepts to doctors, nurses, and patients. The Nordic ecosystem worked as a representative for organizing ecosystem seminars that helped inform about the project's success stories both outside and inside of the hospital.

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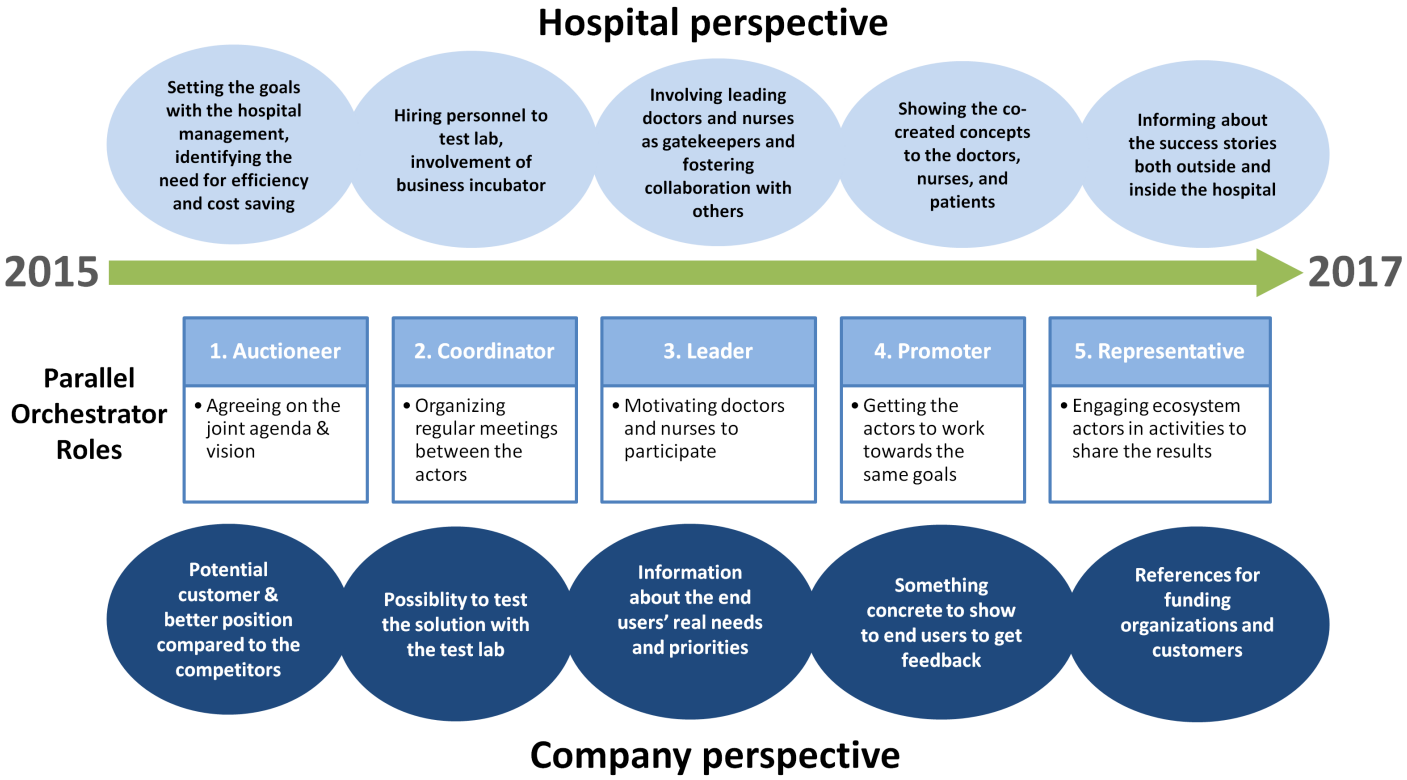

Figure 2. Innovation orchestration roles from different perspectives over time (2015–2017)

Participating companies saw the innovation actions as a potential to gain customers and concrete references as well as to better understand the real needs of end users (i.e., child patients and their families, and doctors and nurses in the pediatric surgery department). They received information about the end-user needs and priorities and had opportunities to show their solutions to the hospital staff and management and gain valuable feedback to develop their solutions further.

A key challenge of networked orchestration in the hospital context was the tradition-based hierarchical culture, which required extra efforts in developing and agreeing upon the joint agenda and vision. Likewise, motivating the actors to participate in the innovation activities was challenging, as the network that was to be orchestrated consisted of diverse actors. Sub-units existed with highly influential leaders (doctors) who were at the same time involved with other innovation networks orchestrated by other hospital project managers, for instance.

Influence of orchestrator's roles

Due to the resource situation at the hospital, additional orchestrators of this project eventually came from a research institute and a business incubator. However, the initially unclear responsibility allocation and activity identification caused a situation in which the research organization tried to carry out too many tasks in the ecosystem with limited influential power. The roles that the core orchestrators were able to adopt were restricted not only due to their own non-medical background, but also due to contextual issues including a more valued and stronger expertise of other actors, prevailing traditions, and also regulatory issues.

Because of the lacking medical background of the orchestrators, many healthcare professionals in the hospital were first suspicious about the capabilities of these new actors to orchestrate the innovation actions. Furthermore, the orchestrators in the health organizations had limited resources and time for innovation actions. It took time for the orchestrators to win the trust of the hospital management and involve gatekeepers (i.e., leading doctors and nurses) in the innovation process within this novel hospital context. Managing innovation coherence to gain mutual understanding and respect is extremely important in innovation networks working in a healthcare ecosystem in which the expert

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resources are limited and there are many players trying to orchestrate other parallel innovation networks with a goal of involving the very same health professionals.

The business incubator organization worked well in the regional settings, and given that their primary goal was to support companies' businesses, they naturally took the practical role of meeting the companies and discussing their business needs related to the project. Research organizations had a target to support the same companies in the innovation process by recruiting and involving end users and helping them to create ecosystemic business models to support innovation. At the same time, the hospital itself had new internal hospital development projects underway, which had targets of their own, such as to rapidly decide what services and technologies would be used in the new hospital settings. The conflicts appeared when the roles of the innovation orchestration were not discussed carefully between the orchestrators. Both research and business incubator organizations met the hospital management, other hospital development project leaders, companies, and health professionals from the same innovation ecosystem to better understand the different goal settings and methods to conduct innovation actions. Thus, in addition to understanding what should be done to advance innovation activities, it was important to understand how things should be done together.

Nevertheless, and somewhat surprisingly, these challenges faced by the orchestrators and the fuzziness in task allocation and limits of role taking did not become visible among the involved companies, patients, and health professionals. All these actors gave only positive feedback about the participation and end results of the innovation activities. One conclusion from this finding is that good orchestration also comprises the ability to keep the hardships at the orchestrator-level, and not let it disseminate to the ecosystem or contaminate individual relationships. From a company perspective, the influence of the orchestration activities was seen as a stronger position in the healthcare sector compared to their competitors, whereas, for high-level experts, the possibility to co-create better technological solutions to be used to solve their concrete work-related needs and challenges was intriguing and motivating. Judging from this outcome, intermediaries between hospitals and companies can be valuable in handling the context-related complexities and are needed for the coordination task. A neutral intermediary might be able to step in as a facilitator-orchestrator and bring the diverging actors together for the joint goal setting and vision, even when the roles that the orchestrators can adopt are limited.

Discussion and Conclusions

Transformational change evident in the healthcare sector drives the emergence of future hospital programs and digital innovations to tackle the need for improved staff productivity, hospital operations, overall patient experience, and high quality of care (e.g., Caulfield & Donnelly, 2013). However, from a company perspective, the medical market is a challenging field for innovation. Hospitals are expert organizations having different systems that are not typically communicating between each other. Additionally, a large pool of other actors are offering similar or partially competitive solutions to same hospitals. Gaining access to and working together with end users, namely medical professionals and patient representatives, can be a challenging to even the largest, most established companies, not to mention the smaller firms.

The specific professional context of this study provides valuable insights about orchestrating within expert organization environments. Both theoretical and empirical research insights were derived from the analysis in this study. By focusing on the roles taken by orchestrators, that is, the specific orchestration activities (e.g., Dhanaraj & Parkhe, 2006; Nambisan & Sawhney, 2011) and the ways to conduct them (e.g., Czacon and Klimas, 2014; Hinterhuber, 2002; Howells, 2006; Hurmelinna-Laukkanen et al., 2014; Ritala et al., 2012; Wallin, 2006) in a healthcare ecosystem, we were able to see how innovation network orchestrators, and more specifically facilitator-orchestrators (e.g., Comacchio et al., 2012; Napier et al., 2012) can take multiple, sometimes even parallel orchestrator roles in networked innovation. More specifically, we gained insights into how and in which limiting or facilitative conditions these roles are practically conducted.

Regarding the theoretical contribution, it became quite evident in our study that an orchestrator can take different roles over time in demanding contexts with a variety of diverging actors and regulatory and tradition-based restrictions. These parallel roles can create a democratic and collegial atmosphere for the ecosystem, which is needed to keep all the professional communities committed to the work, despite their high level of professional authority. Orchestration in this environment is definitely not about commanding, but about "discreet influence" (Ritala et al., 2012). We found support for the idea that the background and characteristics (e.g., the limited power position) of the orchestrator inherently limit the orchestrator actions (see, Hurmelinna-Laukkanen et al., 2014) in this specific context: business

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incubator and research organization as facilitator-orchestrators were not seen to take roles of judges or architects for example, which (theoretically) fall to player-orchestrators (with stronger power positions) more naturally. Instead, they were taking more discrete coordinator tasks to keep all the actors committed. Second, restrictions to orchestration came from the context, such as rules and regulations related to the medical domain (see, e.g., Nambisan & Sawhney, 2011 on a specific type of ecosystem for comparison), or the importance of professional hierarchy and related authority issues. Likewise, the challenge in such a multi-actor environment is that all actors have their individual challenges, such as timing and resourcing challenges that had to be addressed, not to mention their different interests in participating in the collaboration in the first place.

From a managerial perspective, our study highlighted the importance of discreet influence needed when orchestrating a network of high-level experts and patient representatives within the specific network dynamics. For example, in this context, there are tradition-based, implicitly and explicitly accepted professional hierarchies one has to understand when orchestrating the network. In this case study, leading experts led their own innovation units and shared knowledge within professional communities and between them. From the orchestration perspective, this practice was functioning, for those professionals had professional authority needed to keep their units committed to the process. This helped ecosystem orchestrators considerably.

Our case study indicates – reflecting also the general lines in earlier studies (e.g., Dhanaraj & Parkhe 2006; Möller, 2010; Ritala et al., 2012) – that there is a need to create a shared understanding of the roles in an innovation orchestration process, the development stage, the milestones to be pursued, and achievable innovation implementations. Expert ideas need to be continuously taken forward and implemented by the different actors in innovation ecosystem. But it is not only about harnessing ideas, it is also about giving feedback; throughout the innovation process, high-level experts must see concrete results from their work to keep them committed to the ecosystem. Professionals need to see that they have influenced the end result.

It might be impossible to find single orchestrators who possess understanding of all the perspectives, from end users to commercially motivated companies. Thus, co-operation is critical in forming the common understanding. However, combining a variety of perspectives for common goals and practices always brings along challenges for orchestration. Managing innovation coherence with interviews, workshop data, as well as with concluding narratives (where actors' assets are mapped to make the expertise explicit) was found as an important way to show hospital experts and firms how the company assets actually fit to the future pediatric surgery journey of children and their parents. This finding is in line with Nambisan and Sawhney (2011), who emphasized innovation coherence management as a way to manage innovation leverage. In general, supporting communication coherence related to end user needs and suitable company assets is important in innovation networks when working in health ecosystems. In health care organizations, the expert resources are often limited and there are many players trying to orchestrate the coinciding innovation networks by involving the same health professionals. In the context of high professionalism, a lack of coherency may generate selfishness based on diverging interests; every single actor may prioritize their own goals and tasks instead of common goal, hampering innovation efforts and causing a "vicious cycle of separation" among actors. This resource scarceness was seen as the need to integrate the innovation task into the everyday flow of work: in the ideal case, innovation activities are not something "separate", for the sake of innovation, but part of the normal work process. Finally, gaining legitimacy for innovation activities among different stakeholder groups is important.

Of course, our study comes with limitations. As an exploratory case study, the findings cannot be generalized too widely. Also, simplifying the complex setting likely reduces the richness of insight derived from the case. Nevertheless, together with our findings, these and other limitations provide opportunities for future research to find relevant avenues. For instance, the conflicts and contests emerging in the ecosystem and the opportunities to influence and solve these issues through the means of orchestration is a potentially interesting approach. Likewise, the interplay between the influencing actors at different levels seems to be a relevant research topic. Future studies can also achieve wider generalizability of our findings. This study can be used as the starting point.

Orchestration Roles to Facilitate Networked Innovation in a Healthcare Ecosystem

Minna Pikkarainen, Mari Ervasti, Pia Hurmelinna-Laukkanen, and Satu Nätti

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Convergent Innovation in Emerging Healthcare Technology Ecosystems: Addressing Complexity and Integration

Mark A. Phillips, Tomás S. Harrington, and Jagjit Singh Srai

> *Between the idea*
> *And the reality*
> *Between the motion*
> *And the act*
> *Falls the Shadow*
>
> T. S. Eliot (1888–1965)
> Poet, dramatist, and literary critic
> In *The Hollow Men* (1925)

Precision Medicine and Digital Health are emerging areas in healthcare, and they are underpinned by convergent or cross-industry innovation. However, convergence results in greater uncertainty and complexity in terms of technologies, value networks, and organization. There has been limited empirical research on emerging and convergent ecosystems, especially in addressing the issue of integration. This research identifies how organizations innovate in emerging and convergent ecosystems, specifically, how they address the challenge of integration. We base our research on empirical analyses using a series of longitudinal case studies employing a combination of case interviews, field observations, and documents. Our findings identify a need to embrace the complexity by adopting a variety of approaches that balance "credibility-seeking" and "advantage-seeking" behaviours, to navigate, negotiate, and nurture both the innovation and ecosystem, in addition to a combination of "analysis" and "synthesis" actions to manage aspects of integration. We contribute to the convergent innovation agenda and provide practical approaches for innovators in this domain.

Introduction

Precision Medicine and Digital Health are increasingly important areas that are reliant on "convergent" or "cross-industry" innovation (Sabatier et al. 2012; Thakur et al., 2012). A consequence of convergence is that it brings more uncertainty and allows greater influence from new knowledge and actors, including previously disparate technologies and capabilities (Rikkiev & Mäkinen, 2013). In turn, there is an added complexity because convergence contradicts the two dominant forms of organizational learning, namely simplification and specialization (Levinthal & March, 1993). This research focuses on the uncertainty and complex integration issues that arise from the emerging ecosystem, from developing the innovation and in forming a viable value network.

Much of the extant innovation literature has focused on innovation by incumbents in existing industries or with existing value-chain partners (Enkel & Gassmann, 2010). More recently, there has been increasing interest in "cross-industry" or "convergent" innovation (Gassmann et al. 2010; Stieglitz, 2003). However, convergence can result in higher levels of equivocality, uncertainty, and risk as the diverse technology, alliance partners, and ecosystems merge (Enkel & Heil, 2014; Hacklin, 2005; Mason et al., 2013). These considerations manifest themselves as different integration challenges that depend on the nature of the convergence (Rikkiev & Mäkinen, 2013).

For convergence in healthcare technologies, apart from several practitioner articles (Eselius et al., 2008; Gupta et al., 2013; Mason et al., 2013), there are limited studies

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that examine the implications for technological or business model discontinuities (Bojovic et al., 2015; Sabatier et al., 2012) and these few (Bernabo et al., 2009; Dubé et al., 2014; Ramachandran et al., 2011; Shmulewitz et al., 2006) focus more on the phenomenon than on the implications.

Using empirical analyses in five longitudinal case studies with a combination of interviews, field observations (e.g., meetings and workshops), and documents, our exploratory research findings point to a need to *embrace* the complexity. We propose the adoption of approaches that balance taking "credibility-seeking" and "advantage-seeking" positions using non-ergodic routines that navigate, negotiate, and nurture with a combination of "analysis" and "synthesis" actions to manage integration.

Theoretical Background

Addressing uncertainty and complexity

Uncertainty and risk are inherent in innovation and arise from four types of complexity: evolutionary, temporal, relational, and cultural (Garud et al., 2013). Importantly, there are inherent differences between managing risks (with known probabilities) and uncertainty (or "unknown unknowns") (Teece et al., 2016). The major uncertainties and risks in innovation are generally considered to be technological, regulatory, and market based (Hobday, 1998), and they are typically addressed by a variety of mechanisms to "manage complexity", resulting in simplification and specialization (Levinthal & March, 1993). However, such approaches create limitations and may inhibit the innovation itself (Garud et al., 2013). Although several of these challenges are acknowledged (Rikkiev & Mäkinen, 2013), there has been limited empirical research to understand how they are addressed.

Differences between the nature of innovation and its impact have been considered in both the innovation literature (Abernathy & Clark, 1985) and the diffusion literature (Rogers, 2003). In extant literature, there is more focus on the management of risk (Evanschitzky et al., 2012) than on addressing uncertainty, which is considered more likely and harder to manage (Teece et al., 2016).

In addressing uncertainty, McGrath (2001) confirms the earlier findings of March (1991) that the degree of exploration is important; broader searches across more variety can improve performance. The dynamic capability literature points to the use of *sensing, seizing,* and *transforming* to better manage uncertainty (Teece et al., 2016), with abduction (as a mode of inference) being important to create new thinking for subsequent testing. This suggests *creative abduction* (Schurz, 2008) is more relevant (versus *selective abduction,* which chooses from multiple explanations), although creative abduction is rarely discussed in the literature (Prendinger & Ishizuka, 2005).

Sommer and colleagues (2009) identify two approaches to respond to uncertainty: *selectionism* and *trial-and-error*. Selectionism refers to attempting many solutions in parallel and selecting the best based on the outcomes. However, such an approach can be costly and potentially inefficient. Trial-and-error learning refers to adjusting activities and targets as new information becomes available. The combination of complexity and uncertainty, and the need for creative and exploratory approaches using limited and often equivocal information, is counter to much of the traditional innovation literature with linear processes and defined decision criteria, as highlighted by Garud and colleagues (2013) and Bessant and colleagues (2005).

Integration challenges

Integration, by (re)combining knowledge, is inherent in innovation (Grant, 1996; Kogut & Zander, 1993; Teece, 1996). As well as knowledge or technology integration, there is a need for market and organization integration (Tidd & Bessant, 2013). Much of the "integration" literature focuses on intra-organization and cross-functional integration as Evanschitzky and colleagues (2012) identified in their meta-analysis of success factors in 233 innovation studies. Although integration (internal and external) has been identified as an indicator of innovation performance, it is moderated by equivocality (Koufteros et al. 2005). Yet, equivocality is itself inherent in convergence.

Alliance formation (Colombo et al., 2006; Eisenhardt & Schoonhoven, 1996) and management under conditions of high uncertainty would, therefore, appear to be a critical capability for startups and new ventures within an incumbent firm. Previous literature has identified the need for a highly integrated value network as a key factor in performance (Prajogo & Olhager, 2012), but this presupposes a strong understanding of the needs and capabilities of the alliance partners. In convergent innovation, ecosystems and value networks are emerging, so a comprehensive understanding may be lacking.

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Systems-integration risks are not new (for example, see Henderson & Clark, 1990), but have traditionally been addressed by concepts such as modularity (Baldwin & Clark, 1997; Schilling, 2000). However, the presumption in such an approach is that the knowledge is well codified (Cardinal et al., 2001). In convergence, this is more challenging, because such codification is initially limited.

What is less clear in the extant literature is *how* this complexity and integration is addressed. Garud and colleagues (2013) identified some challenges and resulting gaps in both research and practice, and they call for approaches that *embrace the complexity* as a "generative" process, rather than trying to simplify and "manage" it.

Research Design

This research aims to address these issues by considering the question of how organizations address the *challenges of integration* in convergent technology innovation within the wider context of convergent innovation for healthcare and medical technologies in emerging ecosystems.

Given the context of the enquiry, and the evolving nature of the setting, a qualitative approach was adopted (Yin, 2014). The design consisted of two main phases (see Figure 1). An exploratory phase involved 27 semi-structured interviews from a wide range of ecosystem stakeholders, which enabled better understanding of the emerging ecosystem itself (Table 1). The interviews were analyzed inductively using the Gioia (2012) method to identify "dimensions". From these dimensions and a review of innovation and ecosystem literature, an investigational tool was developed (using abduction) for use in the second phase. The second

Table 1. Ecosystem interviews to develop context and constraints

Data Sources	Details
Preliminary Ecosystem Interviews	27 interviews of senior managers and business leaders (including startups, regulators, investors, technology companies, government agencies, and healthcare providers)
Further Ecosystem Interviews	12 interviews of 11 senior managers and business leaders (including startups, regulators, investors, technology companies, government agencies, and healthcare providers)
Observations	11 conferences (covering digital health, pharmaceutical, and medical technologies), meetings, and workshops
Academic, Business Press, and Industry documents	28 public documents and papers

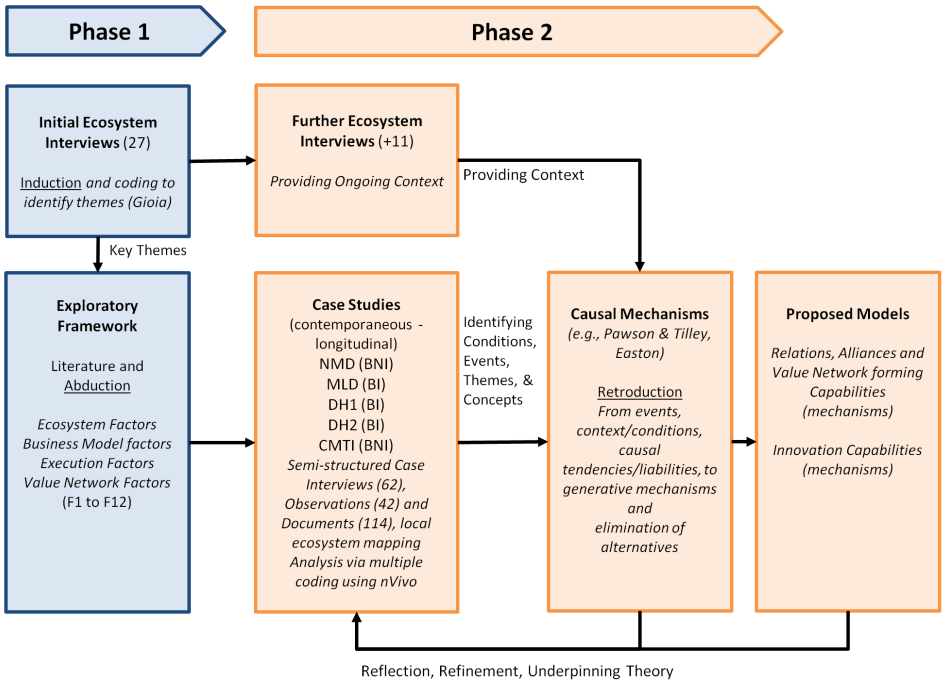

Figure 1. Overall research approach

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phase was based on empirical analyses of five in-depth longitudinal case studies conducted over 15- to 24-month periods employing a combination of interviews, field observations, and primary documents (obtained under confidentiality) as data sources, together with supplementary evidence from public documents. The cases involved three established companies and two startups, with 62 case study interviews, 41 observations, and over 100 documents (see Table 2). Further ecosystem interviews were also conducted to provide contemporaneous context. The data were collected and analyzed using thematic and process coding to identify patterns. A further in-depth analysis based on Sayer's (1992) approach was then used to identify the potential underlying causal mechanisms using the ecosystem data as context (conditions and constraints).

Findings

The exploratory ecosystem interviews identified major issues for actors in understanding the ecosystem itself, the diverse perspectives of actors, and how to create and capture value. But the ecosystem not only creates "problems", it also provides "solutions" for innovators. There is therefore an explicit link between the ecosystem, the innovation, and capabilities needed.

All the cases provided evidence that organizations undertook activities to search and sense-make (and sense-give) in the emerging ecosystem. But the nature of those search and sense-making activities differed; those adopting a more exploratory and engaging approach, for example by snowballing (Goodman, 1961) to identify

Table 2. Case research sources

Case	Organization and Innovation Description	Examples and Numbers (N=) of Interviewees	Number of Observations (O=) and Private/Public Documents (D=)
NMD	New innovation unit in major pharmaceutical/medical technology company developing a novel implantable medical device	R&D Head, Scientific Director, Head of Venture Fund, Alliance Partners (N=15)	• External workshops (O=1) • Business plan, board papers (D=31)
MLD	Startup developing artificial intelligence/machine learning as a basis for screening, diagnosis, and monitoring	CEO, CTO, Medical Director, investor, and suppliers (N=15)	• Board and technical meetings; meetings with investors (O=16) • Business and development plans; technical documents (D=25)
DH1	Innovation unit in large healthcare provider developing mobile and digital health applications for a range of medical conditions	Managing Director, Project Manager, board members, and suppliers (N=15)	• Team meetings; customer meetings; project meetings (O=8) • Business plan and project review reports (D=26)
DH2	Startup developing wearable and digital health solutions	Chairman, CEO, CTO (N=6)	• None (O=0) • Business plan; investment options (D=9)
CMTI	Incubator developing infrastructure and support for convergent medical technologies	CEO, Business Development Manager, board members (N=10)	• Company workshops and conferences; internal review meetings (O=6) • Board paper; internal review papers (D=11)

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distant actors and then engaging them, appear to be more successful. The case findings point to extensive, repeated, and direct interactions as important for sense-making. Decision-making processes were largely informal (and invariably supported by external expertise), using directional criteria, and focused on key issues in terms of balancing value and risk.

Given the newness of the ecosystem, firms invested in activities that aided understanding and created credibility among potential partners, enabling them to engage, negotiate, and move to a position of advantage-seeking. However, these efforts were balanced by activities that continued to support or sustain the ecosystem itself, often with no immediate return, as described by the leader of one case (DH1): *"…there needs to be 'congruence', a real alignment. Not just in terms of the outcome, but also cultural and how you are going to do it. Connections do not just happen – you need to 'cultivate' to create the right opportunities."*

The uncertainty in the ecosystem presents issues, but is also a potential source of solutions. The casual mechanism analysis, derived from Sayer (1992), suggests organizations need to "navigate" the ecosystem, "negotiate" a position, and "nurture" the innovation by a combination of "credibility-seeking" and "advantage-seeking" activities that are "generative" in that they create opportunities. These activities appear to be underpinned by five interrelated processes or organizational routines: searching, sense-making, selecting, shaping, and sustaining. A series of findings and insights from our case studies are summarized in Table 3. These activities and routines support four main objectives to shape the innovation and create value, to manage risks and the integration, and to develop the value network and wider ecosystem (Figure 2).

Discussion and Implications for Practice

The integration problem, as identified earlier, is complex and does not just include technological or market risk, but requires a simultaneous balancing of risk around four aspects: i) technical systems integration, ii) commercial or business models, iii) value network, and iv) organizational integration (O'Connor & Rice, 2013).

Technical systems and integration risks

The bringing together of different scientific, technical, and industry knowledge inevitably adds a new dimension to the technical risk – that of technical systems integration. The cases highlighted several examples: Case NMD sought to integrate diverse science and technology from biology, micro-electronics, flexible electronics, new neural interfaces, energy harvesting (all at a much smaller scale than previously conceived), and new control algorithms. Similarly, Case MLD integrated visual cognition science with "millisecond scale" response monitoring on mobile technologies, cloud computing, and artificial intelligence (AI) technology.

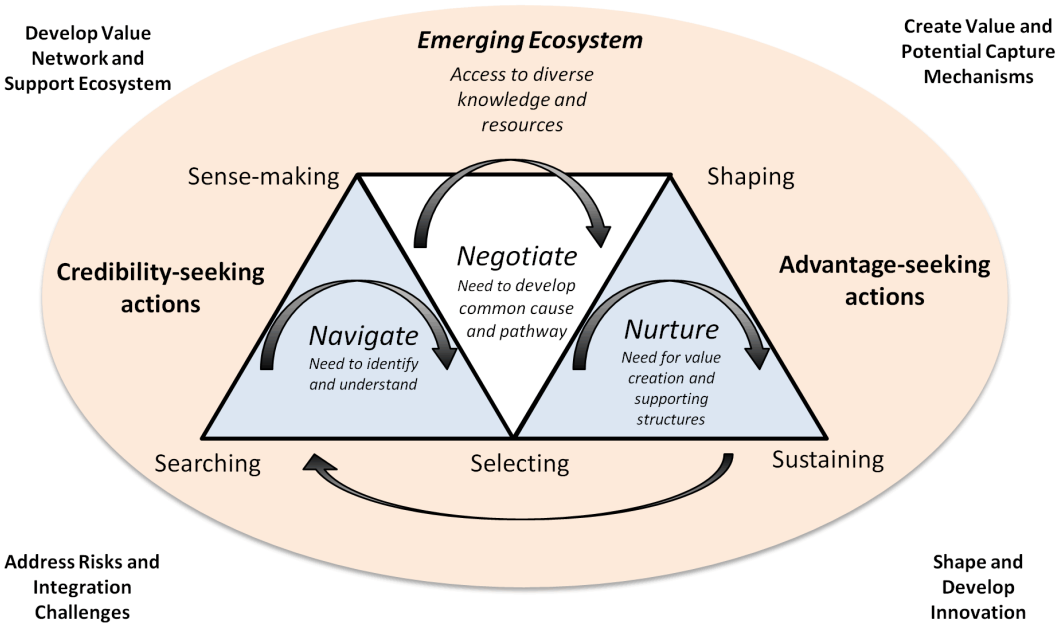

Figure 2. Proposed activity system model of convergent innovation

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Table 3. Example case findings and insights

Process	Example Case Evidence	Insights
Searching	• *"So, … it was structured to an extent. A bit like a structured fishing expedition. We tried many different ways."* Case NMD • *"We had the concept, but we didn't know anyone in the field [xxx] or anything related… So we sent cold call emails out to the likely stakeholders. … and they introduced us to others."* Case MLD	• Searches are often a combination of structured searching (of known domains) and (often) snowballing, using the network of your network to expand the search to new areas, but in a structured way to help address "distant" knowledge.
Sense-making (and sense-giving)	• *"So it's like a bit like a deep dive in…and reflecting and then looking in another area… an iterative process… and trying to make sense of it…"* Case NMD • *"… focused mainly on the value proposition, who the key customers were, and then how to identify key (clinical) stakeholders to help create 'pull'."* Case MLD • *"To be honest, it's a bit like Brownian motion… forever moving around, bumping into different people. And you cannot predict beforehand whether they will add value or not…. and it might just be timing or it doesn't fit their exact interest."* Case MLD	• Sense-making (and giving) through developing "propositions" and wide engagement in ecosystem, often going beyond immediate contact and network to "test" the idea • Involving the "unusual" suspects helps improve the sense-making process. • The ability to connect and make sense depends not just on content, but on timing and mutual interest.
Selecting	• *"The hard choice is going to be – how much do we have a starting point that is much simpler and cruder than the ultimate goal, but while still maintaining a strategic differentiation from the [xxx] industry of today?"* Case NMD • *"… after the community identified the 'problem', we went out and consulted to confirm we had identified the right problem and decision criteria… and finally we checked that the community would be prepared to participate. So it was methodical, but it evolved."* Case NMD • *So we knew that technologically it was different, that we'd need different criteria, and that things like safety data would be different to molecular medicine. So we'd also need to judge the portfolio using different criteria."* Case NMD	• Selection often involves broad strategic aims rather than precise criteria and tries to balance making near-term progress against longer strategic aims. • Engaging the ecosystem in defining success also helps to build confidence in the decision-making process. • The decision is more about interpretation than process in an uncertain environment
Shaping	• *"We were a driver behind the concept… with people wondering why we are in this? … But people are now beginning to realize the potential. [Investment] represents a sort of transition… It's more than just developing technology."* Case NMD • *"So, to start, we are probably going to position ourselves in 'convergence' as a 'Future Health Campus'… which is sort of pervasive."* Case CMTI	• Innovators invest time in helping shape the ecosystem and create a compelling "vision" as well as driving the innovation itself. • Shaping can be by influence rather than direct enactment.
Sustaining	• *"So, you have to invest in relationships, and it consumes your resources. But back to our network: we are building it, we have the first few critical ones in place and then we are working through them, to see more."* Case MLD • *"We have done something that is very distinct from other OI [open innovation] ventures. …. So, we have said we will allow the winner to retain the IP [intellectual property], but with conditions: they must make it broadly accessible to the community. We [NMD] have the first option to license it to research and clinical use."* Case NMD • *How can we find out who's key and engage them? Or which offering is most tractable? To reduce risk."* Case MLD • *"We are well connected locally and continue to spend a lot of time networking. We are always making new connections… More broadly we are connected to [national groups] … so, that gives us an opportunity to influence at a national level."* Case DH1	• Investment is not just in the technology or innovation, but in the wider ecosystem, and in relationships. • In order to sustain the innovation, risk reduction is critical and needs to be addressed early without losing sight of the long-term objective. • Startups and SMEs are less likely to undertake major shaping activities, but they still need to invest in continuing to build connections access to ecosystem resources.

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To overcome these challenges, all the cases worked in a collaborative way with other knowledge and alliance partners, creating opportunities to understand and share. This finding suggests that the approach appears more dependent on building relationships, rather than on information codification (Tidd & Bessant, 2013) and traditional technology integration approaches.

Market and business model risk

Convergent innovation, with increasingly digital content, provides opportunities for innovators to disrupt existing health and care pathways, making the identification of the value proposition and customer more complex and riskier. The nature of the technology used by Case MLD provided multiple options for business models, providing a "platform" from multiple revenue streams. Similarly, Case NMD identified several business models that might be appropriate depending on the success of the technology and its clinical application. However, such changes are not evident from the outset and do not appear to be readily designed, as they often emerge and evolve along with the innovation.

Value network risk

The prevalent approach from the cases was to first build transient partnerships. In doing so, the case firms developed knowledge and built relationships over time, thereby reducing risks. More robust relationships and long-term alliances were developed later. There is a 'trading off' of some short-term risk (by not having well-established networks) against making a "bad decision" on a longer-term partner. The alternative – to delay the formation of any partnerships and thus delay the innovation itself – was also observed in Case DH2, which ultimately was a failed venture.

Internal organizational risks

The risk of an innovation not being accepted by the incumbent organization is widely accepted in the literature (e.g., Danneels, 2011). To avoid resistance and mitigate organizational risk, the cases made multiple but small changes to existing routines. Examples of this approach were identified in Cases NMD, CMTI, and DH1.

Summarizing approaches for addressing complexity and integration

Risks arose from multiple sources: these risks could be considered in isolation, but they are interrelated. They form elements of a complex system, but rather than attempting to simplify the system, it is suggested that the complexity is more often addressed in a holistic way. For example, Case MLD undertook multiple risk reviews, whereby, they address patient and user risks, technology risk, business model risks, and overall project management risks. Similarly, Case NMD took a systemic approach to managing risks, and having mapped the major risk areas at an early stage, they set about addressing those risks in multiple areas (including for example understanding the human biology, developing human-machine interfaces, developing new energy systems, and developing new ways to interpret novel data). The evidence suggests a move beyond the multiple risk approaches identified for disruptive innovation (e.g., Keizer & Halman, 2007) to more comprehensive models as proposed by O'Connor and Rice (2013).

Despite knowing these represent categories of uncertainty that need to be addressed, it does not answer the core question – *how?* Revisiting the case evidence indicates several approaches being employed. Some are rooted in *process,* for example, in conducting formal risk assessments (as in Cases MLD and NMD) and making changes to processes to minimize or mitigate risk (as in cases NMD and DH1). Others aimed at building *relations* (evident in the Cases NMD, MLD, DH1, and CMTI, as previously discussed). Finally, there are cases that are more elusive and harder to classify, but are broadly based around management decisions and propensity to address wider ecosystem risks or in shaping the innovation "agency".

An early treatise on innovation by Usher (1966), revised from a book originally written in 1926, identifies two types of action that innovators may use: *analytic* (analysis) and *synthesis.* Analytic approaches can be conceived as using systematic methods to address largely anticipated or perceived gaps. Synthesis approaches are more creative and look to position the innovation to take advantage of future options. Revisiting the activity system suggested earlier (Figure 2), the underpinning routines may be conceived as being either largely *analysis* or largely *synthesis* driven by either a *process, relational, or agency focus.* This view suggests a conceptual model (Figure 3) that aims to position the integrating and risk management activities, in context, with the underlying approach.

This view also suggests approaches that are non-deterministic. Equally, they are not arbitrary, but *non-ergodic* (Sydow et al., 2012). In such a complex ecosystem, it is unlikely that any previous state will be re-experienced and, hence, innovation approaches become more context sensitive. The challenge is in embracing

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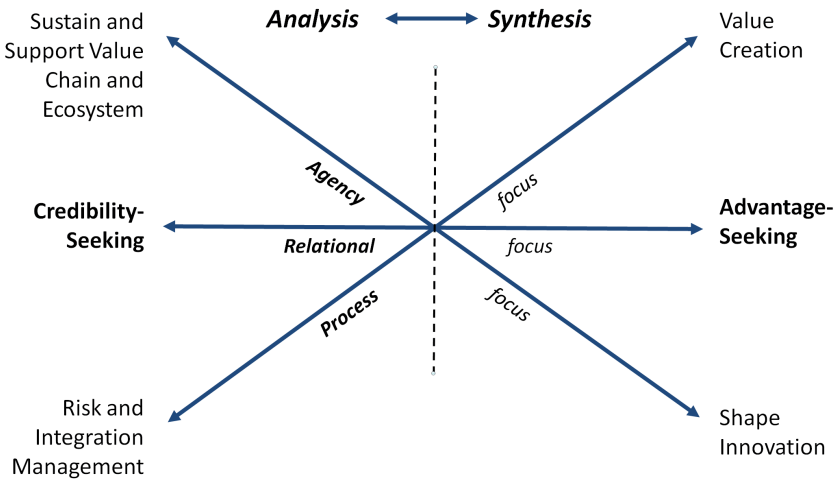

Figure 3. Integration of innovation activities

the complexity and managing the integration. Importantly, the innovator should not fixate too much on any one of the axes in Figure 3, but should look to "flex" between analytic and synthesis actions as needed and as opportunities arise.

There appears from the cases to be no single way of organizing, but they suggest a combination of activities and capabilities to access information and partners, to respond to technological, organizational, and ecosystem changes, and to maintain a focus on outcomes and performance. To quote one of the interviewees from Case DH2: *"...convergence requires you to keep all those different parts synchronized. It's no good progressing one too fast… from a whisky perspective, we have someone called 'The Nose'. They are irreplaceable, they have an instinctive nose, to make it all work. It's not just science. But it's not art either. Convergence is somewhere on that spectrum."*

Conclusion

The case evidence suggests innovators should undertake multiple engagements with diverse stakeholders as part of a search, sense-making, and selection process. Critically, this process can also help to create credibility and visibility within the ecosystem – necessary precursors to form alliances and create opportunities to achieve first-mover advantage. Innovators also have an opportunity to shape outcomes and their value network, but the importance of supporting and sustaining the emerging ecosystem is also identified here as a key activity.

Activities to sustain and support an innovation (or to shape it) are largely a result of management *agency* – to identify opportunities or challenges and then act to address them. The development of credibility, and later advantage-seeking positions, are the result of *relational* activities. The physical creation of value, integration, and the reduction of risk are primarily *process* driven. Actions to sustain, to seek credibility, and to reduce risk are effected by analytic approaches *(analysis),* in assessing the current state, developing options, and then deciding the best course. Finally, the value creation, advantage-seeking, and shaping activities are more about *synthesis* – identifying opportunities in patterns as they emerge.

This exploratory research addresses a relatively new phenomenon and so is limited to a few cases, therefore, limiting the generalizability. A qualitative approach was used, but despite significant observations and interviews, risk remains in inference and interviewee reliability. Our cases are focused on the United Kingdom but also involve partners from outside the UK. Although the cases are longitudinal, they were only studied for two years; however, they represent a formative part of the specific innovations and include major decisions or pivot points.

Future research would point to the need to better understand the emergence of such ecosystems and their impact on innovator processes in different contexts (e.g., different convergence regimes).

In summary, convergent innovation brings increased complexity and integration challenges that are not deterministic. There is a need to "embrace the complexity" by adopting a variety of approaches that balance *credibility-seeking* and *advantage-seeking* behaviours

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and oscillate between *analysis and synthesis actions* to address technological system, market, organizational, and value network integration risks. Although limited to a few cases in an emerging ecosystem, by taking a contemporaneous and longitudinal case approach, we address an identified gap in the literature on "how" organizations innovate in this context.

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Q&A

Mokter Hossain and Astrid Heidemann Lassen

Q. How do digital platforms for ideas, technologies, and knowledge transfer act as enablers for digital transformation?

A. Digital platforms, along with their supporting tools and features, have emerged as important enablers for firms to leverage distributed knowledge (Sedera et al., 2016), because they offer new ways for organizations to collaborate with the external environment for ideas, technologies, and knowledge. Indeed, studies have explored efforts to promote such collaboration on digital platforms with various popular names, such as crowdsourcing platforms (Afuah & Tucci, 2012), open innovation platforms (Frey et al., 2011), and online marketplaces (Dushnitsky & Klueter, 2011). Among others, the open innovation phenomenon highlights that these platforms have a far-reaching impact on how various parties innovate together through alliances, networks, and ecosystems (West & Bogers, 2014). This impact is observable in the explosive surge in the popularity over the last decade of digital platforms for research and development (R&D), idea generation, prediction, freelance work, peer production, co-creation, product design, and public engagement, to name but a few. For example, Dell's IdeaStorm (Hossain & Islam, 2015a) and Starbucks' MyStarbucksIdea (Hossain & Islam, 2015b) are two digital crowdsourcing platforms that are used to engage crowds to solicit ideas from them (Bayus, 2013; Chua & Banerjee, 2013). Moreover, intermediary platforms, such as InnoCentive and IdeaConnection, are organizing online competitions to solve the problems of various organizations (Hossain, 2012).

Although digital platforms provide new possibilities and competence, they however also bring new challenges for organizations, which call for new ways of organizing in order to fully embrace their potential. Understanding the role of these platforms in digital transformation is therefore crucial. We must recognize equally the opportunities and challenges digital platforms provide for organizations, and we need to understand the mechanisms and potential outcomes of various digital platforms. Consequently, we should consider digital platforms as a mechanism for accelerating the digital transformation endeavours many organizations are undertaking today (Berman, 2012). Despite the high significance of various digital platforms, there is limited knowledge in the extant literature about the effect of digital platforms on the organization. Thus, here we discuss *how* digital platforms for ideas, technologies, and knowledge transfer act as enablers for digital transformation.

Digital Platforms for Ideas, Technologies, and Knowledge Transfer

Digital platforms are becoming increasingly important, but many companies are still struggling to reap the benefit from these platforms. Digital platforms enable organizations to bring knowledge from outside to solve many problems organizations cannot accomplish internally (Jeppesen & Lakhani, 2010). Eisenmann, Parker, and Van Alstyne (2006) defined platforms as the "products and services that bring together groups of users in two-sided networks". Digital platforms also work as a carrier of innovation (Klerkx & Leeuwis, 2009). As Lopez-Vega, Tell, and Vanhaverbeke (2016) pointed out, searching for external knowledge is crucial for organizations' innovative activities, and the searching space can be local or distant as well as experiential or cognitive. Digital platforms work as an important carrier for searching external knowledge. Digital platforms for ideas, technologies, and knowledge transfer are two-sided in nature: solution seekers are on one side and solvers are on the other (Eisenmann et al., 2006). The shifting towards a more digital arena implies a new way of sharing knowledge internally and across organizational boundaries. Often, the knowledge sharing via digital platforms entails a high degree of continuous interaction between the two sides. This in turn means that new skills, tools, and management structures are necessary to incorporate external knowledge inside the organizations. Additionally, organizations need to overcome the "not invented here syndrome" – a negative attitude toward external knowledge (Lichtenthaler & Ernst, 2006) and the "not sold here" syndrome – protective attitudes toward external knowledge exploitation (Lichtenthaler et al., 2010).

Q&A. How Do Digital Platforms for Ideas, Technologies, and Knowledge Transfer Act as Enablers for Digital Transformation?

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Organizations can use various types of digital platforms based on their particular needs. They can have their own platforms or use intermediary platforms that complement the internal innovation of other organizations, especially large ones (Lichtenthaler, 2013). Intermediaries have specialized knowledge to aggregate a large pool of knowledge owners. Yet, using them may not give solution seekers any unique edge as their competitors can use the same platforms (Garavelli et al., 2013). Digital platforms can have commercial and non-commercial motivations; each type of platform has its distinct mechanism and demand different expertise for digital transformation. Based on an extensive review of the existing literature and popular press, we have identified seven major categories of digital platforms for ideas, technologies, and knowledge transfer and they are discussed in the following sections.

1. Problem-solving platforms

Problem solving is a popular application of intermediary digital platforms. Examples of popular problem-solving platforms are InnoCentive, IdeaConnection, Hypios, Innoget, and NineSigma. These intermediaries are commercial in nature: their main source of revenue is the upfront payment from the problem-seeking organizations that receive all the solutions submitted by the solvers (Hossain, 2012). The assumption is that a good solution is more likely to emerge from many solvers than an individual solver. Some scholars argue that problem solving through innovation contests may generate similar or redundant solutions (Girotra et al., 2010), but others argue that, even though there might be a redundancy of solutions in parallel settings, it is insignificant even in a very narrow area (Kornish & Ulrich, 2011). Another example of a problem-solving platform is OpenIDEO (openideo.com), a global community used by many organizations to solve world's pressing problems. It leverages innovative design process and online community to create solutions for societal problems.

2. Ideation platforms

Large firms use idea platforms to find designs for their products. For example, LG used the CrowdSpring idea platform to solicit a new phone design at the cost of $20,000 USD, rather than spending millions of dollars on contracting a design firm for the same purpose (Winsor, 2009). Higher financial rewards may not result in more effort from the designers, and only a few designers are active and effective in design competitions (Araujo, 2013). Therefore, encouraging these active designers to collaborate with peripheral designers is crucial to have diverse designers in design activities (Fuge et al., 2014). For this purpose, some intermediaries help organizations to create digital platforms suitable for interacting with different parties. For example, CMNTY (cmnty.com) and Spigit (spigit.com) develop innovation management software for other organizations to launch digital platforms. 99designs (99designs.ca) and Crowdspring (crowdspring.com) have made it easy for many entities to find low-cost designs from "crowds". On the 99designs platform, users create design contests for other users. Designers submit ideas for evaluation and receive financial rewards if their designs are selected (Araujo, 2013). Another example is the Zooppa platform (zooppa.com), which has served over 400 global brands in the production of video and graphic content by completing over 750 community-created projects, through which it awarded $6 million for 145,000 creations.

3. Co-creation platforms

Co-creation is a means of opening the innovation process through external individuals across the world (Füller et al., 2011). Companies are increasingly using mass customization to differentiate themselves from their competitors and find new ways to expand their business. Cafepress and Spreadshirt are two companies that have shown a new way to serve customers through co-creation (Brabham, 2010; Enders, 2010). The CafePress digital platform (www.cafepress.com/cp/info/about/) claims to be "the best online gift shop" with over one billion items that are co-created from a global community of over two million designers. Similarly, creative co-creation is used for tattoo design (CreateMyTattoo), music bands (Sellaband), lifestyle and interior products (Mookum), video makers (Userfarm), to name but a few. Another digital platform, Quirky (quirky.com), has paid out over $10 million USD to its community of around one million members who have contributed more than two million ideas.

4. Online marketplaces platforms

Online marketplaces such as NineSigma and Yet2 play an important role in increasing the use of patents by external entities. Firms may significantly enhance their performance in leveraging external knowledge by developing their reputation as a knowledge giver (Lichtenthaler & Ernst, 2007). According to Dushnitsky and Klueter (2011), there are two main categories of digital marketplace for knowledge trading: venture capital and intellectual property (IP). In the first category, seekers submit their ideas as a business plan and venture capitalists select the ideas to fund. In the second category, owners list the IP available for licensing or other ways of appropriation. According to Dushnitsky

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and Klueter (2017), "online marketplaces are more suitable to serve an industry with (a) a higher cost of searching for technologies in that industry, (b) greater ambiguity about the underlying technology's potential applications across industries, and (c) greater ability to protect inventions from expropriation". An example of this type of digital platform is Threadless (threadless.com), an online t-shirt marketplace where designs are created and selected by the community members. Each week, about 1000 designs are submitted to this online platform for the public vote and 10 designs are finally selected based on average score and feedback of community members, with designers receiving a portion of the proceeds of sales based on their designs.

5. Public crowdsourcing platforms

Digital platforms for the public sector represent a novel way to engage citizens in various public programs. In the United States (US), federal agencies are using the Challenge.gov (challenge.gov) platform as an alternative mechanism to solicit ideas for pressing challenges facing the US government. Challenge.gov has a list of challenges run by 100 agencies across US federal government. So far, federal agencies have offered over $250 million USD in prize money with the participation of over 250,000 solvers. In Singapore, the government has implemented various digital platforms that combine datasets from a wide range of agencies to engage its citizens (Yang & Kankanhalli, 2013). NASA is turning to crowds to explore human space exploration challenges through the open innovation service with a series of contracts. Thereby, it aims at using these challenges to tap into the diverse talents available around the world (NASA, 2015). The non-profit organization iBridge Network runs a digital platform where innovations, such as research results, computer software, copyrighted works, and patented inventions, are listed so that potential entities can use those items for useful purposes. It expedites technology transfer in several ways: i) greater focus on one-to-many transfers, ii) accumulations of innovation from multiple research institutions, iii) direct transactions from a provider to an adopter, iv) option for fee-based and license-based transactions, and v) management as a non-profit platform.

6. Collective intelligence

Collective intelligence is sharing information through collaboration, collective effort, and competition to find a concerted solution to a problem. Collective intelligence shows how applications support human interaction and decision making (Gregg, 2010). Digital platforms are increasingly used in collective intelligence and predictions. Collective intelligence markets (e.g., Lumenogic), crisis information (e.g., Ushahidi), data mining and forecasting (e.g., Kaggle), and crowdsourced image labelling (e.g., Google Image Labeler) demonstrate novel ways of digitization for collective intelligence. Tools that are used for collective intelligence are found to have better performance than theorists can explain: they may be better for idea generation than idea evaluation. However, managers needs to trade-off loss of control and diversity of expertise (Bonabeau, 2009).

7. Freelance and microtask platforms

Microtasking platforms provide opportunities for many organizations to accomplish tasks using crowd labour. For example, computers can use an application programming interface (API) to post tasks that are to be accomplished by humans. Here, requesters post tasks that online users complete and receive a small amount as payment per mini task (Ipeirotis, 2010). Several platforms, such as Amazon Mechanical Turk, Clickworker, Microtask, and txteagle help their clients to transform paper documents into digital format through the widely distributed crowds, each of whom does small task of a large project (Chrons et al., 2011; Kanefsky et al., 2001). TopCoder administers fortnightly online single-round matches and weekly competitions in graphic design and development. It sells software licenses using the growing body of components developed through competition. Pharmalicensing claims to have over 22000 technologies and a network in 110 countries. Chaordix leverages the knowledge and ingenuity of crowds to quickly identify market trends. Some intermediary digital platforms develop software solutions to manage ideas, projects, and products, thereby helping organizations to have sustained creation and enhancements of new products and services.

Conclusion

How digital platforms act as enablers for digital transformation is a pivotal issue, not only for companies but also for academics and policy makers. As demonstrated in the previous sections, there are various categories of digital platforms that are used to solve simple to very complex problems. The digital platform is a recently emerged phenomenon, and as such, it is underdeveloped in practice and under-researched in the academic literature. However, we can see that companies can benefit significantly from various digital platforms that can work as catalysts for digital transformation. Therefore, companies can consider digital platforms as an integral part of their digital transformation agenda.

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Even though digital platforms for ideas, technologies, and knowledge transfer are mostly considered as two-sided, there is a range of parties involved in the successful solving of problems. In a company's own digital platforms, managers need to learn how to deal with external people who are not employees and are only loosely connected with the company. They need to learn how to manage people who are on the other side of a digital platform. A key challenge for companies is to understand and narrate the problem in a simple manner so that external experts can easily understand the problems put forth.

Network effects also play a crucial role in the success of digital platforms. For example, to find the best solutions, ideas, technologies, and knowledge, the platform calls need to reach different experts across the world. Technology owners, for example, can license out their technologies to various parties across disciplines. Hence, the value of technologies is dependent on several external factors. Solution seekers prefer to work with intermediary platforms that have a high number of registered and potential solvers, and therefore, the sides stimulate each other for greater participation and contribution. Solvers, especially those who are successful, not only work with a platform once but also return repeatedly to the same platform to contribute.

Each category of digital platforms works with distinct mechanisms and therefore it is essential for a company to understand these mechanisms in relation to the what it wants to accomplish. Despite numerous studies on digital platforms, the understanding of their role in digital transformation is scarce. It is important to explore digital platforms from the lens of digital transformation. The current literature contains knowledge on what motivates crowds to participate in and contribute to digital platforms (sometimes without any monetary return), how an interdisciplinary team is better than homogenous groups to solve pressing problems, and how companies can appropriate their technologies for external use. However, there is limited understanding of how companies deal with various important activities, such as formulating a problem statement, finding a right set of experts to solve problems, and the financial aspects of using external experts. This discussion may provide a basis for future research in the exciting and rapidly developing field of digital platforms to accelerate our understanding of digital transformation.

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