Resource integration capabilities to enable platform complementarity in healthcare service ecosystem co-creation

Abstract.
Purpose—the Covid situation has increased the usage of multisided digital platforms. For many companies, this has become a business opportunity. Data usage on platforms, however, often requires that several platform companies continuously collaborate and co-create services together for common customers. In this case, the target of the co-creation with several companies in the ecosystem is not to make the same value proposition or solution but rather to use the resources such as data, knowledge, technology, or institutions in a complementary manner. Platforms are often characterized as a combination of hardware and software that includes standards, interfaces, and rules that make it possible for different ecosystem players to complement and interact with each other in the ecosystem. Current ecosystems may include several platforms that do not work without resource integration. Our study aimed to help managers in platform companies understand what do we mean by resource complementarity in service ecosystems from the platform provider’s perspective. More specifically, the study will help to clarify, what capabilities are needed to be taken into account when enabling platform resource complementarity in the data-driven healthcare service ecosystems.

Design—This study was done via a depth qualitative case study in which a health service ecosystem co-creating technological surgery innovation was used as a unit of analysis.

Findings—Our findings suggest that key resource capabilities to enable complementarity in service ecosystems are motivation, knowledge, skills, data, and complementary designed technology components.

Practical and theoretical implications—The paper highlights what capabilities are needed to be taken into account by managers from platform companies to integrate their platforms in data-driven healthcare ecosystems. From a theoretical perspective, our paper increases theoretical understanding of what do we mean by construct of resource complementarity data-driven health service ecosystems value co-creation.

Originality/value—Very few empirical studies in the marketing literature have focused on multi-sided digital platforms and their resource complementarity in the data-driven healthcare ecosystem settings. The present study fills this gap bringing new insights into what do we mean by resource complementarity ecosystems from a platform company perspective in a healthcare context. And what capabilities the platform companies need for their management.

Implications- In our study it became evident that the platform companies need capabilities to carry out analytics, develop AI solutions in the hospital context, integrate their solutions into the hospital processes and conduct internationalization of their services. Secondly, there is a need for capabilities to gain information about the processes, impact studies, gamification, the meaningfulness of new components and functionalities, and the possibilities to develop analytics using hospital data. From a managerial perspective, our results emphasize that organizations need to develop their adaptive capabilities and management procedures to utilize their internal and external competencies and resources and enable co-creative processes within the service ecosystem.

Keywords: value co-creation, complementarity, innovation, service ecosystem, health
1. **Introduction**

The Covid situation has increased the need for multisided digital platforms. For many companies, this has become an important business opportunity. This is true particularly in the healthcare domain, in which continuous changes such as spiraling healthcare costs (Wallin 2017) and an urgent need for digital innovations related to better patient care (Grol and Wensing, 2020) have generated a need to rethink how to co-create platform related innovations and integrate resources in ecosystems, particularly between public hospital players, patients, and private companies. In this context, service platform providers are companies that facilitate the interaction of actors and resources and serve as the venue for innovation (Lusch and Nambisan, 2015). Most often, they also enable the sharing and access of data or enable interaction between the healthcare provider and the individuals.

Technological innovations such as platforms, however, are most often co-created through negotiations and combinations of sometimes overlapping institutions (Vargo et al. 2015). Various definitions of value co-creation have been proposed in the literature (see, e.g., McColl-Kennedy et al., 2012, p. 3 for a summary). Co-creation in digital innovation with customers is fundamentally about communicating with customers to understand their needs and to make sure that the digital innovation will fulfill their purpose (Gustafsson et al. 2012). In this context, resource integration requires new skills, knowledge, and behaviors from all participating actors (Frow et al, 2014). It has been argued by Frow et al (2014) that value co-creation can take place only when an actor’s resources from different institutions are integrated (Frow et al, 2014). A resource itself, however, is not a thing but an abstraction that describes how a thing or idea contributes to achieving the desired outcome for an actor or multiple actors (Koskela-Huotari and Vargo, 2016).

It is not a surprise, that the term resource has had multiple definitions in the co-creation literature during the past decade. For instance, Gummerson & Mele (2010) refer to a resource advantage theory that argues that the company resources are either financial, physical, legal, human, organizational, informational, or relational. When co-creating digital innovations with other companies, consumers, and non-profit organizations a company can mainly get access to the relational resources that can then help them to customize their offerings to the selected segment (Gummerson & Mele, 2010). Resources have also been identified as knowledge, technology, or institutions related to digital innovation (Srivastava and Shaninesh, 2015). Mahony et al. (2005) and Ramsay (1992) emphasize the importance of a need either as a principal or as a starting point for any actions in resource allocation. Most recently, also data has been identified as a potential and very important resource that may allow a new type of resource allocation in value-co-creation (Huhtala, 2018).

To create sustainable new value propositions or new technological platform innovations company managers, however, need to co-create and integrate their technologies with other institutions in ecosystems that may involve multiple actors. (Akaka et al 2019). Ecosystems are a “set of actors with varying degrees of multilateral, non-generic complementarities that are not fully hierarchically controlled” and propose to look beyond generic complementarities to unique and super modular ones (Jacobides et al., 2016). This means that participating organizations in a service ecosystem often have their own needs and interests (Makkonen and Komulainen, 2018) which require managers to develop new capabilities to deal with complementary resource integration (see, e.g., Gummerson & Mele, 2010). In this resource integration, there is a need to find the right resource combinations (i.e., complementarity) and to use heterogeneous resources to co-create complementary value propositions (Harrison, 2001). The complementarity in this paper is defined as the companies’ and hospitals’ ability to match their resources to support the co-creation of value not only for a single actor but for the whole
ecosystem (Gummerson & Mele, 2010). In this context, service platform providers are considered the focal actors in the service ecosystem (Lusch and Nambisan, 2015). Capability-building is linked with activities that relate to deploying the needed resources in combination with other organizational processes for the creation of services, which can potentially provide enhanced strategic benefits. Thus, resources can be seen as an input of the co-creation while a capability is the capacity to deploy these resources in the best possible way.

Complementarity is mandatory for platform providers in such ecosystems (Teece, 2018, Tavalaei et Cennamo, 2021). For example, platform leaders such as Apple and Google provide different but complementary value for users in the same ecosystem using different, but complementary value propositions. (Teece, 2018). Eminent scholars argue that complementarity of platforms is necessary but not easy in between the platform providers, service component providers, and customers (Hullova et al, 2016) especially when co-creating services in the healthcare ecosystems, in which data collection and usage is highly regulated and often dependent of the customers. A firm that is part of the healthcare ecosystem co-creation is supposed to be able to create and use common resources such as data, knowledge, technology, or institutions in a complementary manner still keeping their managerial targets in mind and address managerial challenges to achieve an effective platform integration and complementarity in between the other platforms and service components in the healthcare service ecosystem.

The growing application of heterogeneous data usage possibilities (e.g. patient collected data, the firm collected data, and municipality/hospital collected data) poses new requirements to a firm’s capabilities (Agrawal and Prabakaran, 2020), which, in turn, refer to a firm’s capacity to deploy (data, knowledge, technology, and institutions) resources to achieve the desired end. There has been a great amount of research in the past decade about value co-creation in healthcare (see, e.g., work on co-creation and preventive healthcare by Dahl et al. (2018), work on the co-creation patient perspective by Crawford (2002), and Elg et al. (2012), as well as work on co-creation from the consumer perspective by Janamian et al. (2016), co-creation from the clinical perspective by McColl-Kennedy et al. (2012), co-creation from multiple actor perspectives by Pinho et al. (2014), Bhattacharya et al. (2015), and Frow et al. (2016), and co-creation from a community perspective by Zhao (2009)).

Additionally, a growing number of academic studies have looked into the firm capabilities to deal with ecosystem complementarity. Existing challenges in value co-creation complementarity are related to the heterogeneous motivations (Boudreau and Jeppesen, 2015), unclear roles in between the ecosystem players (Tura et al., 2019), strict governance roles (Zhang et al., 2020) and competition in between the ecosystem players (Zhang et al., 2020). From a resource perspective, platform integration to the service ecosystem requires extensive knowledge (Gnyawali and Park, 2011) and data sharing (Huhtala, 2018). Scholars argue, however, that value co-creation in ecosystems is unlikely to happen unless complementors build win-win connections with other players in the ecosystems (Karhu & Ritala et al., 2020).

Thus, extant research has increased our understanding of the development of firm capabilities and its impacts on ecosystem value co-creation within several managerial disciplines, including service innovation, marketing, business model design and strategic management, etc. Notwithstanding these efforts, we currently lack a holistic and comprehensive understanding of what capabilities are needed to deal with resource complementarity when co-creating data-driven services into the healthcare ecosystems. Therefore, our study aimed to answer the following research question: what do we mean by resource complementarity in service ecosystems from the platform provider’s perspective and what capabilities are needed to be taken into account when enabling platform resource complementarity in the data-driven healthcare service ecosystems. In this study, we focus on exploring
the capabilities needed for resource complementary in data-driven healthcare ecosystems specifically from the platform provider company perspective, focusing on a specific type of ecosystem that aims to co-create healthcare technological innovation and an intelligent and customer-driven solution for orthopedic and pediatric patient surgery journey.

The study was conducted as a qualitative case study for a surgery care-related service ecosystem that aimed to co-create value for hospitals in Finland and Singapore. The study aimed to understand resource complementarity in the ecosystems from the platform player perspective. Our empirical evidence contributes to the construct of resource complementary in data-driven health service ecosystems value co-creation as well as theories of value co-creation, helping also practitioners to understand how to deal with platforms in healthcare ecosystems. To explain it clearly, we introduce and develop the concept of resource complementarity in data-driven healthcare ecosystem co-creation, and construct its definition as “a firm’s capability in integrating resources such as data across boundaries in a very complex global ecosystem.

2. Research background

2.1 Value co-creation and resource integration in health service ecosystems

In the extant research, practitioners have used many terms and definitions to get a grasp of value co-creation and resource integration in service ecosystems, for example, co-creation as a resource integration process (Frow et al., 2016), or service co-creation in terms of resource integration behaviors by actors who have the intention to realize a value proposition (Hilton et al., 2012). In this study, value co-creation is studied by examining a case involving technological innovation in surgery care. Recent empirical studies on technological innovations have stressed the importance of the ecosystem perspective and especially firms participating in platform-based ecosystems (Lusch and Nambisan, 2015; Ceccagnoli et al., 2012; Nambisan, 2018). Resources in value-co-creation are an abstraction of any object that an ecosystem player has access to and can use in value co-creation (Vargo and Lusch, 2004; Vargo and Lusch, 2008). As mentioned previously, resources in co-creation can point to the needs, knowledge, skills, technologies, solutions, equipment, medicine, facilities, financial resources, and data that the different ecosystem players use in value co-creation.

2.2 Complementarity in resource integration

A platform can be seen as a combination of hardware and software that includes standards, interfaces, and rules that make it possible for different ecosystem players to complement each other in order to bring added value and the required interaction where the knowledge is created. Management scholars identify that the aim of the platform players is to get the alignment of common benefits between all complementors and competitors in the ecosystem regardless of the different managerial aims (Zhang et al., 2020). Therefore, being successful requires the identification of opportunistic platform competition strategies with the other ecosystem players (Karhu & Ritala, 2021). With the current technological advancement where healthcare ecosystems are built around platforms and public healthcare players, resource usage and integration are becoming a significant challenge when transitioning towards multi-layered data-driven ecosystems. Collaborative relations in the ecosystems require extensive routine knowledge sharing, knowledge, openness (Gnyawali and Park, 2011), and orchestration capabilities (Kretschmer et al., 2020, Zhang et al. 2020). This is true, especially when platform companies are going to the new markets as a purpose to convince their customers and complementors in the ecosystem to work together with them.
Additionally, the empirical evidence shows that often there is a lack of openness in the ecosystems that includes several platform companies (O’Mahony and Karp, 2020).

2.3 Resource integration in healthcare service co-creation

In the healthcare context, patients and healthcare providers are resource integrators who integrate operant resources (e.g., knowledge, skills) (Zhao, 2015). In healthcare settings, resources may also include self-generated activities such as activities that patients can engage in that contribute to the co-creation of value. Another type of resource identified in the service co-creation literature is operand resources (e.g. equipment, medicine, facilities, financial resources) that are often used to obtain mutual benefits for the ecosystem players (Vargo and Akaka, 2009; Vargo and Lusch, 2008; Zhao, 2015). These resources are often based on things such as healthcare providers, public sources, or the social networks in which patients’ knowledge, experience, and skills are embedded (Vargo and Lusch, 2011, Zhao 2015). One example of data as a resource in the healthcare field is the data in historical patient records (Frow & Payne 2016, Bihno et al. 2018) which may be shared between a hospital and external consultant or data that a patient or health specialist has collected via medical devices. According to Best (2018) companies often aim to improve their strengths via resource sharing in situations when the visibility and credibility of each player are supplemented via the combined capabilities. This requires that the players integrate resources in a mutually beneficial manner (Vargo and Lush 2008, Best 2018).

2.4 Towards complementarity framework in service ecosystem value co-creation

According to our literature analysis about Value co-creation and resource integration, complementarity in resource integration and resource integration in healthcare service co-creation, a healthcare ecosystem consists of service platform providers and hospitals that are co-creating value through resource integration. These integrated resources consist of knowledge and skills, technology and solutions, data and motivation integrated in a complementary manner between hospitals and platform providers resulting in the co-creation of technological service innovations. This research has designed a conceptual framework as presented in Figure 1. The framework elements are: (a) Value co-creation; (b) Resource Integration; (c) Resources; and (d) Digital Innovation and (f) Healthcare Service Ecosystem. The conceptual framework illustrates aims to use resource integration i.e. knowledge and skills, technology and solutions, data, and motivation to co-create value to create digital innovation in the healthcare service ecosystem.

Figure 1. Conceptual framework of resource integration from the complementarity perspective for value co-creation in a healthcare ecosystem
3 Research Methodology

We conducted an in-depth qualitative case study (Yin, 2003) to understand what we mean by resource complementarity in healthcare ecosystems. The service ecosystem investigated in this article is formed as part of a national research and development project complemented by international collaboration. The service ecosystem was formed in a research project called “An intelligent and customer-driven solution for orthopedic and pediatric surgery care”. The project was jointly funded by Business Finland, the research organizations, the hospitals, and the companies involved. The purpose of the project was to develop intelligent customer-driven solutions for surgical care. The need for the solutions was identified in a previous research project where it was found that patients expect more transparency during the care journey, more effective ways to communicate with the care team, better access to guidance and personal information, and ways to manage anxiety, fear, and pain of the child patients (Niemelä et al. 2019). Case studies are a way to explore new emerging research phenomena (e.g., Eisenhardt, 1989) and therefore to gain a rich empirical understanding of the selected phenomenon (Eisenhardt and Graebner, 2007). A qualitative case study approach was chosen for this research because the research field on digital platforms and ecosystems is still emerging, and there is limited research on the ecosystems from the platform provider perspective.

3.1 Case context Our empirical examination was conducted via an illustrative, explorative case study which allows us to understand the complex topic based on multiple data sources (e.g., Yin, 2014). This approach is appropriate in this particular context because understanding the resource complementarity capabilities in the complex ecosystem is challenging, and the boundaries between the phenomenon and the context might not always be so clear (see Yin, 2014). The use of a single case allowed for us more detailed, context-sensitive examination of the capabilities. Specifically, the context of our study is 12 companies and 4 hospitals, and 3 research organizations from Finland and Singapore that together formulated an ecosystem that aimed to co-create and validate digital surgery care innovations for orthopedic and pediatric patient journeys. The co-created innovations that were developed and piloted in all of the hospitals over the years 2017-2021 aimed to help patients before the
surgery, while they were still at home getting ready for the operation, and after they were discharged from the hospital.

When the study started, many of the involved hospitals were facing capacity problems in continuously changing operative environments where they were expecting a dramatic increase in the amount of surgery care patients in coming years. For instance, in one of the Finnish hospitals, an orthopedic surgeon perceived that “there was a need to decrease the length of stay (LOS) of patients, streamline the patient flow, improve employee well-being, i.e., to reduce sick leave days and employee turnover, and improve the patient experience”. During recent years, many changes have been made, such as changes to operation room practices, pain management of patients, and mobilization after operations. The changes have led to positive results, but the challenge has been the maintenance and upscaling of the new practices, deploying new digital technologies, and assuring patient experience in the changing operating environment. When the study was started in 2016, the patients were mainly supported by paper-based guidelines and phone calls in both Finnish and Singapore hospitals. During the study, however, the digital solutions were rapidly taken into pilot use at the different hospitals to further develop the solutions and to get evidence about their effectiveness in the hospital context. In some of the hospitals, Covid situation 2019 was
slowing down the data collection but at the same time increasing the speed of the solution adoption from practical perspectives.

3.2 Data collection
The data gathering took place by the researchers between 2018-2021. Data collection was done using multiple sources of data (e.g. Yin, 2003). The data sources used for the study are described in Table I.

Table. Interviews data source and data usage

<table>
<thead>
<tr>
<th>Source</th>
<th>Details</th>
<th>Use in the analysis</th>
</tr>
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<tbody>
<tr>
<td>12 interviews from the ecosystem companies and hospitals in Finland and Singapore (2019).</td>
<td>Semi-structured, face-to-face interviews was conducted with the ecosystem companies and hospitals in Finland and Singapore.</td>
<td>Gaining an understanding of resource complementarity at the beginning of the ecosystem establishment.</td>
</tr>
<tr>
<td>7 interviews were made for the ecosystem companies in Finland (2020).</td>
<td>Semi-structured interviews were conducted for the ecosystem players in Finland. Due to the covid situation, the interviews were organized as Zoom interviews.</td>
<td>Gaining an understanding of the resource complementarity after two years of work in the ecosystem.</td>
</tr>
<tr>
<td>Regular workshops with the ecosystem players during the years 2018–2020.</td>
<td>5 face to face workshops were organized for ecosystem players in Finland and Singapore in the years 2018–2020.</td>
<td>Gaining different perspectives of resource complementarity.</td>
</tr>
<tr>
<td>Notes from regular meetings with the ecosystem players during 2018–2020.</td>
<td>Regular meetings were conducted between the ecosystem actors to help companies to build value propositions for the hospitals.</td>
<td>Gaining an understanding of the individual organizational perspective of the resource complementarity.</td>
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The main data source for the study consisted of interviews with the platform providers who were engaged in co-creating solutions for a surgery patient care journey working together with health specialists and companies from Finland and Singapore. Continuous meetings were held between 12 companies and four hospitals (two in Singapore and two in Finland) and three research organizations to support the co-creation activities related to the orthopedic surgery solution. Researchers were participated in all the meetings making notes about the research and development discussions between hospitals and companies. All the meetings were noted and used for research purposes. Some of the meetings were also recorded. Additionally, in-depth individual interviews were used to get more detailed insights into the company and clinical perspectives concerning the resource complementarity. The interviewees from the companies represented general management, research management, or sales management...
The interviews were conducted in a semi-structured manner, face to face, in both Finland and Singapore. The duration of each interview was 30–56 min.

3.3 Data analysis

The data analysis followed a case study research process (Yin, 2003). First, the data was aggregated from each company, interpreting common patterns and differences. Second, we combined, sorted, and linked the data from the four cases. Transcripts were analyzed qualitatively and manually coded. The qualitative data were analyzed by conducting an inductive content analysis, which included 3 main phases: preparation, organization, and reporting (Elo et al. 2014). Content analysis is a method that is useful when analyzing written, verbal, or visual communication where words are divided into content-related categories for providing new knowledge of the phenomenon (Elo et al. 2014). In our study, the data were evaluated for quality by 2 researchers. In the analysis, initial impressions were written down as notes. Second, the data were abstracted into open codes and transferred into tables (Appendix 1). The open codes were grouped into categories (Elo et al. 2014), which were named using a word that was characteristic of the content and was formed into subcategories. Similar subcategories were grouped and called upper categories. The data analysis was first conducted by 2 researchers and then with one researcher, who added perspectives of 8 more interviews into the study. The themes of the analysis were based on the conceptual framework and research question addressing knowledge, skills, and data as an integrated resource in the analyzed service ecosystem. The researchers read the transcripts several times, and resource elements that could be found complementing the ecosystem were coded, discussed, and mutually agreed upon.

4 Findings

Major resource integration elements revealed from the analysis included knowledge and skills, data, technology and solutions, and motivation.

Technology and solutions components for the service

From the perspective of the participating company managers, the aim of the surgery care-related ecosystem was to offer a common service value proposition to the customers so that the developed technological solutions could be sold either separately or together in a way that they compete with each other. In our ecosystem, one of the participating companies was developing an IT solution that could complement other solutions in the ecosystem because of their AI expertise. One of the companies offered a platform that collects and analyzes back-end data. The platform builds on all the information that it collects from the patient and makes improvements based on the data. The complementary element in the offering of one of the analyzed companies included a mobile game interface for patients. Data collected in the game was analyzed for the care team and presented for them in the form of a dashboard that displayed green, orange, and red flags stating recommendations for a doctor to follow up with the patient or his/her parents.

One of the companies had plans to develop their application to the direction of being a digital medicine that a doctor can describe a patient. One company offered a video conferencing platform that could be used to enrich any existing healthcare system by utilizing secure video chat functions, screen, and file sharing. Three of the involved start-up companies also offered a game for the surgery journey. Two of them could be played with a
mobile phone and one with a Kinect camera. In one of them, the mobile phone games were specifically targeted at children who were going through surgery and needed psychological support or understanding of what was going to happen during the surgery pathway. One of the companies was also building business use cases using a service robot as a platform. Their idea was that the participating start-ups in this ecosystem could contribute data for the robot and therefore improve it and thus improve the quality of interaction with the robot for child patients in the hospital.

Knowledge and skills

Knowledge and skills were seen as an important integrated resource that positively affected service co-creation and complementarity. For instance, a contract was seen as an important means to enable complementarity in the service ecosystem. One of the interviewees explained this by saying: “Companies can enter to the hospital market more easily due to the existing contracts and relationship another company has created and has in place. The contract enables the integration of other services, service providers, and devices.” Analytics and machine learning were skills that were needed by the ecosystem players who aimed to use data as an enabler for the common value proposition. Two of the companies mentioned that it was important to have integrated data analytics skills that help to build a baseline for the service co-creation between the hospitals and companies. One of the companies, for example, was an in-house big data analytics company. In their work with machine learning and artificial intelligence, they saw it as a major opportunity for ecosystem complementarity. This was explained as follows by one of the interviewees: “We are using AI Technologies to manage and access chronic wounds. Yeah, and hopefully prevent them using a portable device.”

Additionally, knowledge on making risk analyses concerning the patient’s condition to support clinical decision making was seen as an important skill-related resource to support ecosystem co-creation. To use data analytics, specific skills were needed particularly to identify what data is meaningful for the clinical at the hospitals. Other skills required for co-creation revealed from our study were the skills needed to conduct internationalization activities. One of the interviewees explained this, saying: “We have offices in Singapore, Indonesia, Philippines, India, Thailand, Australia, New Zealand, and Africa, which helps other companies to go in different markets in Asia, etc.”

One skill that was seen as relevant for resource complementarity was the ability to deal with subcontractors. For example, one of the companies presented a technology that supported users, and they acted as a facilitator and program manager. They saw themselves as the main contractor able to integrate their processes with all parties and able to deliver the solution for clients in Singapore and to deal with politics and hospital processes.

Gamification skills were mentioned as important by several of the interviewed companies. Three of the involved companies focused on children’s games on digital platforms. One focused on rehabilitation, one on psychological support, and one on getting to know the hospital before the surgical journey. All the games are targeted at a different audience or focus group. One of the companies has specific knowledge about effective gamification techniques and features. They also work following the advice of psychologists who suggest new evidence-based features, while game designers and developers incorporate the features in a fun way.

To be able to create solutions that will be used in clinical setup, companies can benefit from the knowledge and skills of other players in the ecosystem for the regulatory approval process. There are different
kinds of regulatory approvals for different markets that would be needed before entering the market, e.g., FDA approval, MDR approval, etc. One of the companies in the study highlights this need and mentions that they are developing their skill set in that area to reduce the time to access new markets in the future. An interviewee from the company explained: “We do part of the regulatory approval preparation by ourselves, but we also use outsourced resources for that. There are a couple of good Finnish companies doing QMS and taking care of the processes [...] I have also worked for 15 years with these QMS processes and regulatory processes.”

**Data**

From a data perspective, some of the involved companies gathered and combined data to find some results about the quality of care, human behavior (e.g., mental health [general wellbeing, emotional state, fatigue, tiredness, sleep information], pain [intensity, localizations], motoric and reaction times [micro-motorics], balance), and healthcare processes. Two of the companies collaborated such that one of the company’s games appear in the other company’s platform and the one providing with the game will get access to the data collected via the platform. *The collected data for example on preferences or usage habits of the player is used in developing the game further.* One of the companies also profiled their customers based on their strengths or problems they have faced. Then they categorize them into different groups and based on this group they can then start giving personalized support. It was seen as important that the data can be shared with companies and researchers.

From a legislation perspective, personal health data was mainly controlled by the hospital that collected the data from the patient to provide care during the care path. The companies in the research project did not have access to this personal data at any point. If a patient had consented, they could only access pseudo-anonymized data for research purposes in the role of data processors acting on behalf of the hospital.

**Motivation**

The motivation was found to be the most important resource for the successful co-creation of services between the companies and hospitals. From the platform provider perspective, the overall goal was to achieve business growth and new revenue. For example, the ecosystem was helping companies to gain new local and international business. One of the companies saw the ecosystem as a potential way to broaden their platform offering by integrating another company’s service on their platform and selling it as an additional component on their platform. One of the interviewees in the company explained: “*We feel that alone, this other service cannot be sold to hospitals, but it needs to be integrated into another platform.*”

There was value in offering integrated solutions to hospitals that preferred full packages instead of separate systems. One of the companies needed change agents inside the hospital to find a consensus among the stakeholders. Whereas one of the companies was interested in co-marketing 2–3 complementary products to reduce the number of investments needed to reach the market. This was explained by one interviewee who stated: “*Co-marketing is helping our customers to see a more holistic package.*”

The customer hospitals (customers from the participating company perspective) saw that they were platform providers themselves, although the data collection was made using company platforms and services. This was making it hard for companies to charge the hospitals for additional added services on the platform. If a company is not able to charge for new services, it will lose revenue by bringing new services onto the platform. Being a part
of a bigger solution enabled the participating companies to test their products and services. It was helping them to plan resource usage in the development of new products and helping them to understand the market in terms of business, as well as helping the hospitals to change their processes, to carry out co-marketing of their solutions at the hospitals, and to build joint business models with the other players. There were also needs revealed in our study related to information about the services and products provided by other companies, an in-depth understanding to develop analytics, and the need to understand international processes, impact studies, and gamification in general and in healthcare contexts. For instance, according to one company employee: “*Medical and academic peoples are more knowledgeable of the facts and the market needs helping companies create new IVs and core technologies.*”

Some of the companies also wanted to develop a solution that fitted the hospitals’ workflow, as well as their working and business environment. They also wanted to develop a solution that nurses wanted to use. They wanted to get people and future users to commit in the development phase, saying what they needed, what they did not need.

One of the companies offering a gaming platform saw algorithm development as one collaboration opportunity with another company. Providing the other company with data to teach the algorithm would make it smarter and at the same time, the platform provider could improve their service and algorithms. The company felt that collaboration in algorithm development made sense and created value in this case because they complemented each other and did not compete. Some of the companies wanted to develop new components (e.g., a standard camera, computer vision), features (e.g., individualized pain identification and management, psychological support at the right time, valid conversations), and functionalities (e.g., alerts, personalized feedback, touchscreens) including data analytics with AI solutions/algorithms or AI-powered diagnostics. Some of the companies had more experience in AI than others to be shared.

5 Discussion and conclusion

While the future of healthcare systems partly depends on digital personalized solutions, it is envisioned that the healthcare and wellness market will see the massive growth of digital solutions and platforms becoming available. Resource limitation on the part of healthcare providers is a significant issue in European markets. Because of the growing elderly population and continuing struggle with limited resources, it is now realized that hospital organizations need solutions that will not only meet their basic requirements but also complement hospital resources. In the scope of this paper our conducted case study provide a lens to look deeply into the different types of resource complementarity capabilities that service platform providers can focus on when co-creating their platforms with complex healthcare ecosystems including hospitals.

**Figure 2. Results of resource integration from the complementarity perspective for value co-creation in a healthcare ecosystem**
Theoretical implications

Differing from co-creation where value propositions encourage actors to share their resources (Frow et al. 2016), in our study, it was shown how platform providers can offer different platform elements complementing each other in service co-creation ecosystems, e.g., by focusing on different user groups and technological elements. Thus, in our study, we adopt a perspective of value co-creation which refers to a resource integration process between various actors (Lusch and Nambisan 2015). We see that resource integration is the mechanism by which value is co-created based on different technological elements. Additionally, innovation is central to the continuation of value co-creation (Akaka et al. 2019). Elg et al (2012) carried out an empirical investigation of 53 patients emphasizing the patients’ role as an active contributor of knowledge and skills related to healthcare service development. In this context, however, supporting processes, methods, and tools that enable the use of these resources are often missing (Elg et al 2012). In our study, it became evident that skills are needed from many different perspectives. For instance, the platform companies need skills to carry out analytics, develop AI solutions in the hospital context, integrate their solutions into the hospital processes, and conduct internationalization of their solution in the selected markets.

Typically, at the core of healthcare innovation in an ecosystemic context is the ability to address the needs of patients and the healthcare providers who deliver the care. The needs change and innovations may come from the healthcare stakeholders (patients, patient advocacy groups, or other healthcare professionals) or externally from the government in the ecosystems in which the companies are involved. Furthermore, the needs can be met internally in the healthcare organization or externally. However, due to the limited resources, many healthcare providers partner with companies to create products and services that meet their needs. In our study, it was shown, that the needs and information that is obtained from customers can also have many forms. Information is needed not only about needs but also processes, impact studies, gamification, the meaningfulness of new components and
functionalities, and the possibilities to develop analytics using hospital data. Scholars stress, however, that, often this kind of user data is hard to visualize and capture (Kypernetes, 2020).

Understanding of data-based value creation perspective is particularly important for improving service value creation with data in the modern data-rich economy (Lim et al. 2018). For instance, health management services are often use to manage potential breakdowns and maximize availability for stakeholders (Lim et al. 2018). Huhtala (2018) notes that customer data can be considered as a resource that can be used to better understand the customer needs and to improve value diversification among ecosystem players. In this study, it was shown that in the context of surgery care, the data was working as a resource to make technological solutions that could better support the quality of the care and human behaviors. Bihno et al. (2018) pointed out that electronic health records can work as an important source for value co-creation supporting the interactions between the different players in the ecosystem. Therefore, there is a need for future research focusing on data as a resource looking beyond dyadic relationships and an ecosystem perspective of value co-creation (Bihno et al. 2018).

O’Dryer and Gilmore (2018) suggest that companies, especially small and medium size of enterprises should carefully think about the resource combinations that could help them to gain optimal resource usage in between the other players in the alliances. One advantage of the collaboration in the ecosystems is the company’s capability to address gaps that exist between the ecosystem players. Therefore, one reason to engage in co-creation in the first place is to gain benefits of the resource complementarity from the other players working in the same ecosystemic context (Sinkovics, 2018). This study sheds light on the study by Sinkovics (2018) showing what kinds of motivational factors/benefits platform companies expect to gain via the co-creation of services. It was shown in the study that motivation can be examined from different perspectives. Platform providers were using the resources in co-creation because they wanted to grow their business, engage in technical service development, get information, gain a competitive advantage, have data access, enter the hospital as a customer, or engage in internationalization.

Managerial implications

Our work offers the following main contributions. First, in reflecting to our first research question about resource complementarity, i.e. how platform operators could identify ecosystem partners with resources that they can leverage and integrate to create synergy (Lin, Yang, and Arya, 2009; Lin, Yang, and Demirkan, 2007), in our study it became evident that the platform companies working in data-driven healthcare ecosystems to need capabilities to carry out analytics, develop AI solutions in the hospital context, integrate their solutions into the hospital processes and conduct internationalization of their solution in the selected markets. Secondly, there is a need for capabilities to gain information about the processes, impact studies, gamification, the meaningfulness of new components and functionalities, and the possibilities to develop analytics using hospital data. It was shown in the study that platform providers were using the resources in co-creation because they wanted to grow their business, engage in technical service development, get information, gain a competitive advantage, have data access, enter the hospital as a customer, or engage in internationalization. From a managerial perspective, our results emphasize the need for organizational agility in terms of being able to quickly adjust to the increasingly dynamic business environment. Organizations need to develop their adaptive capabilities and management procedures to utilize their internal and external competencies and resources and enable co-creative processes within the service ecosystem. One of the key issues is data governance. Therefore, organizations need to constantly
scrutinize their capabilities and the shortcomings of their technological data management environment and the data management process and develop rigorous business processes and management procedures to support data governance. In addition to data management, the personnel’s competencies should be emphasized. Due to the rapid development in technologies related to digital service delivery, such as AI and 5G, as well as the increasing availability and the amount of data, there is a danger that technology-related capabilities become bottlenecks that may hinder an organization’s ability to contribute to and reap the benefits from ecosystemic resource complementarity. The importance of adaptive capabilities related to technology management and personnel is also highlighted in Blomster and Koivumäki (2021). As further noted in Blomster and Koivumäki (2021), it is the market and technology dynamics that drive the need for adaptive capabilities, which augment and extend dynamic capabilities to enable higher and faster organizational resilience. In other words organizations’ ability to adapt to changes. This creates a competitive advantage through faster sensing and seizing of opportunities (Day and Schoemaker, 2016)

Sustainable co-creative business ecosystems must bring competitive advantages to the organization and there should be a notable business sense in the proposition such as direct business benefits through increased customer value, broader market access, or cost reductions. For these business opportunities to materialize organizations must make sure that their business models are flexible to accommodate value co-creation and co-capture.

Limitations and future research avenues
This qualitative case study was exploratory, focusing on resource complementarity in health care service ecosystems from the platform provider perspective. Typically, companies and in this case, ecosystems and project characteristics are unique to each case study, which is making the comparisons and generalizations of case study results difficult which is an issue related to the external validity (Kitchenhaet al., 2002). However, Walsham (1995) argued that when using a case study approach, the aim is always not to achieve generalization but rather plausibility and logical reasoning through developing concepts and theory. This was the case in our study, in which the target was to understand what do we mean by resource complementarity in service ecosystems from the platform provider’s perspective and what capabilities are needed to be taken into account when enabling platform resource complementarity in the data-driven healthcare service ecosystems. In addition to service ecosystems in other contexts, it would also be fruitful to analyze how these types of platform-based ecosystems evolve. Therefore, we suggest that a longitudinal analysis of such ecosystems should be included in the future research agenda.

References


Yin, R.K. - Qualitative Research Methods, 2003 - books.google.com


Appendix 1: Service platform providers’ role in the service ecosystem

<table>
<thead>
<tr>
<th>Service platform provider</th>
<th>Role in the service ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 BCB</td>
<td>Quality register platform</td>
</tr>
<tr>
<td>#2 Buddy</td>
<td>Patient engagement platform</td>
</tr>
<tr>
<td>#3 Near Real</td>
<td>Audiovisual and information communication platform</td>
</tr>
<tr>
<td>#4 Kinexs</td>
<td>Rehabilitation platform</td>
</tr>
<tr>
<td>#5 Kronikare</td>
<td>Wound analysis platform</td>
</tr>
<tr>
<td>#6 Solteq</td>
<td>AI Machine learning-driven platform for wound analysis</td>
</tr>
<tr>
<td>#7 Esco</td>
<td>Video communication platform</td>
</tr>
<tr>
<td>#8 Rehaboo</td>
<td>Rehabilitation platform</td>
</tr>
<tr>
<td>#9 Adesante</td>
<td>AR/VR based visualization platform</td>
</tr>
<tr>
<td>#10 Goodlife</td>
<td>Rehabilitation platform</td>
</tr>
<tr>
<td>#11 Lingsoft</td>
<td>Linguistics and semantics analytics platform</td>
</tr>
<tr>
<td>#12 Senirosome</td>
<td>Rehabilitation platform</td>
</tr>
</tbody>
</table>

Appendix 2: Data analysis

<table>
<thead>
<tr>
<th>Main category</th>
<th>Generic category</th>
<th>Subcategory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td></td>
<td></td>
<td>Some of the involved companies gather and combine data to gain results about the quality of care, human behavior (e.g., mental health [general wellbeing, emotional state, fatigue, tiredness, sleep information], pain [intensity, localizations], motoric and reaction times [micro-motorics], balance), and healthcare processes. Two of the companies collaborate so that one of the company’s games appears on the other company’s platform and the one providing the game gets access to the data collected via the platform. The collected data for example on preferences or usage habits of the player is used in developing the game further.</td>
</tr>
<tr>
<td>Legislation</td>
<td></td>
<td></td>
<td>Personal health data is controlled by the hospital that collects the data from patients to provide care during the care path. Companies in the research project, do not get access to personal data at any point. If consented by a patient, they can only access pseudo-anonymized data for research purposes in the role of data processors on behalf of the hospital.</td>
</tr>
<tr>
<td>Personalization</td>
<td></td>
<td></td>
<td>One of the companies profiles their customers based on their strengths or problems they have faced. Then they categorize them into different groups and based on this group they can then start giving personalized support.</td>
</tr>
<tr>
<td>Sharing</td>
<td></td>
<td></td>
<td>One of the companies has data that can be shared with companies and researchers. The second company has a one-way gateway providing data to the hospital or the client.</td>
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<tr>
<td>Knowledge and skills</td>
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<tr>
<td>Analytics</td>
<td>Two of the companies have data analytics services. One of the companies, for example, has an in-house big data analyst in their team working with machine learning and artificial intelligence.</td>
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<td></td>
</tr>
<tr>
<td>Subcontractor/implementation</td>
<td>One of the companies represents the technology, supports users, and acts as a facilitator, program manager, or main contractor. They help integrate all the parties and deliver the solution for clients in Singapore.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artificial intelligence</td>
<td>Three of the companies have expertise in machine learning and artificial intelligence. They use AI Technologies to manage and access chronic wounds.</td>
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</tr>
<tr>
<td>Existing contracts</td>
<td>Companies can enter the hospital market more easily due to existing contracts and relationships another company has created and has in place. The contract enables the integration of other services, service providers, and devices.</td>
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</tr>
<tr>
<td>Internalization</td>
<td>One of the companies has offices in Singapore, Indonesia, Philippines, India, Thailand, Australia, New Zealand, and Africa, which helps other companies to get into different markets in Asia, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome measures</td>
<td>Some of the companies have specific knowledge about what kind of data can be used and is meant to collect and integrate from different sources. In addition, they know about (international) measurements that are needed, and which measurements are valuable to clinicians. They also know how to obtain and use the data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Processes</td>
<td>Some of the companies have specific knowledge about politics, chemistry, processes (e.g., evidence-based medicine guidelines in Finland), and decision-making in different organizations.</td>
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<td></td>
</tr>
<tr>
<td>Sharing of knowledge</td>
<td>Some of the companies share information with the healthcare organizations in Finland.</td>
<td></td>
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<tr>
<td>Research</td>
<td>One of the companies has specific research skills on gamification.</td>
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<tr>
<td>Risk calculator</td>
<td>One of the companies knows about carrying out risk analyses of the patient’s condition to support clinical decision-making.</td>
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<tr>
<td>Technology</td>
<td>One of the companies has technology enabling remote visits. In addition, they have different features such as a second audio channel optimized for stethoscope audio as well as investigation or examination cameras. They have also developed a solution to copy and redirect audio and video signals to a server where artificial intelligence algorithms are running for AI-powered diagnostics.</td>
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<tr>
<td>Games</td>
<td>Three of the involved companies focus on children’s games on digital platforms. One focuses on rehabilitation, one on psychological support, and one on getting to know the hospital before the surgical journey. All the games are targeted at a different audience or focus group.</td>
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<tr>
<td>Gamification techniques</td>
<td>One of the companies has specific knowledge of effective gamification techniques and features. They also work with psychologists who suggest new evidence-based features while the game designers and developers incorporate the features in the games in a fun way.</td>
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<td></td>
</tr>
<tr>
<td>The regulatory approval process for medical devices</td>
<td>One company works partially in the field of European medical device regulatory approval and outsources part of the work. MDR approval is required if the devices/software are meant for clinical use.</td>
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<tr>
<td>Motivation (need)</td>
<td></td>
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<tr>
<td>Business growth</td>
<td>Some of the companies find new local and international business cases and market needs in the project. Being a part of a bigger solution allows them to test their products and services and perhaps even to get used in real life. In addition, it helps them to plan resource usage in the development of new products and helps them understand the market in terms of business.</td>
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<tr>
<td>Broadening the platform offering</td>
<td>One of the companies can see some potential for broadening their platform offering by integrating another company’s service on their platform and selling it as an additional component on their platform. They feel that alone, this another service cannot be sold to hospitals, but it needs to be integrated into another platform. There is value in offering integrated solutions to hospitals that prefer full packages instead of separate systems.</td>
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<tr>
<td>Change agents</td>
<td>One of the companies needs change agents inside the hospital to find a consensus among the stakeholders.</td>
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<tr>
<td>Area</td>
<td>Description</td>
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<tr>
<td>Co-marketing</td>
<td>One of the companies is interested in co-marketing 2–3 complementary products to reduce the number of investments needed to reach the market. Co-marketing would help customers to see more holistic packages.</td>
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<td></td>
</tr>
<tr>
<td>Business models</td>
<td>There is a need for co-created business models for companies to address the opportunities and needs of each company and to create business value. Some of the companies, for example, are balancing between the two or some mix of the two alternatives.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The challenging business model for a joint offered platform service</td>
<td>One of the companies pointed out that the customers, in this case hospitals, see a platform serves as one solution although it is a collection of many companies’ platforms and services. This makes it hard to charge the hospitals for additional added services on the platform. If a company is not able to charge for the new services, it will lose revenue for bringing new services onto the platform.</td>
<td></td>
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<tr>
<td>Revenue</td>
<td>One of the companies does not yet have to pay customers (revenue). The company needs to get FDA approval to enter the USA market.</td>
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<tr>
<td>Competitive advantage</td>
<td>One of the companies points out that participation in the research project gives a competitive advantage in the selected market.</td>
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<tr>
<td>Collaboration</td>
<td>Some of the companies will deepen their existing collaborations or start new ones.</td>
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</tr>
<tr>
<td>Data</td>
<td>There is a need for two-way collaboration to get data to improve platforms and to develop new components and functionalities, for instance, AI-driven prediction models for preventive care. In addition, for one company, there is a need for data to make neural networks/algorithms smarter.</td>
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<tr>
<td>Enter the hospital</td>
<td>One of the companies makes it easier for companies to access a closed hospital environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td>There is a need for information about services and products provided by other companies. In addition, there is a need for in-depth understanding to develop analytics, new components, and functionalities to create value for customers—hospitals and in the end the patients.</td>
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<td></td>
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<tr>
<td>Internationalization</td>
<td>Internationalization or globalization is one of the key drivers of companies.</td>
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<tr>
<td>Product development</td>
<td>There is a need to develop new components and functionalities to enhance existing platforms/products. According to one company, medical and academic people are more knowledgeable of the facts and the market needs which can help companies create new IVs and core technologies.</td>
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</tr>
<tr>
<td>Algorithm development</td>
<td>One of the companies offering a gaming platform sees algorithm development as a collaboration opportunity with another company. Providing the other company with data to teach the algorithm would make it smarter and at the same time, the platform provider could improve their service and algorithms.</td>
<td></td>
<td></td>
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<tr>
<td>Avoidance of repetitive tasks</td>
<td>There is a need to avoid repetitive tasks between the companies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artificial intelligence/ Machine learning</td>
<td>Some of the companies want to develop new components (e.g., a standard camera, computer vision), features (e.g., individualized pain identification and management, psychological support at the right time, valid conversations), and functionalities (e.g., alerts, personalized feedback, touchscreens) including data analytics with AI solutions/algorithms or the AI-powered diagnostics. Some of the companies have more experience in AI than others.</td>
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<tr>
<td>CE marking</td>
<td>One of the companies wants to have a CE marking.</td>
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<tr>
<td>Depth camera</td>
<td>One of the companies wants to develop depth perception with AI.</td>
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<tr>
<td>Gamified elements</td>
<td>Some of the companies want to develop and add gamified elements to their platform and study how this could be done, and what should be integrated to increase empowerment, for example</td>
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<tr>
<td>Feedback</td>
<td>Some of the companies need to get feedback from the customers.</td>
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<tr>
<td>Integrations</td>
<td>There is a need for different degrees of integration between the companies.</td>
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</tr>
<tr>
<td>Personalization</td>
<td>One of the companies wants to provide personalized recommendations.</td>
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<tr>
<td>Process development</td>
<td>Software and services need to be redeveloped so it helps customers to develop their processes.</td>
<td></td>
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</tr>
<tr>
<td>Technology and solutions</td>
<td>Robotics</td>
<td>Smart Mirror software</td>
<td>User tests</td>
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<tr>
<td></td>
<td>One of the companies wants to develop their robot to have semantically correct and proper conversations with children based on data.</td>
<td>One of the companies wants to develop smart mirror software.</td>
<td>Some of the companies would like to have user tests to improve the usability of the products.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Developed solutions</th>
<th>Complementary solutions</th>
<th>CE marking</th>
<th>Solutions</th>
<th>Data collection and analysis</th>
<th>Dashboard</th>
<th>Digital medication/medicine</th>
<th>Integration platform</th>
<th>IT consulting</th>
<th>Patient care journey platform</th>
<th>Quality register</th>
<th>Robotics</th>
<th>Software-as-a-service</th>
<th>Video conferencing</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed solutions should not compete with each other. Instead of competing, the solutions developed should be complementary.</td>
<td>Artificial intelligence/machine learning</td>
<td>One of the companies have a CE marking for a medical device.</td>
<td>One of the companies is an IT provider that in this project aims to teach its artificial intelligence-based platform with data collected in the research project. One of the companies think that this IT provider can complement their solutions because although they also work with AI, the other company has more experience of it.</td>
<td>One of the companies offer a platform that collects and analyzes back-end data. The platform builds on all the information that it collects from the patients and makes improvements based on the data.</td>
<td>One company offers a mobile game for patients. Data collected in the game is analyzed for the care team and presented for them in the form of a dashboard that shows green, orange and red flags stating the recommendation for a doctor to follow-up on the patient or with their parents.</td>
<td>One of the companies has plans to develop their application in the direction of being a digital medicine that a doctor can describe a patient in the near future.</td>
<td>BCB platform and BCB system. One company is an audio-visual systems integrator.</td>
<td>One of the companies do IT consulting.</td>
<td>One of the companies offer a patient care coordination and patient journey automation platform. It is a patient solution but is also a platform where (the whole) the patient zone is documented, and then other companies can bring their solutions to the points where they are needed.</td>
<td>One of the companies offer quality registers.</td>
<td>One of the companies is building business and use cases by using a service robot as a platform. One of the companies states that the participating start-ups in this project could contribute to providing data for the robot to improve it and therefore improve the quality of interaction with the robot for child patients in the hospital.</td>
<td>Two of the companies offer their platform as software-as-a-service to hospital customers.</td>
<td>One of the companies have a video conferencing platform that can be used to enrich any existing healthcare system by utilizing secure video chat function, screen sharing and file sharing.</td>
<td>Three start-up companies offer a game for the surgical journey. Two can be played with a mobile phone and one with a Kinect camera. The mobile phone games target children who are going through surgery and need psychological support or to understand what is going to happen during the surgical journey.</td>
</tr>
</tbody>
</table>
Interview instrument:

FOR COMPANIES

Background

· Introduce you and the organization you are working for (e.g. how many people work in the organization…)?

· What kind of background do you have about the collaboration with hospitals?

Expectations

· Could share an example of an innovation project that you have been working on with the hospitals or care providers?

· Where did you get the innovation idea?

· What were your expectations regarding the innovation work?

· How would you describe your role in the project?

· How has the project been so far? What has been most rewarding and most challenging parts of the innovation work?

· Would you change anything? Why?

· Did you have business/ professional relationships with the player before the collaboration started?

  o If yes, in what context and in what capacity?

  o If yes, has that enabled or empowered your collaboration with those organizations?

· How does your organization approach the issue of making sure that you can benefit from new ideas, inventions and innovations? (e.g., do you actively protect your ideas somehow?)

  o Has your approach changed? How? (e.g. has the change been notable, or subtle, deliberate or integral part of other changes,…)

· How do you feel, the changes in the operations environment, such as digitalization and increasing networks, shape your way of innovating, competing and profiting from innovation? (IPDMC paper)

· How do they affect your activities with regard collaborative innovation?

Networks and cooperation

· What is the process for identifying ideas for health technology innovation?

· Let’s assume, I find out something important idea for health innovation that may affect others in the organization, how will you manage that information?

· How do you identify a potential collaborator within the ecosystem?

· What is the basis of collaborating with specific stakeholders? Who do you work most closely with and why?
· How is the communication and information sharing been with other actors in your innovation co-creation e.g. other actors from the same hospital? How has the cooperation been?

· Are some of the participants more visible in the network than others? Why do you think that they are/are not?

· How has the working been different in your organization and in cooperation with other participants?

· Could you please share an example of cases that you consider to be some type of failures in your innovation collaboration?

  o How and why it failed? Why did you stop the collaboration? (e.g. what conflict interests you perceived among different actors? How did they result in the failure? (re: IMP paper)

  o What happened afterwards? What actions were taken after the failure?

  o What did you learn from the failure?

· Would you be aware of any event where there has been some problem related specifically to IP and its use in collaboration? If so, please elaborate how was it managed. (or related to your attempts to benefit from innovation)

  o what IP, and whose IP was in question?

  o what kind of a problem emerged? (e.g., not being able to agree on who owns IP, who can do what, a case of abuse of IP (what kind of abuse) ),…?

  · What happened afterwards?

  o How did the IP related problems affect collaboration?

  (e.g., What did you do? Did you change your strategies? Did you develop new approaches?)

  o What were the learnings from that and how did you implement them for you projects? (e.g., What did you do? Did you change your strategies? Did you develop new approaches?)

**Innovation**

· How is the innovation (work) visible at your organization?

· What kind of actions are made to enhance innovation?

· How are the employees engaged to the innovation creation process?

· What kind of value is expected to get from the project?

· For the specific technology innovation case, what/who are your key customer groups?

· What do you offer (products/Services) to your customers (patients group, doctors, other health professionals)?

· What is the value add / benefit that the customers get from your offering?

· How can these products/services be sold or delivered to outside (international) hospitals?

· What are your most important activities that you do and why are you competitive in the markets?
· How do you define prices for your products/services?

· How do customers pay for your products/services, i.e. what is your revenue model?

· Who are your key collaboration partners?

· How do you see your hospital different compared to your most important competitors (national and international)?

· What are your most important costs?

· How do you measure the success of innovations/network orchestration? (financial measures (break-even; return on investment) or non-financial measures (increased throughput; productivity; patient/societal wellbeing etc).

· Over what time frames do you anticipate success to emerge from innovation? Do you continue to add resources if you are not getting the success anticipated? (expected payback from investment - i.e. after 3 yrs. break-even is expected? Given technology - it might be 1 year. How easy is it to move away from failing innovations?).

**Business model**

· What/Who are your key customer groups?

· What do you offer to your customers (products/Services)?

· What is the added value / benefit that the customers get from your offering?

· How do you sell and deliver your products/services to customers?

· What are your most important activities that you do

· What are your competitive advantages in the markets?

· How do you define prices for your products/services?

· How do customers pay for your products/services, i.e. what is your revenue model?

· Who are your key collaboration partners?

· How do you see your company different compared to your most important competitors?

· What are you most important costs?

· Why and how do you think that you can grow in new markets successfully?

· Why do you think that you can make profits and remain profitable in the future?

· How and why do you think you can scale up your business in the future?

**Internationality**

· What type of players are you working with in international field?

· How do you see international cooperation?
· What expectation do you have regarding the internationality?

· What kind of challenges there has been considering the international cooperation compared to the collaboration that you have done?

**Other**

· Have you identified any new business cases coming out from your previous innovation collaboration? Which stakeholders are involved in those specific business cases?

· What role do you see diagnosis-related activity-based funding models playing in the future? (hint – changes from focus on illness to a focus on wellness)