



Network-centric business models for health, social care and wellbeing solutions in the internet of things

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ABSTRACT

In this multiple case study we analyze solutions based on connected devices in the context of health, social care and wellbeing. Based on the consideration that a solution is a combination of services and products, we build on the notion that business models can be studied at a firm-level and also at a network-level. The network-level analysis is used to motivate the reasons why solutions emerging at the intersection of the healthcare and the ICT industries benefit from collaboration among different actors. We conclude that the firm- and the network-level development of business models provide alignment in the business network and are useful to establish the relation that technological component have with overall solutions. Our findings suggest that some component bring novelty in the final offer without affecting the ongoing operation, while other component aim at improving the internal working processes, with minimal effects on the final offer to end users. We discuss the benefits of a network-level perspective for each case.

1. Introduction

In this paper we analyze solutions based on connected devices in the context of health, social care, and wellbeing. By connected devices, we refer to sensors and wearable devices connected to the Internet. These devices are a fundamental aspect of the emerging Internet of Things (IoT), which is sometimes referred to as the next revolution for the Information and Communication Technologies (ICT) (Porter & Heppelmann, 2014). Solutions based on the IoT generally include sensors that collect information which is sent and processed in cloud analysis engines. This information is then made available to different users and system.

Considering the IoT as an enabling set of technologies, they make possible the development of solutions that provide flexibility, scalability, and novelty for customers and end users. In the healthcare context, the IoT is perceived as a key enabler for a transition towards preventive care and wellbeing solutions (Free et al., 2013; Schraefel & Churchill, 2014); aimed at the automation of working processes, reducing healthcare expenditures, and enabling novel services for the self-management of health.

In practical terms, developing these services requires a combination of resources and competences from different fields (in particular, from healthcare sciences and ICT engineering). In other words, the value creation process is not limited to single firm boundaries; it is rather

considered that value is co-created among different actors that belong to a network (Nenonen & Storbacka, 2010; Vargo, Wieland, & Akaka, 2015). As Hakanen and Jaakkola (2012) conclude, the effective co-creation requires customers and suppliers to understand and align preferences, needs, and capabilities. This is particularly relevant when solutions are developed at the intersection of different industries, where technology innovation needs to be combined with new concepts and ways to interact among actors (Bouwman, De Vos, & Haaker, 2008).

The benefits of collaboration in business networks are a well investigated area. The topic finds a renewed interest in the development of solutions based on connected devices and the IoT, where there is a clear cross-industrial interest. It is uncommon for actors in the ICT domain to enter the healthcare market without a strong collaboration with actors that are already involved in the healthcare domain, and vice-versa.

However, Nikou and Bouwman (2017) argue that studies on healthcare solutions based on mobile technology have had a strong focus on the technological component on business models, and non-technical aspects such as value proposition, organizing, and revenue models have not received the attention required. We agree with this claim and further consider that many solution developments lack a clear value proposition at early development phases, and are usually guided only by technology possibilities. Moreover, research on business models has given attention to concepts and approaches in strategic

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management, but empirical–contextual–research is largely missing (Bouwman, Molina-Castillo, & de Reuver, 2016). This is particularly accentuated on the use of business models in the development of services and solutions within business networks (Palo & Tähtinen, 2013).

Therefore, the overarching question guiding this research is *How can a network-level perspective be used in business model design for solutions based on connected devices in health, social care and wellbeing?* We consider multiple case studies in the areas of social care and wellbeing in order to provide an answer. We discuss, based on empirical data, how the business opportunities are addressed from a network perspective in solutions based on the IoT. We consider the emerging topic of business model development from a network perspective. Business models from a network-level perspective cover the creation of a common value proposition when there is resource dependency among actors from different industrial sectors. The case studies are analyzed considering the network level aspects of the business models, with emphasis on the actors bringing a novel IoT component into existing services in social care and wellbeing. The main contribution of the paper is on empirical support for research on network level business model, which has been deemed a required work in this topic (Bankvall, Dubois, & Lind, 2016; Palo & Tähtinen, 2013).

Our findings suggest that the benefits of a business network perspective largely depend on how the technological components relate to existing services in the areas of social care and wellbeing. These technological components can either improve an existing service by automating internal working processes, or they can enable novel value propositions and convenience to end users. In general terms, the collaboration in the network can be used to improve the efficiency without an original intention to change the service offering, or it can be used to create additional value and differentiation in the service offering, without affecting the internal logic of the service delivery.

The remainder of this paper is organized as follows: in the next section, the theoretical background is presented, emphasizing the emerging notion of business models in networks. This is followed by a description of the research design method, including the selection of case studies, the data collection strategy and the data analysis process. Afterwards, the four case studies that build this research are presented in detail. This is followed by a cross-case comparison and analysis of the findings. In order to generalize our findings, we then compare our cases with other solutions available in the market. Finally, the conclusions and implications are presented in the last section.

2. Theoretical background

To study a business network perspective for digital technologies and connected devices, we consider that value emerges at the intersection of the resources and the capabilities from different actors (Jaakkola & Hakanen, 2013; Lusch & Vargo, 2006), including customers as co-creators of value (Lusch, Vargo, & O'Brien, 2007). Also, we consider that the effectiveness of companies depends on how they implement business models that can address evolving customer values (Carbone, 2009). The study of the value creation process from the perspective of a single actor provides limited understanding regarding the value creation for the customer, since solutions are an ongoing combination of activities and resources among diverse actors who integrate their resources (Jaakkola & Hakanen, 2013) and labor activities (Ehret & Wirtz, 2010).

Normann and Ramírez (1993) refer to value constellations, or value networks, as a model to emphasize the perspective on the overall system, with focus on the value creation. The concept of value networks has been applied to the study of product, service, innovation, and knowledge flow (Basole, 2009). A similar concept regarding a constellations of actors is business ecosystem, which is originally defined by Moore (1996) as “the network of buyers, suppliers and makers of related products or services”. This network is bounded within a socio-economic environment which includes the institutional and regulatory

frameworks. The business ecosystem perspective makes emphasis on the interconnectedness and the interdependence among economic agents (Anggraeni, Hartigh, & Zegveld, 2007), where individual activities share the fate of the whole (Moore, 2006). It has been commonly suggested that a business ecosystem is developed around a core, which corresponds to shared and common assets, such as platforms, technologies, processes, and standards (Iansiti & Levien, 2004a, 2004b; Mazhelis, Luoma, & Warma, 2012).

We can draw parallels between the business or value networks (Halinen & Törnroos, 2005) and the concept of business ecosystem. The business ecosystem can be conceptualized as a group of interdependent economic actors which simultaneously create and capture value by combining its resources; it aligns around one or more central firms or platform (Moore, 1996; Muegge, 2011, 2013; Valkokari, 2015). According to Heikkilä and Kuivaniemi (2012), the key difference between business ecosystems and business networks can be seen in the variety of actors involved. While business networks are regarded as firms collaborating to deliver value to a customer, business ecosystems usually include competitors, suppliers, potential collaborators, public institutions, and investing firms. Nevertheless, other scholars suggest that they can both be indeed the same object of study (Anggraeni et al., 2007). Provan, Fish, and Sydow (2007) consider that, generally, networks are bounded by organizations that have a clear and common purpose. Contrarily, Muegge (2011) propose that business ecosystems are intentional institutions where organizations self-identify as part of it. On a similar take, Vargo et al., (2015) present a service ecosystem perspective as systems of actors integrating dynamic resources with mutual value creation.

Whether taking the concept of value networks or business ecosystem, it becomes evident that not all critical challenges can be appreciated at a firm level, but rather on the ecosystem or network level (Leminen, Westerlund, Rajahonka, & Siuruaenen, 2012, Leminen, Rajahonka, & Westerlund, 2015). No single actor can stir an entire network (Håkansson & Snehota, 1989). We consider the Industrial Marketing and Purchasing (IMP) Group approach to study business relationships useful; because it sees everything as an interaction and emphasizes the associations among the resources, the activities, and the actors in a network. To this end, the Actors–Resources–Activities (ARA) model proposes that firms interact on three distinct layers: via actor bonds, resource ties, and activity links (Ford, Gadde, Håkansson, & Snehota, 2006; Håkansson & Snehota, 1995). The ARA model can be used as the underlying framework to represent the interaction across multiple organizational boundaries (Jaakkola & Hakanen, 2013).

In order to analyze how business opportunities are exploited by actors in a network, we consider the concept of business models. There are many definition of what a business model is, and it is commonly agreed that its objective is to exploit a business opportunity (Zott & Amit, 2010). Zott, Amit, and Massa (2011) have identified four views on the topic: (i) a unit of analysis, (ii) a holistic approach on how firms do business, (iii) a concept developed through firm's activities, and (iv) an explanation of value creation and capture. Zott and Amit (2010) discuss business models as *activity systems*, including what activities are performed, how they are linked, and who is performing them.

Chesbrough and Rosenbloom (2002) take on business models includes a value proposition and how a firm is organized and positioned to create a profit potential. For them, the objective of a business model is customer-focused value creation (Chesbrough, 2007). Osterwalder, Pigneur, & Tucci (2005) have a similar approach; their framework indicates that a business model should express the logic of a firm; describing the value a company offers to customers, the network of partners creating and delivering this value, and the logic generating profitable and sustainable revenues.

These approaches for business models include aspects such as the networks of actors and how the activities are distributed among them; they are focused on individual firms and only observe the network through that firm (Amit & Zott, 2001; Chesbrough & Rosenbloom,

2002; El Sawy & Pereira, 2013; Osterwalder & Pigneur, 2010). All business model definitions contain a set of dimensions or elements. As stated by Wirtz, Pistoia, Ullrich, and Göttel (2016), the views of business models have recently stated to converge; they present an integrated framework on business models based on the compilation of current research. The framework conveys 20 different components organized into 9 groups. One of these groups corresponds to the network model. This brings back the notion that, in order to develop new technological solutions, actors and roles are identified and organized in business networks. Service innovation requires an environment where multiple and diverse actors can collaborate with their particular resources and capabilities; this can only be accomplished if the business models are attractive and beneficial to all the actors involved (Bouwman et al., 2008). New business models are developed by actors in the network to define their value creation and appropriation (Palo, 2010).

An alteration in a business model will represent a change in a firm, in the firm's relationships, and ultimately, a change in other firms' business models (Clarke & Freytag, 2011); leading to changes in the value creation in the network of actors (Palo, 2010). Further on, a critical factor to establish strong collaborative business relationships is to have aligned business models that are complementary in terms of resources and capabilities (Bouwman et al., 2008; Chesbrough & Schwartz, 2007; Nenonen & Storbacka, 2010; Palo & Tähtinen, 2013). Orchestrating efficient business networking relationships enables firms to maintain a renewed technological superiority (Mattila, Yrjölä, & Lehtimäki, 2016).

Clarke and Freytag (2011) extend the perception of business models from a dominating intra-organizational perspective to an inter-organizational perspective between firms in the network of actors. Similarly, and drawing on network theory, Komulainen, Mainela, Sinisalo, Tähtinen, and Ulkuniemi (2006) advocate for a network perspective to present the concept of network business model. Based on Komulainen et al. (2006), Palo (2010) suggests that the three core elements of network business models are (i) the product or service, (ii) the business actors and their roles, and (iii) the value creating exchanges among the actors.

A network perspective on business models is an emerging theme to study the value creation between stakeholders, going beyond the boundaries of a single firm (Bankvall et al., 2016). Bankvall et al. (2016) depart from a network approach to propose that the analysis of business models relies on and evolves through interactions between actors in a network. They continue to propose that the analysis of network-embedded business models captures how the firms and their relationships compose the wider network in terms of the value creation and the business exchange patterns (Bankvall et al., 2016). In Table 1, we show the different perspectives on business models, initially presented by Bankvall et al. (2016).

A parallel interpretation can be found in the concept of ecosystem business models for the IoT (Leminen et al., 2012; Westerlund, Leminen, & Rajahonka, 2014), which suggests the value creation and exchange in the IoT requires active involvement from all the relevant stakeholders and a common understanding across the network of actors.

Table 1
Different focuses on business model: firm-centric and network-centric business models, considering firm level and network level analyses. Based on Bankvall et al. (2016).

	Firm level analysis	Network level analysis
Firm-centric business model	Value proposition and exploitation considering a focal firm	Firm's relationships with suppliers, customers and other external actors
Network-centric business model	The role and position of a specific firm within a network	Value network configuration to create and deliver a common value proposition

We argue that the concepts of “network business models” (Komulainen et al., 2006), “networked business models” (Palo, 2010; Palo & Tähtinen, 2013), “network-centric business models” (Bankvall et al., 2016), “network-embedded business models” (Bankvall et al., 2016), and “ecosystem business models” (Westerlund et al., 2014) reflect the same viewpoint of developing and aligning the value creation process from a networks perspective. In this study, we elaborate on the use of business models to evolve and strengthen collaboration in business networks in order to create valuable proposition for solutions based on connected devices and the IoT in the context of healthcare.

The concept of network business models is in line with our research aim, therefore, it is used to guide the analysis of the data collected from case studies, considering the firm-level aspects of specific actors in each case and complemented with the network-level view.

Palo and Tähtinen (2013) provide a framework for network-centric business model development; targeting technology-based services in emerging markets. The framework considers that the development starts with each actor entering a business network with their individual business models. This is followed by an opportunity recognition, which leads to a collective understanding exploitation based on a network-centric business model. The framework includes three elements; i) Business net development with actors and their roles in the network, ii) Business opportunity identification and, iii) Networked business model development. Further on, the framework considers a time dimension that begins with the service development, moving to a pilot phase and ending in a market phase (Palo & Tähtinen, 2013, Fig. 3). The focus of this work is on present pilot and future market phases of services.

We follow the proposition by (Palo & Tähtinen, 2013), suggesting that a network-level business model is a collective business model which “guides how a net of companies will create customer and network value by developing collective understanding of the business opportunities and shaping the actions to exploit them.”

3. Research design and method

3.1. Selection of case studies

We define a multiple-case design research as a strategy. This approach provides comprehensive descriptions to generate or test a theory. Case study research is “appropriate in the early stages of research on a topic” (Eisenhardt, 1989) which corresponds to a contemporary phenomenon (Kohn, 1997; Yin, 2009), such as the development of services based on the IoT.

Each case study is about a solution provided by a network of actors. For each case the aspect to be analyzed are business models. This is done on the network- and firm- levels. On the network level, we focus on the complete solution. On the firm level, we focus on one actor for each case to present how are they related to the network and how do they contribute to the value proposition.

Considering that only a limited number of cases can be effectively studied, we screen cases and select four considering different areas of social care, wellbeing and corporate care. We also consider if the solutions are provided in the private and the public sector, if the use of technology is aimed at internal efficiency or improved value proposition, and cases with different levels of maturity in the market.

We gained initial access to the companies involved in each case through common research projects. The cases—presented as *Alpha*, *Beta*, *Gamma*, and *Delta*—were selected based on purposive theoretical sampling (Glaser & Strauss, 1967). We focus on ventures, or solutions, that combine the contribution from several aligned actors. Each case represents a network of several companies that co-create value.

3.2. Data collection

To explore the network perspective on business models, we rely on purposive theoretical sampling to systematically collect data as part of

the analysis process (Glaser & Strauss, 1967). The preliminary knowledge in the area is determined from an initial set of experts sampling. Afterwards, the sampling is expanded based on a preliminary assessment. In other words, an initial round of primary data collection was executed with limited informants before refining the research aim. We use a combination of primary and secondary data to support the triangulation between multiple sources and provide stronger support for the findings (Eisenhardt, 1989). The complete sources of primary and secondary data include:

- Semi-structured interviews that are centered in themes related to service development, challenges for innovation in healthcare, collaboration efforts, and customer relationships.
- Research projects that included focus groups on challenges for innovation in healthcare, business models, and collaboration in solutions based on the IoT.
- Attendance to industry conferences focused on health, social care, and welfare technologies.
- Literature and discourse review on ICT services for health and social care, including online fora, experts' blogs, open reports, and open interview transcripts. Web information regarding each case study is used as complementary data. The web-sites for all the companies involved in each case were visited to collect information on their scope and offerings.

Interviewees and attendees to seminars were selected based on their role in their company regarding solution and service development and inter-organizational collaboration. The informants have positions such as CTOs, CEOs, business development managers, and experts in health and social care solutions based on the IoT.

The sources of primary data for each case are listed in Table 2. All the sources are used to elaborate the description of each case study. Sources referred to as discussion in conferences correspond to unstructured interviews initiated on conferences for practitioners in innovation for home and social care. The visit to installation corresponds to a guided tour with experts to display the results of a publicly-funded installation of one solution. The student project refers to a thesis developed in collaboration between the research group and one company involved in case *Beta*, with a clear objective to analyze business model alternatives.

In addition, primary data from industry experts is used to support the analysis and discussion; these sources are presented in Table 3. The data collected from these sources is not directly linked to the case studies, but come from experts in the field and support the findings related to innovation in health, social care and wellbeing based on IoT.

3.3. Data analysis

The objective of the data analysis is to find how the business opportunities are addressed from a network perspective in solutions based on the IoT. The analysis starts with observations leading to a preliminary data organization and analysis (Hsieh & Shannon, 2005). The preliminary analysis points at three aspects: there are different innovation perspectives in healthcare, there are distinctive contexts within healthcare for the services, and there are strong suggestions of business model development in networks. A second-stage analysis was directed from the theoretical foundations (Hsieh & Shannon, 2005). We begin the data analysis by presenting each case study.

A fundamental aspect to represent for each case is the business relationships. Interfirm relationships include alliances, partnerships, joint ventures, consortia, collaborations, and supply and marketing agreements (Basole, 2009). Our focus is on the resource dependency as the reason to establish interfirm relationships, considering that firms are constrained in terms of technology, politics or knowledge. This is predominantly the case for providing complex solutions; they depend on complementary resources from other actors (Basole, 2009; Vargo et al.,

2015).

We rely on business model concepts to explain the logics of value creation. The IMP approach provides conceptual and methodological tools to describe and explain business models as a network phenomenon, and “*case studies illuminating interaction among parties involved in emerging network-embedded business models are needed*” (Bankvall et al., 2016).

In the analysis we follow the framework for network-centric business model development proposed by Palo and Tähtinen (2013), explicitly targeting technology-based services in emerging markets. The framework considers that the development starts with each actor entering a business network with their individual business models. This is followed by a business opportunity recognition, which leads to a collective understanding exploitation based on a network-centric business model. We consider entrepreneurial activities which are expected from any actor steering the development and taking care of “*identifying the business opportunities to be exploited, and facilitating the development of the networked business model*” (Palo & Tähtinen, 2013).

We organize the description of each case in two tiers. First, we explain the overall service provided by the network, and then we make emphasis on the actor bringing the novel IoT aspect into the service. We refer to this actor as the *actor under study*, which can provide alternate service descriptions based on its core competences. Based on the actor under study, the description of the network is then expanded to cover other relevant actors, following the representation shown in Fig. 1. Each actor is represented on a block; the main role of the actor appears on italics at the top, the set of activities right below the name. The block in blue color represents the actor under study.

For the network-centric business model, we follow the elements introduced by Palo and Tähtinen (2013) in the following manner:

- 1) Business net development: this element corresponds to the actors and their roles in the network. In this paper, we describe the actors and roles that are present in each case.
- 2) Business opportunity identification: this element corresponds to the development of the business opportunity, which can be explained through the value proposition of the solution provided by the network of actors.
- 3) Networked business model: this is the core element to be presented for each case study and discussed in the analysis section, in the paper we present this element as the interaction between the actors involved. We highlight alternative business models, including how actors interact, for the actor under study.

The analysis considers how each actor contributes to the overall solution; making a distinction between services and products that are peripheral or core components of the overall solutions. Propriis (2002) presents innovation as four different types: product, process, incremental and radical innovation. Product innovation corresponds to new and improved product, process innovation is related to new and improved process, incremental innovation corresponds to improved product and process; finally, radical innovation related to new product and process. From these categories, the scope of this paper is limited to product and process types of innovations. This is in line with two of the perspectives suggested by Herzlinger (2006)¹ for innovation in healthcare:

- *Consumer facing perspective*: innovation which focuses on the interaction with the users. Value is generated by providing novelty and convenience. The aim is to improve the quality, by focusing on care

¹ Herzlinger (2006) presents a third innovation perspective for technology-based ventures. This refers to medical technology innovation, such as treatments, drugs, or methods for diagnose. We consider this type of innovation to be outside of the current scope of solutions based on the IoT and connected devices as it represents radical innovation—following the categorization by Propriis (2002).

Table 2
Collection of the primary data sources for each case study.

Case	Description	Occurrences (Informants)	Year	Type of data
<i>Gamma</i>	Research project meeting	3 (3)	2014–2015	Collaboration for IoT services
	Interviews	2 (2)	2014–2015	Collaboration and business opportunities
	Solution presentation	1 (2)	2016	Presentation of the tech component
	Dedicated interviews	1 (2)	2016	Business models
<i>Alpha</i>	Discussion in conference	1 (2)	2013	Presentation of the tech component
	Study visit to installation	1 (1)	2013	Description of the benefits to users
	Discussion in project	1 (1)	2016	Collaboration and business opportunities
	Participation in workshop	1 (1)	2016	Collaboration for IoT services
	Dedicated interview	1 (1)	2016	Business models
<i>Beta</i>	Research project meeting	3 (3)	2014–2015	Presentation of the tech component
	Dedicated interviews	5 (4)	2014–2016	Collaboration and business opportunities
	Student project	1 (2)	2015	Analysis of suitable business models
	Participation in workshop	2 (1)	2016	Collaboration for IoT services
<i>Delta</i>	Discussion in conference	1 (1)	2013	Collaboration and business opportunities
	Dedicated interview	2 (1)	2010, 2015	Business models
	Solution presentation	1 (1)	2016	Presentation of the tech component

Table 3
Collection of additional data sources from industry experts, divided into dedicated interviews and organized seminar.

Format	Type of actor	Profile	Topic (Year)
Interviews	Mobile network operator	Global business manager	Operator entry to IoT (2013)
	Municipality	Broadband strategist	City network (2013)
	Managed IoT services	CMO	IoT verticals (2015)
	Managed operation	Product manager	Control over data (2015)
	Clinic	Senior cardiologist	Private/public use of IoT (2015)
	Research institution	Senior researcher	Needs and barriers (2015)
	Digital health accelerator	Head of strategy	Business strategies (2016)
Organized seminars and focused meetings	Mobile network operator	Business dev. managers	Position in IoT (2013–2015)
	Device manufacturer	Research director	Wearables' connectivity (2015)
	Research institution	Management researchers	Business ecosystems (2016)
	Research institution	Project manager	ICT healthcare in Sweden (2016)
	City administration	Project manager	Innovation in healthcare (2016)
	Mobile network operator	Business dev. executive	Position for healthcare (2016)
	Employer's association	Technology expert	Public policy relation to private companies (2016)



Fig. 1. Actors and activities representation, highlighting one illustrative actor for each case discussion.

self-management or workflow.

- **Integration perspective:** innovation which focuses on consistent service delivery. Value is created by improving the resources and staff efficiency. The aim is to scale services while lowering the cost of care.

In summary, the cases are analyzed considering network level aspects of the business models, with emphasis on business opportunities for actors bringing a novel IoT approach into health care, social care and wellbeing services. The data is clustered in themes, as suggested by Saldana (2009). For the overall cases, we present four themes: the context of the solutions, the motivation to develop the solutions, the type of customer, and position of the key involved actors. In addition, we present four themes for the actors under study: the departing point for innovation, the level maturity in the market, the innovation perspective, and the relation to the overall solutions (peripheral or core service component). First, each case is described and initial findings for individual cases are presented, followed by a cross-case synthesis (Kohlbacher, 2006; Yin, 2009).

4. Presentation of the case studies

In this section, we present four case studies illustrating the use of connected devices in social care and wellbeing. Following (Palo & Tähtinen, 2013), We divide each case description into three parts; first, a general service description, next the network-centric business model and finally a summary. The network-centric business model includes the following elements; actors and roles, the identification of business opportunities, and alternative business models together with how actors interact. For the actors under study, we describe alternative business to in order to explain in which setups they see a benefit in a business network perspective. The sections on initial findings serve as the basis for the cross-case comparison.

4.1. *Gamma: wearable technology as a digital coach*

4.1.1. *Component provided by the actor under study*

The actor under study in this case employs a chest-belt with movement detection sensors which gather data that is processed in a cloud-based analysis engine. The chest-belt is equipped with wireless communications in order to transmit the data to the user's smartphone, where the aggregated data is processed. Immediate feedback is provided as audio signals during training and the analyzed data can be visualized over a smartphone app. In addition, peer-to-peer channels can be enabled between the users and coaches for personalized suggestions and encouragement. Nowadays, the system is offered directly to end consumers, based on monthly fees that provide access to the analytics.

4.1.2. Network-centric business model

4.1.2.1. Actors and roles. The driving actor in this case is the movement analytics provider, which corresponds to the actor under study. The solution is beneficial for the race organizer in order to provide novelty to their offering, for this reason, it also has a partnership with a workout tracker application, in addition to test and health analysis centers around the country. For the actor under study, it is fundamental to be involved in strong collaboration with sports organizations that handle the target user base. This collaboration provides access to customers with minimal marketing efforts, based on a trusted and pre-existing relationship. The race organizer can use the partnership to differentiate its offer. Interestingly, the analytics component provides the possibility to include expert coaches in sport and wellness activities, opening an additional revenue stream from individual coaching sessions.

4.1.2.2. Business opportunity. The context of this case is elite sports and training activities. By means of a wearable device, it is possible to provide feedback on measurements regarding the quantity, the quality, and the correctness of movements. The users can get individual feedback in order to adjust their training effort, enhance their technique, and decrease the risk of injuries. For a sports association, which in this case is a race organizer, it provides added as value innovative solutions used to differentiate their offers. This race organizer is in charge of several competitions and creates partnerships to provide additional services to participants with activities throughout the year.

4.1.2.3. Alternative business models for the actor under study. The actor under study has considered alternative ways to reach users. For all the alternatives, the revenues are expected to come from recurrent fees on analytic services. In the *Gamma* case study, which targets participants on a cross-country ski race, the actor under study provides precise feedback and training insights for this event, and it is advertised as a certified digital coach for the competition as part of the partnership with the race organizer, this is an existing alternative and it is shown in Fig. 2(a). Another alternative for the actor under study which is currently used is a stand-alone service, currently targeting cross-country skiers, as presented in Fig. 2(b). It is worth mentioning that the same movement analysis engine has been applied to other customer segments as research and pilot projects, such as ice hockey players, independent elders that want to stay active, people exercising in gyms that want to enhance their training activity, and sedentary adults that struggle to engage in sports activities. The latter has been addressed as a pilot project with a gym, where users are reached and handled by the gym and the wearable device is provided as part of an initial training

program to increase motivation and engagement; this alternative is shown in Fig. 2(c) and it corresponds to an alternative design that was part of a collaborative research project and was not continued after the project ending.

4.1.3. Highlights from case gamma

The context of this case is private sports and training activities. The motivation is to improve performance and avoid possible injuries with direct digital assistance. The actor organizing the business network is the race organizer, and both the race organizer and the actor under study have direct relationships with the end users. There is a clear consumer facing approach from the actor under study. The solution can be considered as an added component for participants, however, it is provided as a stand-alone service. In addition, the actor under study started as a technology development idea that tested different customer segments and currently exploits the cross-country ski market.

4.2. Alpha: service platform in assisted living at homes

4.2.1. Component provided by the actor under study

The actor under study in this case is a platform development company which has developed a system for remote home monitoring that can provide automatic reminders, alarms, and support. The system gives the possibility to have predefined control setting. For example, a sleep-time setting that can inform about unlocked doors and windows, or if the stove or the lights are on. Relatives and home care provider can configure settings according to the specific needs over a web or mobile interface. The information from the system can be delivered via text messages, web interfaces, pre-recorded audio messages, or self-selected images. Nowadays, the system is installed in several homes, hospitals, and sheltered homes, with positive effects for the end-users. This solution is mature and has been available in the market for over ten years.

4.2.2. Network-centric business model

4.2.2.1. Actors and roles. The driving actor in this case is the public social care provider, which adopts an ICT-based solution to improve the service offering while lowering the operational costs. A housing company owns and manages the assisted living properties and sees this solution as a differentiating factor. The actor under study provides a gateway device that collects information from sensors inside the home and it is connected to an external network, such as the Internet. The devices to be installed in the home can be provided from different vendors, combining wired and wireless sensors.

It is important to mention that the set of activities done by each actor depends on specific agreements and installations. Nevertheless,

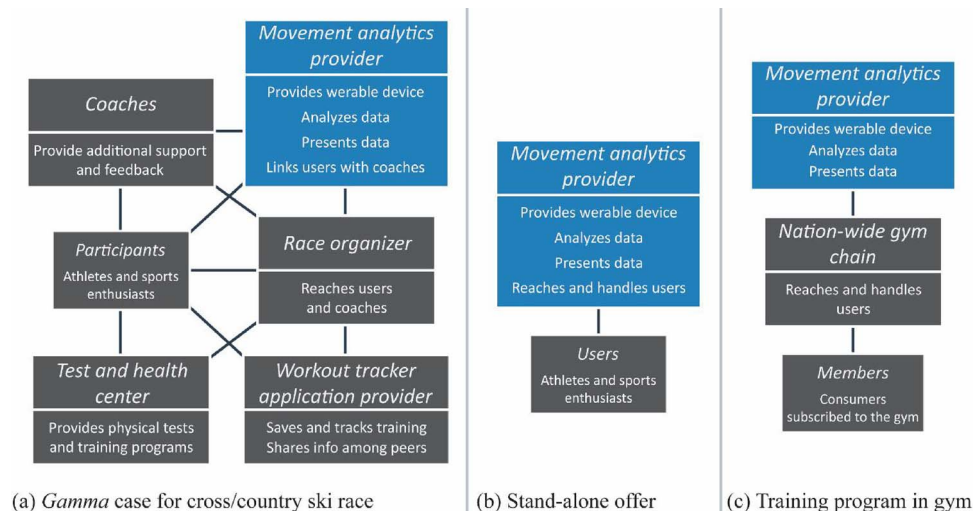


Fig. 2. Gamma case: illustrating three alternative business models for the movement analytics company.

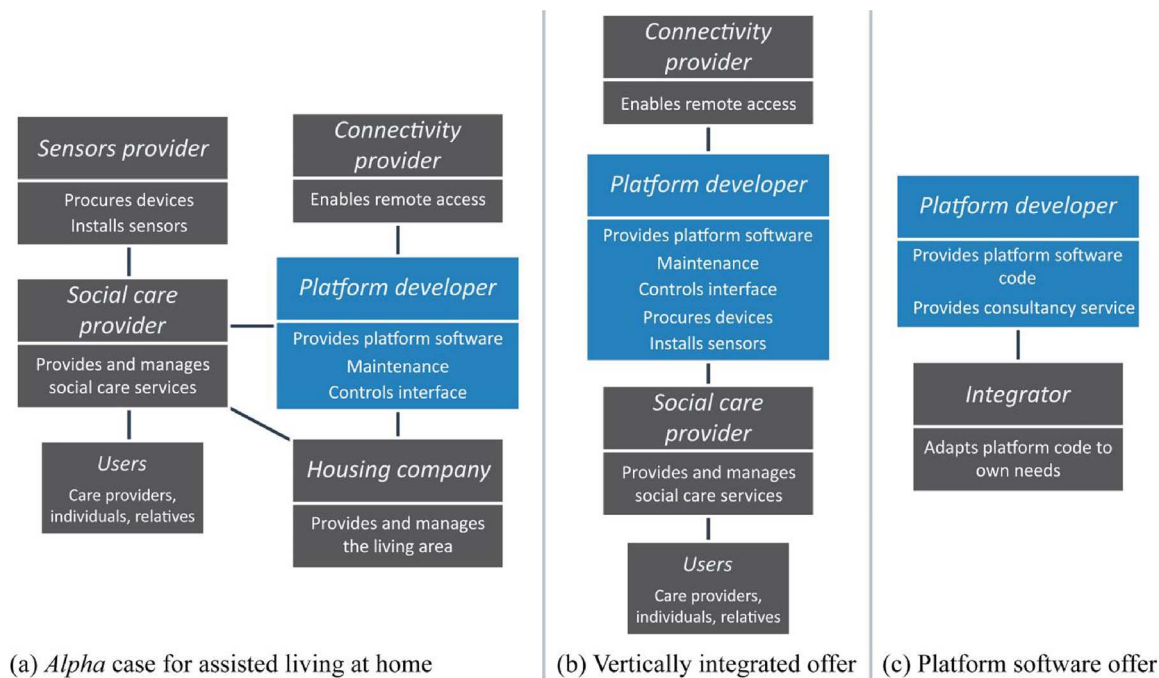


Fig. 3. Alpha case: illustrating three alternative business models for the platform development company.

for the social care provider, the business network is beneficial in order to improve the working processes without developing new products or competences internally. For the actor under study, the value is the possibility of being part of the solutions, while focusing on the platform component.

4.2.2.2. Business opportunity. The context of this case is public social care services. By deploying and connecting sensors in living areas, where individuals require constant monitoring, it is possible to provide support while giving more independence to the individuals in the comfort of their homes. For local authorities in charge of social care services, the solution improves their resource utilization and lowers the overall cost, while adding new functionalities and the possibility to react faster when needed, based on event alarms.

4.2.2.3. Alternative business models for the actor under study. There are three different alternative business models which are currently exploited by the platform development company—the actor under study; as shown in Fig. 3. The first alternative represents the *Alpha* case for assisted living at the home; the software, maintenance, and update activities done by the actor under study allows them to focus in their core asset—the device management platform—while being part of the overall solution delivery. We show the interdependence among actors of this alternative in Fig. 3(a), this setup has been devised based on direct discussion and collaboration with social care providers and housing companies. Another alternative consists on a vertically integrated offer, where the actor under study takes care of additional activities, such as the procurement and installation of the sensors. This is done in exceptional situations, and it is described as unattractive since it requires a strong salesforce and customer support activities; this alternative has allowed additional deployments for the actor under study, since it covers an additional request from social care providers who do not wish to engage on additional business relationships with suppliers. Therefore, this alternative is mainly used to explore possible future markets in trials and pilot projects; this is shown in Fig. 3(b). A third alternative is in a “seller-buyer” setting, where the platform developer obtains direct revenues from the source code of the platform software and consultancy services given to integrators that adapt their software to different markets. This alternative requires minimal

workforce, but it distances the actor under study from closer interaction with the users that could help in order to improve its core asset, it is not developed or exploited from a network-centric perspective by the actor under study. This alternative is shown in Fig. 3(c).

4.2.3. Highlights from case alpha

The context of this case is public social care services, motivated and driven by efficiency in terms of time management for the staff. The social care provider is the actor that has direct relationships with the end users; the business network is organized around the social care provider. The actor under study has an integrator perspective and is a key service enabler, providing an essential component to handle sensors and manage event logics from the data. The platform can be used in different settings, such as home automation, home care, security, etc.; however, it is worth noting that it is not a stand-alone component, since its benefits are only evident when several sensors are integrated. The actor under study started with a technology development idea that gradually adapted to the market needs.

4.3. Beta: stress management in corporate care

4.3.1. Component provided by the actor under study

The actor under study in this case has developed a data analysis engine that provides contextual and objective information regarding the time, the activity, and the location associated with stress level fluctuations. The input is collected from wearable wristband devices, which can be a dedicated hardware or third-party wearable devices featuring a galvanic skin response sensor to measure the skin resistance and thereby the stress level. The users can pair the device to a smartphone, a tablet, or a personal computer in order to visualize the analyzed data. Due to privacy considerations, the data from the users is anonymized and aggregated before it is presented to employers or insurance companies. This solution has been recently introduced in the market, with agreements in place and expected to be in operation within a year from this writing.

4.3.2. Network-centric business model

4.3.2.1. Actors and roles. The driving actor in this case is the corporate

care provider that wants to improve their bundled care offers for corporate customers. It is beneficial for corporate insurance providers and employers who want to provide solutions that can help employees with their stress self-managing and monitoring. The actor under study is working on a partner agreement with a trusted corporate care provider; as part of the agreement, the wearable devices are leased during the contract period. For the corporate care provider, the partnership is beneficial to provide added value with innovative solutions without the need to develop new internal competences. For the actor under study, the partnership is beneficial in order to reach customers through a trusted corporate care provider.

4.3.2.2. Business opportunity. The context of this case is corporate care and wellbeing. The idea of the solution is to provide wellness service bundles to medium and large corporations. These bundles have the objective of encouraging wellness activities for employees, considering that the mental and social working environment is as important as the physical environment. For the medium and large corporations, the solution is valuable to prevent possible downtimes caused by excessive or continued stress levels.

4.3.2.3. Alternative business models for the actor under study. The actor under study could potentially market and handle their component as a stand-alone service—in a seller-buyer setting. However, it is an alternative that has been discarded by the actor under study since it would require a strong salesforce and it would incur into competition with established brands offering wellness wearable devices. There are two alternative business models under consideration by the actor under study. The first corresponds to the *Beta* case for stress management in corporate care, which has been design as part of a collaborative project. Similar to the *Alpha* case, it can be seen that each actor can focus on its core competences. For instance, the actor under study can focus on delivering and improving the data analysis and representation, while accessing a large customer base. Similarly, the corporate care provider can provide an innovative added value as part of their wellness bundles. The interdependence is shown in terms of the activities performed by the key actors involved in Fig. 4(a). In an alternative scenario, the actor under study provides the wearable devices as a support tool during annual medical checkups performed by occupational care providers, this is presented in Fig. 4(b). This setting has been tested in a trial service to explore the user engagement and benefits for occupational care providers. Interestingly, the final customer is the same type of customer in both alternatives, but it is reached from a different perspective.

4.3.3. Highlights from case beta

The context of this case is private corporate care service bundles,

motivated by a user focus to help reducing work-related stress issues; and avoid employee downtimes due to fatigue or stress. The business network is organized around the corporate care provider, which has the direct relationship with the medium and large companies that correspond to the customers of the service; they enable the interaction with the final users. The actor under study is positioned as a consumer facing solution. The actor under study provides an added component that is integrated into a corporate package. The solution is not marketed directly to consumers. Contrarily, it builds on top of already existing business relationships. In addition, the actor under study started from a technology development idea that is gradually adapting to the market conditions, since it was originally designed as a tool for early detection of stress-related medical disorders.

4.4. Delta: integrated planning, resource management and reporting in home care

4.4.1. Component provided by the actor under study

The actor under study in this case has developed a digital key system, which is based on hardware units that are installed in door knobs, a mobile phone application, and the server software. The door units can be mounted into existing door locks and the access is tailored for each individual home to ensure security. The digital key is downloaded to the required mobile phone and the system registers the time and events related to the door activity, this adds the additional benefit of providing an immediate guarantee to relatives that the agreed service is being provided. The solution simplifies the existing key management issue in home care, which involves administration of keys, and traveling times to collect individual keys for each home (for security reasons, the staff can only carry one key at the time). In addition, using the mobile phones allows better coordination on dynamic schedules and agendas. Nowadays, this solution has been extensively adopted by several local authorities. This solution is mature and has been available in the market for over ten years, with a more recent expansion to international markets.

4.4.2. Network-centric business model

4.4.2.1. Actors and roles. The driving factor in this case was a combined interest from a local authority to solve the issue of key management and the capacity of the actor under study to develop the required hardware and software for the digital key system. In addition, a system integrator provides effective solutions for home care staff to make reports and read relevant information from the central business system. The scheduling solution maximizes resource utilization in staff planning and scheduling for the home care provider.

4.4.2.2. Business opportunity. The context of this case is public home

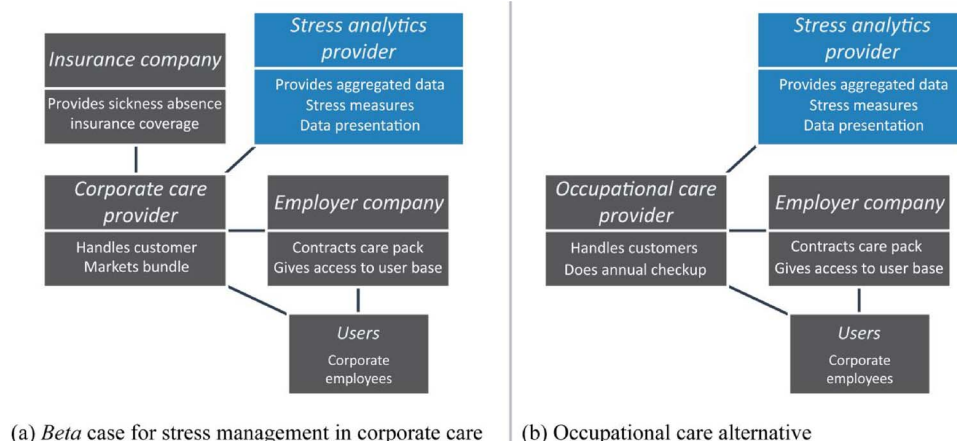


Fig. 4. Beta case: illustrating two alternative business models for the stress analytics provider.

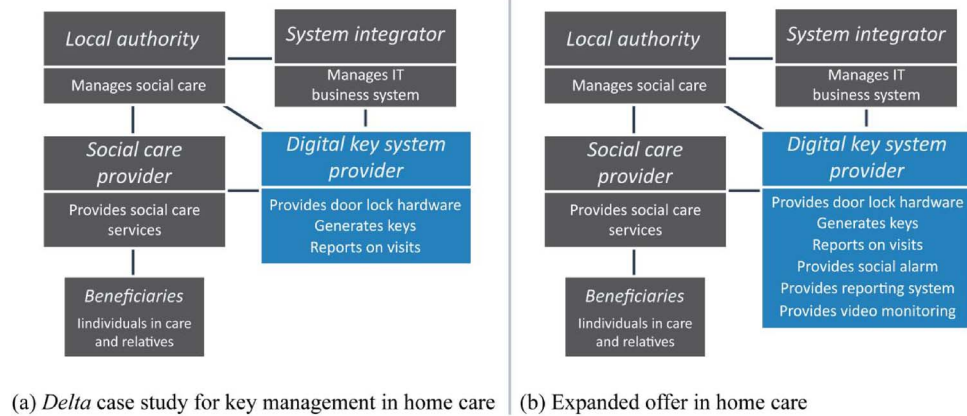


Fig. 5. Delta case: illustrating two alternative business models for the digital key system provider.

care services. The idea is to improve the resources used in home care by means of digital technologies. The solution includes functions such as digital key management, time planning and management, task reporting, and documentation based on homecare visits. With support of effective planning solutions for staff scheduling, more focus can be given to the essential activities of nursing and patient care.

4.4.2.3. Alternative business models for the actor under study. Two business alternatives are presented for the actor under study, which does not have a fixed pricing model, since it is adapted to the requirements of each local government. The first alternative corresponds to the *Delta* case study, which was initiated as a public-private project between a local government and the digital key system provider to find a solution to the existing issue of key management; the interdependence among actors in shown in Fig. 5(a). The second alternative represents a comprehensive set of modules that the actor under study has developed or acquired as part of an expansion strategy to build new capabilities on top of the system in place for the digital lock system. The actor presents this set of components as a platform to give home care providers a holistic view of their operation and simplify the management tasks. The set of components includes social alarms that are used in case of falls or need of urgent assistance, a digital reporting tool to provide detailed documentation during home care visits, and a video monitoring system for individual that need continuous supervision. As shown Fig. 5(b), the set of components represent additional activities carried out by the actor under study.

4.4.3. Highlights from case delta

The context of this case is public home care services. The motivation is to improve the workflow and time dedication for the home care staff by means of digital keys and planning tools. The business network is organized around the local authority for social care. The staff and receivers of social care are both users under the social care provider. There is a clear integration perspective from the actor under study. The actor under study started by providing a component to the local authority business system to simplify the key management tasks, but it has expanded the offer to additional services, gradually becoming a key actor for home care services. In addition, the actor under study has developed a new solution based on an existing need expressed by the local authority. This solution-oriented approach has been an important driver for success.

5. Analysis and cross-case comparison

In this section, we provide a cross-case comparison and analysis starting with Table 4, where we separate the main findings for each case. We further divide the findings associated with the general solution from those associated to the actors under study. The idea behind this

Table 4
Cross-comparison of the case studies.

		<i>Gamma</i>	<i>Alpha</i>	<i>Beta</i>	<i>Delta</i>
For the overall solution described in the case					
Context where the solution is provided	Social care		✓		✓
Motivation to use devices in the solution	Wellbeing and sports	✓		✓	
	Efficiency in management		✓		✓
	Improve user experience	✓	✓	✓	
Customer type	Business		✓	✓	✓
	Consumers	✓	✓		
Who interact with the devices?	Service providers (incl. staff)				✓
	Service beneficiaries (incl. relatives)	✓	✓	✓	
Who uses the data generated by devices?	Service providers (incl. staff)		✓	✓	✓
	Service beneficiaries (incl. relatives)	✓	✓	✓	✓
For the actor under study in each case					
Innovation perspective	Integrator		✓		✓
	Consumer-facing	✓		✓	
Relation of its component to the overall solution	Core component (Changes the logic of a service)		✓		✓
	Additional component (Improves a service offering)	✓		✓	
Departure point of the development	Technology development	✓	✓	✓	
	Handle existing need		✓		✓
Level of maturity in the market	Recently available	✓		✓	
	Mature solution		✓		✓
Network used to change a service working processes, not the offering			✓		✓
Network used to change an offering, not the working processes		✓		✓	

separation is to build the arguments on the benefits that a network perspective can provide to certain actors, depending on how their component is related to the overall solution described in each case. The aspects are grouped and analyzed in the following four subsections.

5.1. Business opportunities and business networks

The business opportunities can be grouped according to the context where the solution is provided and the motivation to use devices in the solution Table 4. The general context for all the case studies is within care and wellness. However, a closer analysis evidences slightly different setup for the cases. *Alpha* and *Delta* are in the area of public social

care, while *Beta* and *Gamma* are in the private sector, targeting well-being and sports activities.

Both cases taking place in the social care context have a strong motivation on efficiency regarding time planning, resource management, and staff working processes. The objective is to automate or simplify daily routine activities, such as key management, route planning, reporting, etc.; once this is achieved, social care staff can provide more dedicated care to the service receivers. Apart from the efficiency aspects, the *Alpha* case has a motivation to give more independence to individuals in the comfort of their homes and, moreover, in both cases it is suggested that event reporting and online access to status provides a clear benefit to the relatives of the social care receivers.

Contrarily, *Beta* and *Gamma* have a strong motivation to improve the way individuals can access and manage information and activities related to their own wellbeing, using smart devices to increase self-awareness and receive individual and direct feedback. Both cases present little motivations on the efficiency side, besides general aspects related to internal scalability of the service.

It is not trivial to define the customer for complex health services provided by a network of actors (Bunar, Stroetmann, Whitehouse, & Wong, 2016), and each case study in this work presents different considerations for it. Taking the cases related to social care, the customer of the service are the individuals receiving care, which have a primary relationship with the corresponding social care service provider.

However, it is also possible to suggest that the social care service providers are a business type of customers that receive technology services to improve their efficiency. This consideration will ultimately depend on the level of analysis. On a network-level, the final customers of the network are the individuals. On a firm-level, the customer of the digital components corresponds to the social care service providers. Perhaps the only case suggesting a clear business customer type is *Beta*, where the customer corresponds to companies that want to give corporate care packages to their employees. Contrarily, in *Gamma* the customer type clearly refers to individual consumers that purchase the digital coach service.

This brings another finding, which is the fact that the users of the devices and the data are not necessary the same. For *Alpha*, the individuals living at the home are the only ones which directly interact with the connected devices, while the care providers and relatives mainly interact with the configuration and the data generated–reported–from those devices. For the *Delta* case, only the social care staff interacts with the digital lock, but the reporting information is used by the relatives and the home care service provider as well. The only case where the devices and the data are only used by individuals is in *Gamma*, which is also the only case where the service is directly offered to end customers.

5.2. Network-level business models

We emphasize that it is possible to make a clear distinction between two innovation perspectives on a firm-level, one focusing on scaling the delivery of the service and another focusing on supporting individuals. They correspond to the integrator and the consumer-facing perspectives introduced by Herzlinger (2006). These innovation perspectives reflect the main objective of our actors under study as part of the network-level business model. One careful consideration is the fact that the innovation perspective does not limit the scope of the benefits that a service based on connected device can bring. Using *Alpha* as an example, we can see how the innovation for the actor under study was directed at improving the efficiency of the social care provider, but this does not

limit the benefits for the individuals that can have better life and more independence at their homes, as presented in Fig. 7. A key finding in this area is the fact that developments driven by a pursuit to improve efficiency will always showcase a strong central presence of an integrator in the network.

Considering the consumer-facing perspective, it would be intuitive to assume that this type of solutions will always be marketed directly to consumers by the technology provider, which corresponds to the scenario described for case *Gamma*. However, this is not the situation in *Beta*, where the stress management solution is developed with a consumer-facing perspective but channeled through the relationship between corporate care providers and companies with a large employee base.

Another interesting comparison can be done between the innovation perspective of the actors under study and the way their component is integrated into the overall solutions described in the case studies. We argue that consumer-facing innovations tend to relate to overall solutions as a small, or add-on, component. In other words, they provide additional value by creating a differentiation in the final offer, but these components are not intrinsic requirements for the overall solution to operate. For example, in case *Beta* the stress analytics device provides accurate feedback to the users, but the corporate wellness package can still be provided without this component.

Contrarily, when a component comes from an integrator perspective, it becomes a central part of the solution, even if it is not evident to the end customer of the service. These components effectively change the working process and the way a service provider operates. Without these components, the solution cannot properly operate. The actor under study for *Delta*—the digital lock system provider—started at the periphery as an added component that matured into a solution that changed reporting and time-planning activities. This actor is doing new acquisitions of components which are added initially as peripheral components. A similar situation can be appreciated in *Alpha*, where the actor under study initially had the main proposition to give more independence to individuals with support of connected device. But as part of the development, the solution matured into a core component to change the working process for the social care provider.

The actors under study on *Beta* and *Gamma* provide peripheral components. It could be argued that it is due to fact that these components are part of wellbeing solutions that do not change any core service, but this is a strong generalization that needs further support. However, we infer that it is related to the fact that the components have been recently introduced to the market, and perhaps they could become core components of solutions if they manage to change the logic of the service provision.

Palo and Tähtinen (2013) suggest that the business development begins with an exploration of possible, yet uncertain, opportunities based on new technology. This argument is largely aligned with our findings, where most of the actors under study mentioned that their early exploration was part of a research project on the development of new technology components.

However, the actors that have mature product and services in the market make more emphasis on the fact that they started the development based on clearly identified needs after discussions with service providers. This aspect is particularly emphasized in the *Delta* case, where the idea of a digital lock system was designed as part of a public-private project with a local government. This factor has positively influence the rapid development and expansion of the actor under study.

In Fig. 6, a comparative framework groups the alternative business models described on each case study. The four-field framework



Fig. 6. Comparative framework for the alternative business models for the actors under study.

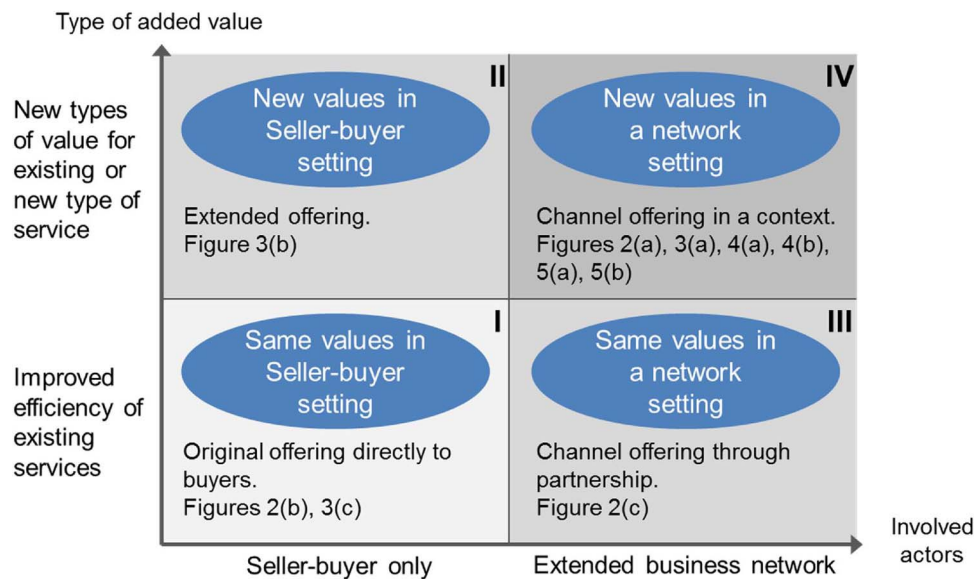


Fig. 7. Innovation perspectives at different stages for the public social care services. It can be argued that technical solution providers work as integrators, while the social care providers have a consumer-facing perspective.

highlights the differences between the buyer-seller setting and the business networks settings. We consider that all business networks evolve from a “buyer-seller only” setting as presented in quadrant I in Fig. 6. It is relevant to note that for cases *Beta* and *Gamma* there is no alternative business model allocated to quadrant I; the reason being that this alternative was not discussed in detail during the collection of primary data, since for these two cases the actors under study indicated that this setup was not be commercially viable for them, therefore, they decided on early development phases to focus on collaborations with partners. In any case, our suggestion is that the development of the network takes a departing point on quadrant I.

On quadrant II we consider the alternative business models where the original offering is complement by additional activities to cover an existing need on the customer side, this is achieved without engaging on collaborative activities with other actors. On quadrant III, the original offering is maintained (compared to quadrant I), how channeled via partnerships in order to leverage on existing customer relationships, in other words, the business network is used as distribution channel. Finally, quadrant IV groups the alternative business models where there is a clear aggregation of complementary competences from participating actors.

6. Discussion and comparison with other cases

We departed the research presented in this paper with the question *how is a network-level perspective on business model design useful for innovation based on connected devices in health, social care and wellbeing?* In order to provide an answer, we first consider the benefits of taking a network perspective for the analysis. Our findings suggest that the benefits of the network perspective for the case studies are largely based on the resource dependency aspects (Basole, 2009; Jaakkola & Hakanen, 2013; Lusch & Vargo, 2006).

A closer analysis of each case offers a complementary view of this motivation. In *Alpha*, the actor under study states that even if they target a growing societal issue, it still corresponds to an immature market with “no real volume”. Therefore, their internal operation, activities, and know-how are kept focused on the software development and maintenance. In the *Beta* case, the actor under study has a long-term vision to enter the heavily regulated healthcare market; for this reason, working at the periphery of the corporate care provider allows them to be part of a service, without the need of a dedicated salesforce

or capabilities in an area that might not be part of its long-term plan. In addition, the corporate care provider strongly benefits from this peripheral actor that provides a differentiating and novel offer to their current customers without having to develop or manage new component internally.

In general terms, the resource dependency in the network can take two different tactics, which reflect how technological components are related to overall solutions: (i) use the network to improve the efficiency without an original intention to change the final service offering, and (ii) use the network to create additional value and differentiation in the service offering, without affecting the internal logic of the service delivery.

We have considered four specific cases to build the analysis. However, there is a multitude of examples in the global market that contribute to the discussion. We present a non-exhaustive set of examples in Table 5; based on them, we generalize our findings from the case studies.

Incumbent players in the ICT industry dominate the global position of the integrators. Building on their existing trust and global reach, the examples in Table 5 have created interfaces and platforms that allow the creation of applications and system by third parties which can be considered “peripheral components” of solutions. Interestingly, as part of the integrators in the health and social care area there is a strong presence of telecom actors (other examples, besides Telia in Sweden, are AT&T in the USA and Orange Healthcare in France); we infer that IT actors such as Apple and Google focus on the integrator view for consumers and the global market (which currently focuses on wellbeing), while telecom actors focus on the health and social sectors in the countries where their footprint is already present. This geographical differentiation is largely due to the fact that health and social care count with legacy systems and technologies that require local integration, while the wellbeing area does not depend on any legacy structure.

In the consumer-facing domain, it is more common to find actors which have emerged more recently in the market. Here, many of the solutions can be considered *Over-The-Top* services that do not require being part of any infrastructure. However, they are dependent on the existing platforms and technology availability provided by integrators. As a remark, a business developer on a digital healthcare accelerator program suggests that “digital care companies are targeting consumer market directly because it is easier, many of the developers actually come from the gaming industry, and they don’t really know how to deal with the

Table 5

Other examples in the global market for health, social care, wellbeing and sports.

	Health and social care	Wellbeing and sports
Integrator (efficiency)	Philips eICU program ^a (IT integration) Telia Care Integrator ^b (IT integration) Nokia Healthcare ^c (IT integration) <i>Aim:</i> improve service delivery, efficient data and knowledge share	Apple HealthKit ^d (app development framework) Samsung Simband ^e (hardware reference) Google Fit ^f (app development framework) <i>Aim:</i> integrate data into comprehensive output for developers and users
Consumer-facing (convenience)	AdhereTech ^g (pill dispenser) Clinicloud ^h (thermometer, stethoscope) Mango Health ⁱ (routine manager app) <i>Aim:</i> devices and apps to improve the interaction of beneficiaries with the healthcare system	Upright ^j (posture correction device) Garmin ^k (fitness trackers) Withings ^l (part of Nokia) (several devices) <i>Aim:</i> improve daily activities and provide feedback to consumers

Online sources [Accessed on January 4, 2017].

^a www.philips.com/healthcare.^b www.telia.se/foretag/losningar/healthcare/telia-care-integrator.^c networks.nokia.com/healthcare.^d developer.apple.com/healthkit/.^e www.simband.io/.^f developers.google.com/fit/.^g <https://adheretech.com/>.^h <https://clinicloud.com/>.ⁱ <https://www.mangohealth.com/>.^j <http://www.uprightpose.com/>.^k <http://www.garmin.com/>.^l <http://www.withings.com/>.

regulatory aspects, and are used to develop directly to end consumers". This adds to the point that the wellbeing solutions do not depend on legacy structure.

There are indications that innovation in the healthcare domain is intrinsically harder than in wellbeing in terms of regulation, and many solutions target the wellbeing consumer market as a starting point for development. A clear example can be seen from Withings; they have announced the intention to go beyond the direct consumer market and enter the clinical device space, beginning with remote patient monitoring (Comstock, 2016). Withings target direct consumers, but works in parallel to get FDA approval on its devices. Supporting the idea that, even if the innovation is evidenced in the consumer market; the long-term strategy is to enter the clinical-or healthcare-domain; in preventive healthcare and management of chronic conditions is where the two areas are starting to collide (Comstock, 2016).

Compared to our case studies with an integrator perspective, perhaps Philips eICU is the example that better showcase a solution that improves efficiency without an original intention to change the final service offering provided at intensive care in hospitals. On a global scale, we see two roles for integrators: in health and social care, they improve internal efficiency; in wellbeing and sports, they enable third party development of solutions.

Particularly in the wellbeing domain, the integrators aim at facilitating the creation of new solutions by other firms. These wellbeing integrators also provide access to their user base, similar to the role of the race organizer in case *Delta*. Considering the consumer-facing examples, they create additional value and differentiation, without affecting the logics of current health, social or wellbeing services.

7. Conclusions and implications

Research implications: our findings provide empirical support to Palo and Tähtinen (2013) proposition claiming that firm-level business models are useful to identify opportunities and are the departure point to create a collective understanding of the opportunities that can be exploited in a network-level business model. We extend this claim by suggesting that firm-level business models should be adapted to create further alignment in the network. This particularly holds for the actors bringing technological novelty which has been recently introduced to the market, but it extends to other actors in the network. In our cases,

we show the effect on traditional service providers after the adoption of new technology. We have summarized our findings using the four-field framework in Section 5.2, where we highlight the differences between buyer-seller setting and the business networks settings. The grouping of the alternative business models illustrates how business network settings evolve from "buyer-seller only". Hence, we contribute to the general framework proposed by Palo and Tähtinen (2013) by further clarifying that the development of these business models in networks can be detected by the addition of new values into existing solutions or by collaboration with additional relevant actors in the network. The cases in the upper right corner of Fig. 6 (quadrant IV) illustrates one of the Foundational premises of the service dominant logic which suggests "the customer is always a co-creator of value – There is no value until an offering is used–experience and perception are essential to value determination" (Lusch et al., 2007).

When it comes to division of labor between firms (Ehret & Wirtz, 2010), we can see that in our case studies, the resulting solutions—which involve a combination of product and services—is achieved by the aggregation of resources and related activities (labor) from different actors in order to form a wider and improved offering to the customer. Hence, in our cases it is not necessarily about outsourcing or moving from dividing a set of labor and other resources within a firm to a situation where you divide labor and resources between multiple companies. Our research shows that, even if actors clearly differentiate their activities in the network, they resulted from an aggregation and development toward a common solution.

Our primary data analysis had strong alignment with Palo and Tähtinen (2013) argument that in early development phases, entrepreneurial activities are needed by an actor steering the development of the business opportunity. These actors are not necessarily the ones orchestrating the relationships in the network, since our cases show that opportunity recognition activities are covered by the actors bringing the technology components.

The innovation perspectives in healthcare suggested by Herzlinger (2006) provide supporting grounds to analyze the motivation and implication of certain solutions. We complement the scope of the integrator perspective by suggesting that this type of innovation not only provide the benefits of scaling a solution, but it is also closely linked to internal changes in the logic of a services, becoming key component that are required for the solutions to operate. While innovation

following a consumer-facing perspective is usually a part of a network as additional component that adds value, without a clear intention to change the working processes for other actors in the network. Moreover, we present how both perspective can effectively benefit from a network-centric development of solutions.

Managerial implications: on managerial grounds, the main takeaway is that the network-level perspective brings additional considerations on how a component relates to the overall solutions, depending on the type of innovation under consideration. Consumer-facing innovations relate to overall solutions as additional component that differentiate the final offer, but are not intrinsic requirements for the overall solution to operate. For example, the overall solution in case *Gamma* in a cross-country ski race; the wearable device is not required for the race, but it adds novelty and a better experience to participants. Components with an integrator perspective tend to become a central part of the solution and are required for a proper operation and delivery of certain services.

No perspective is better than the other; they are useful to highlight the scope and position of the technology in the overall solution; the important message is to understand that, regardless of the type of innovation, components are generally a part of a larger solution and a network perspective in the development provides a strong engagement with existing service providers.

For incumbent players, both in the healthcare and in the ICT industries, a network perspective is desirable to innovate without incurring in drastic changes on the ongoing core operation. We have shown examples of social care service providers adopting new technology as peripheral components that provided strong support to eventually change their operation into more efficient and dynamic working processes, enabled by connected devices.

Conclusions: Developing services in the IoT context generally entails a combination of resources and competences from different fields, beyond the computing or telecommunication industries. Going back to the departing research question *How can a network-level perspective be used in business model design for solutions based on connected devices in health, social care and wellbeing?* We considering that a network-level perspective on business models can enable an alignment of interest from different actors and, moreover, it provides the advantage of steering technological development towards identifiable customer needs. This aspect is highlighted in the case *Delta*, where the solution was developed in a public-private project looking into existing challenges in social care.

We consider that a network-level business model can provide the practical tools to start developments of technology after the customer needs have been identified. The essence of this argument supports the propositions by Palo and Tähtinen (2013) and Carbone (2009), the later considering that a network perspective effectively embraces a market pull model instead of a market push of new technology.

We finally argue that even if literature concepts such as business networks or networked business models are not part of the lingo adopted by our sources of empirical data, we see a practical inclination to explicitly target collaborations to complement competences and create new solutions based on connected devices. Business models and the need for collaboration are well understood by practitioners, but there are no explicit indications of the use of business models frameworks as part of the coordination activities within the networks.

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