HEALTH CARE SERVICE INNOVATION:
dynamic service capabilities in the Rotterdam area

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ABSTRACT

Health care expenses are growing faster than the GDP in the Netherlands. The demand for health care will grow even more substantially in the future due to an ageing population. Innovative efforts can contribute to more efficient health care services. At the same time the quality can be improved for patients and citizens. Despite tremendous opportunities, innovating in this sector is complex and involves many actors. This research attempts to obtain insights in how different actors are involved in the service innovation process.

The role of various actors is approached from a regional innovation system (RIS) perspective. Dynamic service innovation capabilities (den Hertog et al., 2010) are used to explain and analyse different aspects of the service innovation process. How these dynamic capabilities are distributed among participants indicates the importance of various actors participating in the innovation process. An answer is formulated to how the RIS enables and supports health care service innovation.

Three service innovation cases are investigated in the Rotterdam area. The research furthermore points out the importance of *user pilots, co-developing* and *an open innovation structure*.

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1. INTRODUCTION

Health care is a valuable good in our society. We all want to stay healthy and receive good care when needed. With an annual growth of 5 to 10%, our national health care expenses are rising faster than our GDP the last decennium. The financial crisis increased this gap with the GDP even further. The demand to health care will only increase in the future due to an ageing population and new treatment possibilities. These rising costs have increased the attention to find more efficient ways for delivering health care. Innovation can play a vital role in this challenge to deliver qualitative health care more efficiently to patients (Collot d'Escury & Alma, 2011; Blankers et al., 2012; Team zorg, 2008).

The health care sector comprises many services for delivering care. To research innovation in this sector it is thus worthwhile focusing on service innovation. Services in general form a growing proportion of the world's economy (IMF & IBM, 2008) and have become the largest sector in most developed countries (OECD, 2011). Yet, the dominant paradigm for innovation and management thinking is still based on technological innovation and product development. This also seems to apply to most statisticians, policy-makers and the wider audience (den Hertog, 2010). Service innovation in the health care sector creates *new value* for both health care providers and their clients (den Hertog et al., 2010).

Service innovations are usually researched from a firm-level perspective. Den Hertog et al. (2010) identify a set of six *dynamic service innovation capabilities*, which are the capability of executing coordinated activities favouring the innovation success. These provide a useful insight in the strengths and weaknesses of an organisation for engaging in service innovation projects. If an organisation has many strong capabilities it is assumed to be good at innovating. However, innovation does not depend on one actor. The same literature shows that access to networks and new business partners is very important for service innovation in order to co-design and co-produce (den Hertog et al., 2010). Also, users have been identified as important for product innovation and appear to be even more influential for developing new services (Oliveira & von Hippel, 2011). This shows that multiple actors, and thereby the environment in which service innovations take place, have significant influence on its success. An approach involving different actors and emphasising their relations thus seems useful for researching service innovation.

Successful development, implementation and diffusion of innovations in the health care sector proceeds according an interactive and interdisciplinary process (van Wijngaarden et al., 2010). This means that health care innovation does not take place in isolation nor in a linear process, but comprises a variety of actions of different actors that are involved, as well as their inter-firm relations (Wiig & Wood, 1995; Andersson & Karlsson, 2004; Smits & Kuhlmann, 2004). The innovation system approach emphasises the interaction between the actors and their collective performance as a result (van Lente et al., 2003). Because innovations in the health care sector appear to proceed in such a manner, innovation system theory provides useful handholds to describe and analyse this phenomenon. From this perspective the importance of different actors can be analysed for service innovations instead of focussing on one organisation. The innovation system comprises different actors like firms, customers, knowledge institutions, political arrangements and intermediaries (Lundvall, 1992; Edquist, 1997; Tödtling & Trippl, 2005). Originally innovations systems focus on

technology as a basis of analysis. However, service innovations also take place within an innovation system. Approaching service innovations from a systemic perspective is less common, but not less logical.

Apart from national legislation, local authorities formulate policies and ambitions for several topics, health care included. Such *regions* can have different industries and specialisations as well as they differ in innovative performance. The success of a region depends on inputs that favour innovation, which can be spatially bound, like for example interaction and knowledge spillovers (Tödtling & Trippl, 2005). Compared to regional projects, national initiatives can be more complex and might fail as we have seen with the electronic patient record (EPD). The law that obliged health care providers to be connected to the national EPD has been rejected in April 2011[1]. Regional initiatives might have a better chance of succeeding. Activities of many health care providers are also spatially bound. It thus makes sense to take a regional approach for researching health care service innovation. The notion of a *regional innovation system* (RIS) regards the actors the same as in any other innovation system, albeit the boundaries are geographically redefined by the reach of its actors' activities, defining a functional region. This means that the boundaries of a RIS reach as far as the influence of local authorities and economical activities of organisations that are settled there. Many health care providers operate within a region, as well as the influence of many policy makers, such boundaries are thus a functional delineation.

The dynamic service capabilities den Hertog et al. (2010) identified provide a useful insight of service innovations. The regional innovation system exists out of organisations that either have these capabilities or not and execute certain activities accordingly. This research uses these dynamic capabilities to investigate health care service innovations in a systemic perspective. Instead of looking at one organisation, the presence of these dynamic capabilities among different actors is investigated for service innovation projects. Actors in the RIS make a collective effort to successfully innovate. This means that not one organisation has to be successful in every facet of the innovation process, but different actors complement each other.

RESEARCH QUESTION

There is not much insight into how service innovation in the health care sector takes place and how successes or failures relate to the regional innovation system. This research attempts to reveal these issues in order to identify the possibilities to support the service innovation process. Rotterdam is identified as a suitable region to investigate this proposed issue due to its extensive health care sector (see the methodology chapter). The approach of Den Hertog et al. (2010) is used to analyse service innovation projects in terms of six dynamic service capabilities (see the next chapter). Therefore, the research question is:

How does the Rotterdam regional innovation system enable and support the dynamic capabilities of health care service innovations?

To answer this question three service innovation projects in the Rotterdam health care sector are investigated. It is determined how these service innovations relate to the Rotterdam health care RIS

[1] www.rijksoverheid.nl/onderwerpen/elektronisch-patientendossier, 2011.

and what actors are involved. By definition, the RIS is the same for all projects as it contains all the actors in the environment. The role and influence of certain actors can however differ for each individual case. A comparative analysis is made between the cases to reveal similarities and differences in how dynamic service capabilities are distributed among the participants. This provides insights into how service innovation in the health care sector benefits (or not) from the regional innovation system in which it takes place.

JUSTIFICATION

Social – Heath care involves all of us, either because we need medical attention or because we are obliged to have a health care insurance. Due to rising expenditure, the sector is facing the challenge to cut costs and improve its quality at the same time. The growing demand asks for more *efficient* and *smarter* solutions to deliver health care to clients. Supporting service developments thus has a strong societal value as people need health care and the population is ageing. Research on this topic is lacking (Nauta et al., 2011) and this thesis contributes to a better understanding of health care service innovation.

Theoretical – Most innovation literature focuses on technological developments. However, services have become the largest sector in most developed countries (OECD, 2011) and in understanding innovation processes a shift should be made towards a service-based paradigm (IFM & IBM, 2008; den Hertog et al., 2010; Oliveira & von Hippel, 2011). Although innovation system theory is originally focused on technology, service innovations also occur in this setting. This research integrates dynamic service capabilities with the regional innovation system. Instead of taking a firm-level perspective service innovations are regarded as a collective act of involved actors. The use of both theories is thereby put to a test.

This thesis also makes a contribution by addressing innovation in the public sector. Most innovation theories focus on private organisations (Mulgan & Albury, 2003; Nauta & Kasbergen, 2009). Researching innovation in the health care sector extends the literature on public innovation and on innovation in the health care sector.

2. THEORY AND DEMARCATION

Innovation has gained more and more attention over the last decades, both in management and in research. The concept *innovation* is used in various forms and enjoys different definitions. This thesis regards innovation from a service perspective.

To address innovation, many models have been developed to provide insight into how the innovation process can be influenced and managed. These models change and are enriched over time as more empirical research adds up to our understanding in different fields of innovation. To grasp the complexity of an innovation process, it is often divided in smaller and better understandable parts. This enables one to gain more detailed insights, but also to influence or steer the process from a managerial perspective. Usually these models distinguish different phases or stages (Eveleens, 2010). These phases do not proceed in a linear process where a next phase starts when the previous ends. Instead it is described as an *evolutionary process* where these phases can be identified throughout the whole process. There is a constant feedback loop through the process that enables an organisation to learn and make improvements for current and future projects. In a

way experience is build that can favour innovation (Tidd et al., 2005; den Hertog et al., 2010).

Like phases of the innovation process, dynamic service capabilities split up the innovation process into smaller and better understandable parts. This thesis regards these dynamic service capabilities in a regional innovation system. The focus is not on one organisation, but on an innovation project in which different actors participate. According to innovation system theory success does not depends on one actor, but rather relies on a collective act of different participants (van Lente et al., 2003).

SERVICE INNOVATION

Services are very important in our economy and have become the largest sector within OECD countries (OECD, 2011). A logical implication is that service innovations are thus important for future economic growth and understanding this phenomenon is useful. However, research in this domain is often addressed from a producer centred perspective, where the focus lies on product and technological innovation. The intangible character of services can easily be neglected and so can the important role of users be underestimated (den Hertog, 2010). Services are also less standardised, more dispersed and usually not focused on products. By addressing innovation in general, but especially when considering new service offering, this should be taken into account and a shift must be made from technology based thinking to a service paradigm (IFM & IBM, 2008; den Hertog et al., 2010; Oliveira & von Hippel, 2011).

This research focuses on new health care services. The role of technology is however not regarded irrelevant, nor is it the intention to neglect its importance. Technology often lies at the heart of a service or enables a new service solution. Because of the intangible character services entail, users experience technology not as a product, but as a utility. Access to services and the option to participate becomes more important than ownership following this reasoning. Services in this way show that technology, like innovation, can never be the goal itself but rather is a means to an end. Put differently it encompasses an instrument to achieve something else. The ICT industry is a striking example of an important technology enabling many new service solutions. Numerous examples can be thought of from educational purposes to financial banking.

Den Hertog et al. (2010) developed a model for managing service innovation and understanding the service innovation process. The *ultimate goal* of service innovation is creating new service experiences and service solutions. These can consist out of a new service itself, a new service portfolio or a new service process, in all cases value is created for the customer and/or the producer. One of the key characteristics of new service propositions is co-creation. Interaction between the client and provider proves an important part in the service innovation process (den Hertog et al., 2010).

DYNAMIC SERVICE INNOVAITON CAPABILITIES

Different phases can be distinguished in the innovation process from the start of an idea to successful implementation and diffusion. In general these are something like: idea generation or search, selection, realisation, sustaining, diffusion, differentiation, and learning (Eveleens, 2010). The ability to influence this process to one's favour can result in a competitive advantage. Den Hertog et al. (2010) identified six dynamic service innovation capabilities. These are the capacity of an innovator or organisation to master the

innovation process and improve upon itself by learning. Having strong dynamic capabilities should enable an organisation to innovate repeatedly.

These *dynamic capabilities* are by definition not the same as *activities*. Hence, a capability implies the ability to do something, while an activity refers to an act. However, dynamic capabilities do relate to certain activities. For example, if one is exquisite at playing piano (maybe even without knowing), but never plays, it is not much use, nor is it very relevant. Without activities an organisation is not able to participate in the market or innovation trajectories. Dynamic capabilities can therefore not be separated from related activities, especially in an attempt to describe them. For modelling these dynamic capabilities they are thus not meant to be that different from activities because they reflect what someone is capable of doing. Exploiting these dynamic capabilities enables an organisation to seize opportunities, adapt to user needs and innovate repeatedly. The dynamic service capabilities resemble phases of the innovation process as described by Tidd et al. (2005) and many others, which are also linked to activities (often referred to as *routines*). Like phases in the innovation process they do not necessarily follow one another in a specific order. The six dynamic service innovation capabilities den Hertog et al. (2010) distinguish are:

A. Signalling user needs & technological options

Interpreting signals from the real world is key for innovators. Service innovations are often an answer to unsatisfied customer needs or new technological opportunities translated into new service propositions. More specifically, it is "the capability to see dominant trends, unmet needs and promising technological options" (den Hertog, 2010). As the title implies, this capability can be divided in two sub-capabilities.

The first relates to the capability to emphatically understand users and sense their potential needs. The interaction between the provider and client is an important source for innovation. This was already identified for product innovation and appears to be even more important for service innovation (den Hertog et al., 2010; Oliveira & von Hippel, 2011). Identifying customers' demand is valuable for market research and to respond to market developments in an early stage. Eric von Hippel (1986) described *lead users*, a user group whose needs exceed that of the marketplace and even modify existing products and services or create new ones to satisfy their own need. These ideas flow back to organisations that can further develop and market these concepts. Identifying and involving these lead users can be valuable to anticipate on future needs (von Hippel, 1986). Users also generate valuable feedback to learn from and improve services with. Following this logic users should be interacted with intensively and be involved in the innovation process. Some of the tools to do so are dialogues with lead users, joint experimentation and prototyping, user panels, account management systems, client profiling, analysis of how services are used, trend analysis in client groups, etc (den Hertog et al., 2010).

The second relates to the capability to identify new technological opportunities. Technological developments enable improvements of the service portfolio, customised services and new ways of interacting with clients. Service innovators must scan their environment for promising technologies to adapt and renew their service portfolio. A group of people can for example be made responsible for scanning promising technologies and discussing new

options with technology providers, this can also be part of a business development function or an ICT department (den Hertog, 2010).

Signalling requires an active attitude that must constantly be executed and translated into a search routine to find new opportunities, as well externally as internally (den Hertog et al., 2010). This capability can be described as the sense organ of an organisation to interpret the world and identify opportunities.

B. Conceptualising

New services cannot be developed, researched, prototyped and tested like physical goods. Conceptualising relates to the often called, *fuzzy front end* of innovation. It is a creative service design process that has no logical beginning or end and is less tangible and more codified (den Hertog, 2010). Picked up signals and initial ideas are conceptualised in new service concepts through such a creative process (Normann, 2002; Frei, 2008). The capability to conceptualise, design and prototype a new service concept is central to develop new services. Essential is an open innovation culture that values entrepreneurship, experimentation, prototyping and out of the box thinking. There should be an ongoing process between the service innovator and client (den Hertog, 2010). Fuelled by signalling, this capability is strongly connected to all other capabilities and can sometimes overlap with similar activities. Conceptualising is characterised as a design activity that goes beyond conducting research or making a business case, in other words getting concepts from paper to services in practice (den Hertog, 2010).

C. (Un-)bundling

New service offerings are often the result of an architectural reconfiguration of existing elements (van der Aa & Elfring, 2002). Existing services can be striped down to bare essentials and offered as individual services, applying a stronger focus and perhaps higher specialisation. But service elements can also be bundled into new service offerings, enriching existing services by creating new combinations (Normann, 2002). The capability for such architectural reconfigurations involve designing new service experiences and solutions by bundling and unbundling service elements, enriching and customising services in novel ways and blending various (sometimes unrelated) service activities (den Hertog, 2010). Making smart combinations and unbundling or stripping services down, are two varieties of this capability. Also services can be stripped down to its basics and these elements can be offered as additional bundles. Such choices and activities can vary within same industries and relate to business strategies and new revenue models (den Hertog, 2010).

D. Co-producing & orchestrating

As mentioned earlier, access to networks and new business partners is very important for service innovation. The combinatory nature of services not only involves different service elements, but also involves different service providers as well as customers. This means that service innovators often co-design and co-produce services with partners. Such alliances can involve multiple participants like other providers, suppliers and customers and must be managed to benefit from (den Hertog, 2010). Innovators themselves must engage in these alliances, but also be able to manage and orchestrate these various coalitions that stretch

beyond the boundaries of the firm. Executive capabilities can be decisive for success in this perspective. This capability also involves investing in partners who are needed now or might be needed in the future. Having access to value networks is a key capability for service innovators (den Hertog, 2010). The variety of possible partners can involve competitors from one's own industry.

E. Scaling & stretching

Introducing a new service in one location is different from launching it in a wider context. The capability of scaling is mostly about diffusion. The capability of stretching relates to branding and strategy. A successfully established brand can be valuable to enter new markets and launching innovative service concepts. This should be consistent with overall firm strategy and relate to (potential) clients (den Hertog et al., 2010). Communication and branding are key in this capability in order to create a recognisable service offering (Krishnan & Hartline, 2001).

F. Learning & adapting

The learning capability is less directly involved with developing or implementing a new service offering. It rather reflects upon this process. By deliberately learning from managing service innovations, the other dynamic capabilities can be strengthened. Therefore learning can be seen as a second order capability as it enables one to improve on its own processes (Zollo & Winter, 2002; den Hertog et al., 2010). The capability to learn enables one to get better and better at this tough-to-manage process. It is essential for adapting and improving the overall service innovation management and to perform tasks more efficiently and effectively. Innovation is inherently uncertain (Dosi, 1988). Keeping track of failed and successful efforts is therefore useful to reflect on this process (den Hertog, 2010).

A systemic reflection on the innovation process is however rare to identify. Service innovations are in general less formalised, more distributed and not as explicitly managed and funded as in manufacturing firms and their R&D (den Hertog, 2010).

THE END OF THE LINEAR MODEL

The idea that R&D is the driving factor behind innovation as assumed in the more traditional linear model, is outdated for some time. This model describes the innovation process as a chain of activities starting with R&D followed by applied research and product development that ends in commercialisation. This would imply that more R&D leads to more innovation (Andersson & Karlsson, 2004; Smits & Kuhlmann, 2004). We know that stimulating innovation is not as easy as increasing R&D budgets and many studies show that innovation processes do not proceed in such an order.

Rather a systemic model is assumed in which innovation is favoured by interaction and networks among actors that come from both public and private sectors (Wiig & Wood, 1995; Andersson & Karlsson, 2004). Instead of a linear order, innovations evolve in a non-linear way (Smits & kuhlmann, 2004). The ability of generating innovations depends less on isolated individual actors and more on collaboration among them, with their collective performance as a result (van Lente et al., 2003; Andersson & Kuhlmann, 2004). In figure 1 the dynamic service capabilities as depicted by den Hertog (2010) are shown. These capabilities do not follow each other in a linear order, but so to say surround new service experiences and solutions by being part of a *non-linear innovation process*.

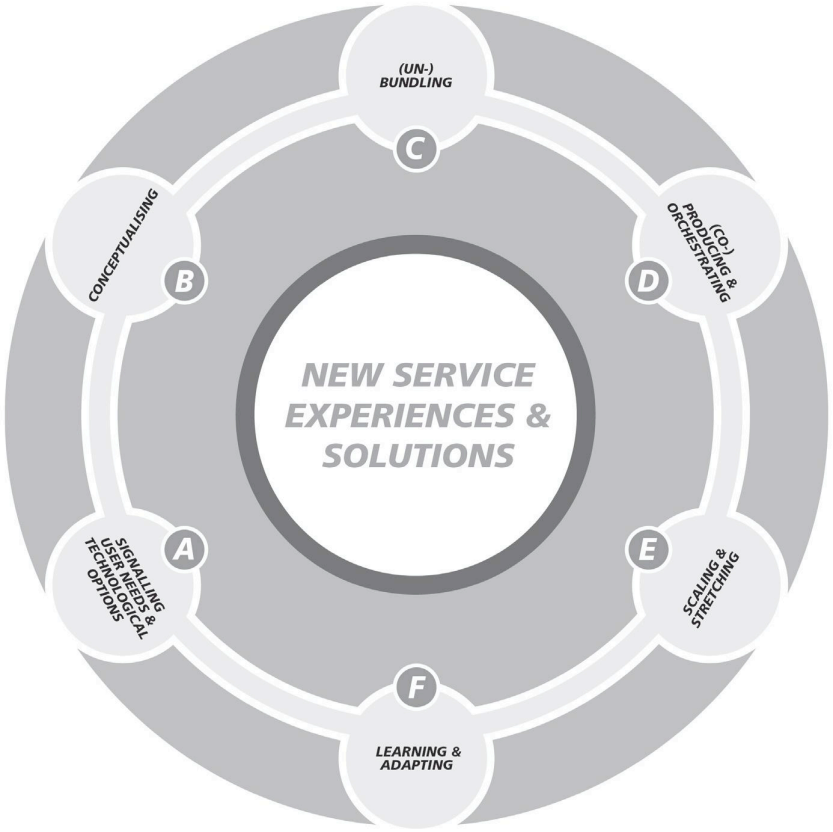

Figure 1. Dynamic service innovation capabilities for managing service innovation by den Hertog (2010).

INNOVATION SYSTEMS

Christopher Freeman (1987) introduced a systemic approach to innovation processes. From his study of Japan he defines a national innovation system (NIS) as: "The network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman, 1987). Lundvall (1988) also argues for the system approach on the national level because the national system of production is mutually interdependent with the process of innovation.

Later studies started focussing on regions and clusters. Regions are identified as an important basis of economic growth and strength, innovation is thus important for their success. Also policy makers and institutions are often bound to a sub-national level. The innovation system approach is very useful as a framework to analyse a region (Tödling & Trippl, 2005; Asheim & Coenen, 2006). Regional innovation systems (RIS) have like NIS geographical boundaries, however the studied area is smaller and focused on a *functional area*. Definitions for RIS are therefore often derived from NIS, a region can be defined as "territories smaller than their state possessing significant supralocal governance and cohesiveness differentiating them from their state and other regions" (Cooke et al., 1997). Important to note is that regions differ on many grounds and there is not one best practice innovation policy that can be applied in general. Success stories can therefore not be copied so easily and even appear to depend on unique local circumstances. Keeping this in mind, looking into a region can reveal interesting insights in how innovations proceed and provide handholds for policymakers (Tödling & Trippl, 2005).

The innovation system approach is useful as it provides a framework for analysing the interaction between the actors involved and their collective performance as a result. It takes the flow of technology, information, knowledge and other resources between people, industrial firms, universities, research institutes, political arrangements, and intermediary organisations as the key to the innovation process (van Lente et al., 2003). Innovations in the health care sector evolve in an interactive and interdisciplinary

process, involving multiple actors (Wijngaarden et al., 2010). RIS insights thus seem very useful for researching this phenomenon.

REGIONAL INNOVATION SYSTEM

Regional innovation systems (figure 2) can be described according different building blocks that comprise actors who interact with each other. In the *socio-economic and cultural setting* of a region three building blocks can be distinguished. One involves the business and industrial clusters of a region, where firms are ideally linked by horizontal and vertical networking. Tödling & Trippl (2005) call this the *knowledge application & exploitation subsystem*. The second involves various institutions that produce and diffuse knowledge and skills, such as research institutes and universities. This can be labelled as the *knowledge generation & diffusion subsystem*. *Policy* actors form the third as they can play a powerful role in shaping the regional innovation process by creating a set of rules. The regional socio-economic and cultural setting is not a self-sustaining unit. There are various links to a wider *(inter-)national context*, such as firm networks or national and European policies (Tödling & Trippl, 2005).

Although innovation systems originally focus on technology as a basis of analysis, service innovations also take place in this setting. The RIS framework is useful to address service innovations and analyse the role of different actors in the innovation process. This thesis makes an integration of the RIS framework with the earlier described dynamic service innovation capabilities.

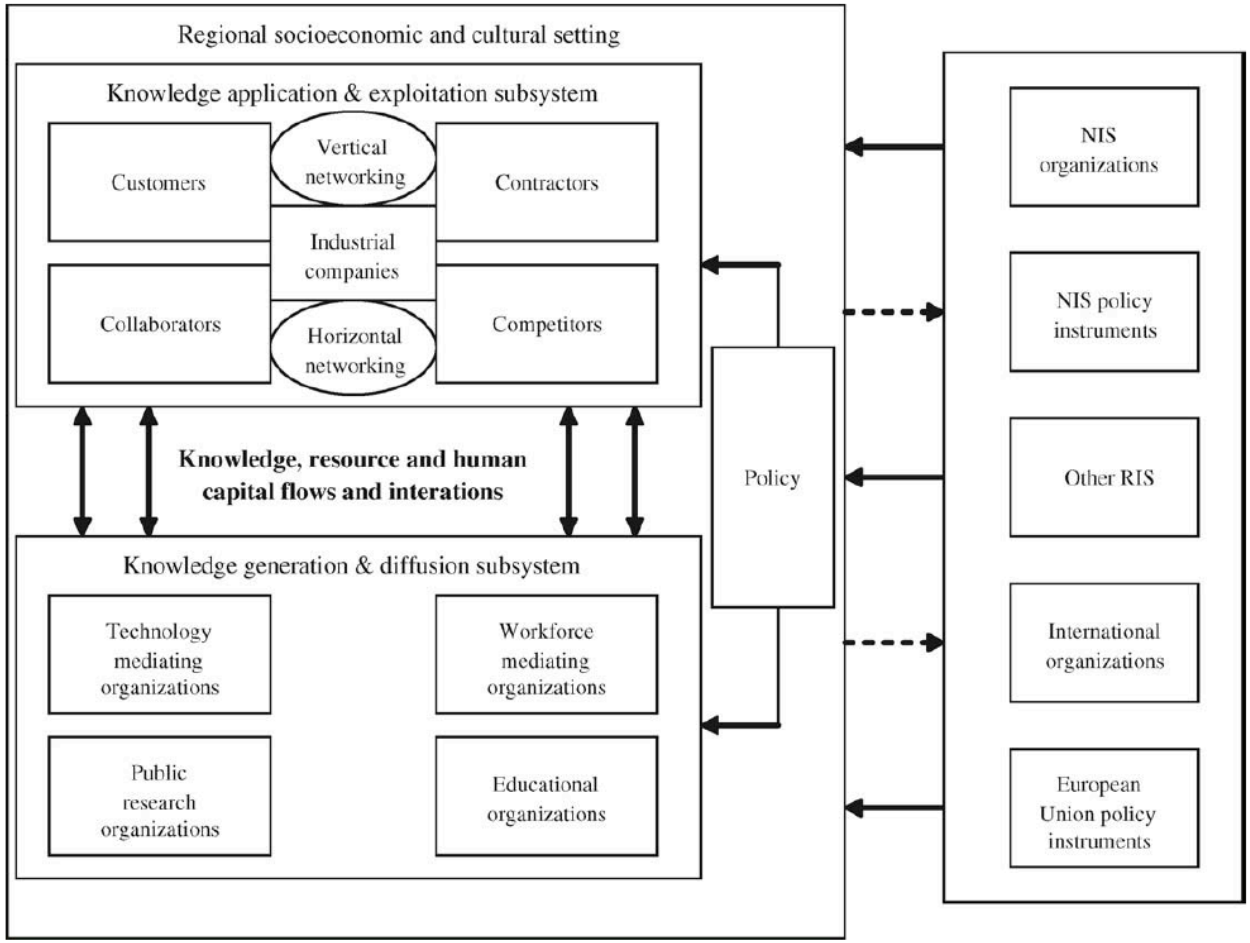

Figure 2. Regional innovation system by Tödling & Trippl (2005).

DYNAMIC SERVICE CAPABILITIES FROM A RIS PERSPECTIVE

The described dynamic capabilities are intrinsically focused on a service innovator or firm. However, as mentioned before, innovation does not happen in isolation. Many of the dynamic capabilities involve other actors in the system, like users or partner organisations. Interaction with other actors is identified to be important for developing new services (den Hertog, 2010). Users and co-producers are even more relevant than for product innovation. Approaching service innovations from a systemic perspective is less common, but not less logical. The dynamic service capabilities provide an insight in the innovation process on the organisational level, while the RIS approach takes the analysis to a network or meso-level. This thesis integrates both approaches by analysing how RIS actors participate in the innovation process. From this perspective, the success of an innovation depends on multiple organisations and the dynamic service capabilities they entail. By collaborating, different participants complement each other in the innovation process. This research focuses on how the dynamic service capabilities are *distributed* among the participants. It is not likely, or maybe even desired, for one organisation to master all dynamic capabilities. In this way the dynamic service capability approach provides a more detailed use and insight of regional innovation systems.

INNOVATION IN A PUBLIC SECTOR LIKE HEALTH CARE

Most innovation literature is focused on the private sector (Nauta & Kasbergen, 2009) and it is often assumed that the public sector is inherently less innovative. The public sector might have a different urgency to innovate, as organisations are less likely to expire and arguably less motivated by profit. Yet it has an extensive history of innovation. A barrier can be a dominant culture of risk aversion and the need or guarantee for proven technologies in health care (Blankers et al., 2012). Innovation in the public sector is however very important to keep up with public needs and expectations. The pressure of exceeding costs is for example an important reason to engage in innovative activities and so is the stronger recognition of success among clients. Organisations in the public sector sometimes regard innovation as an optional luxury or added burden, it rather should be a core activity to develop better ways of meeting needs, solving problems, and using resources and technologies (Mulgan & Albury, 2003).

It remains important to keep in mind that most theories, models and best practices are results from the private sector. These do provide very useful insights and handholds for understanding innovation in the public sector as well. They are thus useful for this research, but might also include assumptions that might not always go.

3. METHODOLOGY

This research attempts to find an answer to how service innovations evolve in the health care sector. Dynamic service capabilities are useful to understand the service innovation process and the regional innovation system approach reveals how different actors contribute to this process. The analysis can be divided into three parts. This section discusses the case selection, data gathering, research framework and indicators.

Firstly three health care service innovation cases are selected in a suitable region. This region must have a significant health care sector where new services are developed in pursuit of delivering better health care. A completed case description is made to reconstruct the innovation process for each case.

Secondly, the service innovation cases are analysed using the framework explained later in this methodology chapter. The dynamic service innovation capabilities, as described in the previous chapter, are combined with the regional innovation system approach. With this framework, the role of different RIS actors in respect to the dynamic service capabilities is described. This reveals how different dynamic capabilities and related activities are distributed among the participants.

Thirdly, a comparative analysis is made of the three health care service innovation cases. This will reveal similar success or failure factors, but also point out if there is any resemblance in how different actors enable and support health care service innovations. From the comparison of the cases conclusions can be formulated.

REGION AND CASE SELECTION

- Rotterdam

First a region is identified to research health care service innovations in a RIS perspective. Rotterdam is identified as a suitable region to investigate this proposed issue. It has one of the largest health care sectors in the Netherlands and the largest university medical centre (Erasmus MC). Rotterdam has the ambition to excel in this sector by stimulating innovation. In 2010, the Rotterdam health care sector offers 60.000 jobs, which is 19% of the total employment and has an approximate turnover of 2,7 billion euro. It is the fastest growing sector in Rotterdam and is expected become the largest. The labour force cannot keep up with this growing demand (EDBR, 2008; Gemeente Rotterdam, 2010). In Rotterdam 10% of the people work in the health care sector already, which will rise to 25% by 2030 following the current trend. This development poses new challenges, as well as new opportunities for entrepreneurs and innovators (EDBR, 2008). Wijngaarden et al. (2010) found that innovations in the Rotterdam health care sector evolve in an interactive and interdisciplinary process, making it suitable to investigate this region using a RIS approach.

With the region identified a set of cases still need to be selected. Cases are needed because this thesis attempts to reconstruct the service innovation process and the involved dynamic service capabilities. Three service innovation projects are selected that are running long enough to reconstruct the innovation process. These are the *Zorgportaal Rijnmond*, *Diabetes Station* and *health care domotics*. These are relatively large and recent projects involving different actors. Enough data could be gathered to make a solid collection and people were willing to cooperate and being interviewed.

These three cases are in their implementation/scaling phase. This means that the services are not (yet) widely diffused throughout the health care sector. However, the cases provide enough data to make an analysis and are suitable to compare as they are in the same phase of the innovation process. Because the cases are relatively new for the market they relate to modern challenges in health care and form solutions for specific problems.

- Zorgportaal Rijnmond

The Zorgportaal Rijnmond (ZPR) is an online portal to organise health care. Citizens and health care providers can exchange information through a secure website and access reliable information about care and wellbeing. Applications can be offered through the open source platform to both patients and health care providers. The goal is to increase the convenience for citizens and providers of information exchange.

In 2008, the Economic Development Board Rotterdam advised to develop a health care portal in the report *Op kop in Zorg*. The ZPR is a step in organising health care more efficient, responding to the increasing demand and costs. Citizens can have insight in where waiting lists are shortest, gather information online and get answers without seeing someone in person. Health care providers can share information like blood test results, scans and x-ray photos. The portal is based on open source software so entrepreneurs can offer services they developed on the ZPR to health care providers, institutions and citizens. The ZPR is build on three subprojects, these are: ZorgInfo TV, Medisch Kerndossier and Digitale Vraagwijzer.

With the Digitale Vraagwijzer patients can find suitable answers to their questions and are redirected to health care institutions and providers. The Digitale Vraagwijzer is developed in collaboration with Regelhulp of the Ministry of Health, Welfare and Sports (ZPR, 2011).

ZorgInfo TV is a video and message connection for providing information to patients. Individual patients or groups can establish a secure video connection with health care providers. Real time questions can be asked using text messages and the videos are recorded in a database so they can be viewed later as well. A pilot of the ZorgInfo TV is done with cystic fibrosis patients and nine broadcasts have been made on various topics (ZPR, 2011).

The Medisch Kerndossier is the first step into realising a regional electronic patient record (EPD). A first pilot is done with 12 patients of the Erasmus MC and a second pilot will be done with 200 patients. The goal is that all citizens in the Rotterdam region will have access to their own patient data. Data from all Health care providers will be collected in one record that is managed by the patient himself who can grant access to others (ZPR, 2011).

Other applications of the ZPR are the Medische Encyclopedie, zelfmanagement dagboeken, ZorgSite, Rijnmond Connect and Navigator.

Contacts that are interviewed: Aernout Visser, innovation broker health care in Rotterdam and project leader at Zorgportaal Rijnmond. Anne Marie Weggelaar, program manager of the Zorgportaal Rijnmond. Frans van der Meché, chairman of the EDBR Taskforce Medisch en Zorg. Pieter van Rijn, program manager Medisch & Zorg. Nick van den Berg, senior project manager economy for urban development and works on ICT infrastructure for health care.

- Diabetes Station

The number of diabetic patients is increasing 9% annually. The capacity to handle the number of patients cannot meet this growing demand in the future. Eric Sijbrands, internist at the Erasmus MC, designed a *virtual doctor* that can substitute a *real doctor* for diagnosing patients. Diabetic patients need to be diagnosed about four times a year to monitor the development of their disease. Often there is no need to adapt treatment and the patient goes home again. This is a sub-optimal activity for a doctor because there

are waiting lists and the current capacity is already reaching its limits.

The Diabetes Station is an interactive measurement station where diabetic patients can independently measure certain vital values. Such a virtual doctor is not bound to a hospital location and can be placed anywhere in public spaces where people go anyway, like for example shopping malls, train stations, etc. Also reducing pressure on the infrastructure of health care providers. In sense, it substitutes regular diagnostic visits personally with a doctor. If any of the measurement results fall outside a preset bandwidth, the patient is still redirected to a doctor who will decide if treatment needs to be adapted. If critical values are measured an ambulance is immediately sent to pick up a patient.

Feedback from the Diabetes Station can be provided in anyone's own language. This means that patients don't need to bring someone to translate the doctor's advice if they don't speak Dutch. In Rotterdam there are 167 different nationalities with many non-Dutch speaking patients. People from different cultures also regard illness and health care differently. Especially with chronic diseases like diabetes, you don't have to 'feel sick' per se, but treatment is already very important in an early stage. The cultural setting is thus important for treating diabetes and a virtual doctor can take this into account and give personalised advice.

Although diabetes is a very complex disease, it can be approached using a clear protocol. The standard diagnosis in which a doctor can be substituted consists out of measuring weight, BMI, glucose levels, an eye photo, foot photo and blood pressure.

The Diabetes Station is not marketed as a machine, but as a fully integrated 24x7 service to health care providers. This means that the patient can login and do measurements himself, then the results are interpreted and compared to a preset bandwidth, and sent to his or her doctor. This service is provided by IPT Telemedicine (KPN) and the Erasmus MC.

The Diabetes Station can thus increase the capacity of the health care chain (ketenzorg) and let doctors focus on treatment. For patients it is easier to be diagnosed, they don't have to go to a hospital and feedback is provided in their own language. This increases the independency of patients from doctors.

Contacts that are interviewed: Rob Posthumus, manager at the Erasmus MC Technology Transfer Office. Joop Wallenburg, director at IPT Telemedicine. Eric Sijbrands, internist who initiated the Diabetes Station.

- Health care domotics

Domotica refers to technologies and services for intelligent housing or home automation. The word derives from the Latin word *domus* (meaning house) and *informatics*. Domotics include a wide range of applications, but this thesis focuses only on the health care variant where a screen-to-screen connection is involved. The goal of health care domotics is to ease living and enable people to live independently. Especially older people that otherwise require extra care or live in nursing houses can live independently for a longer time. From a distant location health care providers can monitor, support or intervene when something is wrong or help is needed. For domotics we can see a strong combination of housing technology with a surrounding service to provide health care.

Health care solutions for older people through domotics fall under *extramural care* or *home care*. This means that older people as users are able to live independently instead of in a nursery house. It can be that a nursery house is located next to a living complex and

services are shared, but this does not need to be so. Senior people indicate that they want to live longer independently as well, because it would improve their living quality (Sponselee et al., 2008; Lockhorst, 2010). Stichting Ouderenhuisvesting Rotterdam (SOR) is a housing corporation that provides housing for seniors. Because plans for implementing domotics in new houses combined with the necessary health care services were developing slowly, the SOR decided initiate a project themselves. They choose Erasmusbrug to handle the alarm service and Niko Projects to develop the technologic system. Erasmusbrug offers a 24h service that is integrated with the domotics. Niko Projects develops domotic technologies and computer systems that are implemented in houses.

Contacts that are interviewed: Joris Teulings, Niko Projects. Josephine Dries, SOR. Luc van den Heuvel, Erasmusbrug. Wim Nattekaas, Aafje.

DATA GATHERING

Data is mainly gathered by conducting interviews. Interviews are held with entrepreneurs, managers, scientists and other representatives of organisations involved in the selected projects. Interviewing is regarded as one of the most important and essential sources for case study information (Yin, 2009) and provides rich in-depth data. The interviews are semi-structured, enabling an open conversation that can contain valuable additional information. Because the cases are all in an implementation/scaling phase, the development is still fresh in mind of most people. It is also easier to reach people who are (or were) involved because the cases are not too old. This resulted in personal case descriptions, containing interesting additional answers that could not be anticipated on beforehand. See appendix 1 for an overview of the interviews.

A documentation search is made through the internet, annual reports and similar sources to complete the data collection and cross check the validity. Eighteen people are interviewed over half a year and some are interviewed twice. The interviews took approximately 1 hour. The data validity is checked by interviewing different people on the same topic over time and using other sources, often referred to as *triangulation* or *cross-examination*. Although different perspectives of the respondents, no conflicting data was found.

Internship

From the February 1st till November 1st 2011, I was placed for an internship at the Economic Development Board Rotterdam (EDBR). "The Economic Development Board Rotterdam submits recommendations relating to the city's economic development to the Municipal Executive, both by request and at its discretion. The Board, with approximately 30 members, brings representatives from the authorities, business community and institutions together and takes action designed to accelerate the implementation of economic policy. [...] The EDBR identifies promising economic projects and promotes rapid execution of the projects and implementation of the policies with the objective of accelerating and enhancing the development of Rotterdam's economy. Consequently the EDBR's guiding principles are 'prioritise, connect and accelerate'."[2]

[2] www.edbr.nl, 2011.

The EDBR released the advisory report *Op Kop in Zorg* in 2008 about health care opportunities in Rotterdam. Because they might engage in a new health care project they are interested in innovation in this sector. The EDBR has a very extensive network of interesting people from companies, health care organisations, knowledge institutes, the Erasmus University and the local government that has been valuable for this research.

METHODOLOGICAL FRAMEWORK

This thesis integrates of *dynamic service innovation capabilities* and the *regional innovation system*. To combine these theories, the involvement of different RIS actors is described along dynamic service capabilities. There are different parties in place that are involved with and contribute to the innovation cases. These are actors in the RIS of Rotterdam and applying this model indicates how certain activities and capabilities are distributed amongst them.

In order to link these capabilities to the RIS, a focus is applied on several actors. Instead of describing every possible actor, the RIS is simplified to five actors that provide a representation of the RIS in total. The following actors are expected to be the most influential, represent the RIS and are relevant for health care service innovations: *Service innovator,* Patients/citizens (u*sers), Health care providers (users), Partners, Knowledge Institutions,* and the *Local authorities* (see figure 3). The actor group *users* is twofold. On the one hand patients or citizens are end-users, but on the other hand health care providers can also be customers and utilise new services. Therefore the actor group *users* is split up.

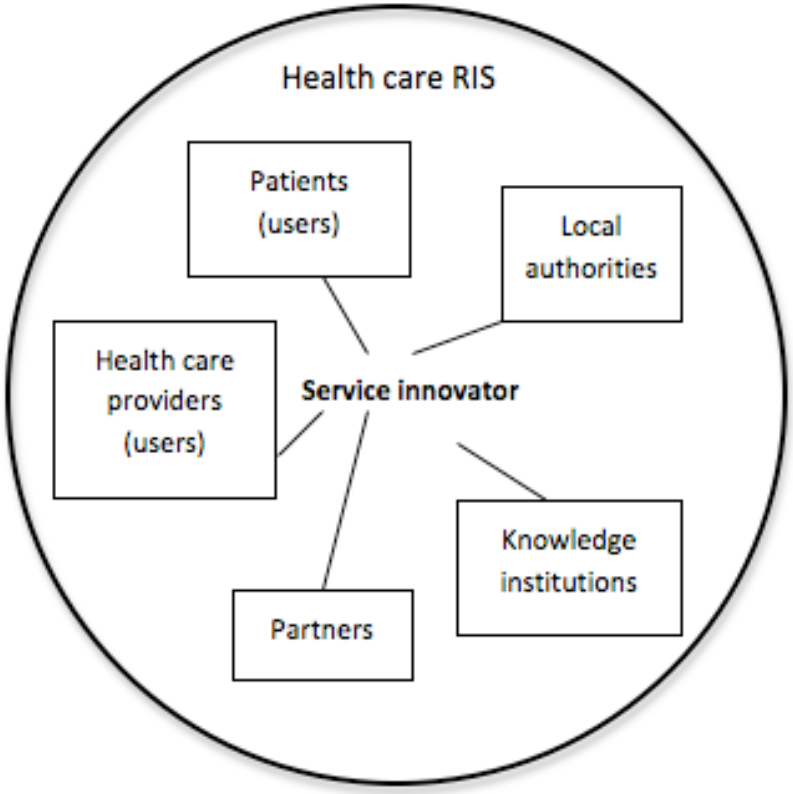

Figure 3. Actors in the health care RIS.

These five actors link to different building blocks of the regional innovation system as depicted in figure 2. Both the *knowledge generation & diffusion* and the *knowledge application & exploitation* subsystem are represented by these actors, as well as the local authorities represent the *policy* actor. The role each actor plays in different facets of the innovation process is especially interesting. Actors can support the process, but also hamper success. This

integration helps analysing the importance of the environment in which the service innovation process takes place.

As mentioned earlier, the innovation process is investigated using dynamic service capabilities. How these dynamic capabilities are distributed among the participants (RIS actors) is described along the outline of table 1.

Role actors	Service Innovator	Patients / Citizens (users)	Health care providers (users)	Partners	Knowledge Institutions	Local Authorities
A. Signalling user needs & technological options						
B. Conceptualising						
C. (Un-)bundling						
D. Co-producing & orchestrating						
E. Scaling & stretching						
F. Learning & adapting						

Table 1. Distribution of dynamic service capabilities among actors.

With this framework the role of actors in the innovation projects is analysed. This role can be different per innovation case as well as for every dynamic capability. For example, a certain actor can be very important for signalling opportunities, but make no further contribution in the process.

INDICATORS

The set of dynamic capabilities as presented by den Hertog et al. (2010) forms a useful basis to analyse how service innovations are managed. They represent different aspects of the innovation process. In many cases they are strongly interlinked and even overlapping. This indicates the evolutionary fashion in which the process of innovation tends to proceed.

For some capabilities specific data is hard to find due to the codified nature of processes, while others can be identified very clearly. A clear set of indicators is missing to *measure* these dynamic capabilities. However, *related activities* provide insight in the presence of dynamic capabilities.

The dynamic service capabilities are indicated by several observable activities that point to their presence. With such a set of indicators it can be determined how dynamic capabilities are distributed among participants. A set of indicators is a useful guideline for the interviews and to identify the dynamic capabilities. The semi-structured interviews also provided interesting additional information.

Indicating dynamic capabilities

In the theoretical description of the dynamic service innovation capabilities the goal of every capability is explained as well as how they contribute to managing service innovation. How these goals are reached is however a more practical question. Certain activities, tools or techniques can help achieving these goals and indicate the presence of dynamic capabilities. Although the goal of a dynamic capability is rather fixed, there are numerous ways in how it can be achieved. A list of indicators is presented in table 2 as an example and guideline for identifying dynamic service capabilities. Other

examples are encountered during the data collection and when describing dynamic capabilities in innovation cases. The same dynamic capabilities are observed in the cases, although they are not always achieved the same way.

Dynamic service capability	Indicating activities
A. Signalling user needs & technological options	**- Understand (potential) users and their values** *Dialogues; Joint experimentation; Prototyping; Pilots; Trend analysis; Analyse how services are used; Client profiling* **- Search for technological options** *Make people responsible; Development function; ICT department; Discus with (groups of) technological providers*
B. Conceptualising	**- Translate idea into operational service offering** *Creative process / think out of the box / open service innovation culture; Conceptualise; Design; Prototype; Experiment; Entrepreneurship*
C. (Un-)bundling	**- Architectural reconfiguration to create new service experiences** Divide services in smaller elements; Make new combinations
D. Co-producing & orchestrating	**- Manage innovation beyond the boundaries of the firm** *Engage in partnerships; Build relations and trust; Co-design; Co-produce; Customer interaction; Executive capabilities/activities; Open innovation structure*
E. Scaling & stretching	**- Diffuse service** *Implement service in other locations; Branding* **- Stretch service portfolio** *Marketing; Use successful brands for new services; Enter new markets*
F. Learning & adapting	**- Deliberately learn from how innovation is managed** *Keep track of failed and successful efforts; Reflect on process; Evaluation; Adapt and improve capabilities/management*

Table 2. Indicators/activities for dynamic service capabilities (den Hertog, 2010).

4. CASE RESULTS

In this section the results of the interviews and alternative data sources are presented. First the case history is described for every case and second the presence of dynamic service capabilities is investigated, as well as how these dynamic capabilities are distributed among the participants.

CASE DESCRIPTIONS

The case descriptions are based on interviews with representatives of involved organisations (see appendix 1 for an overview). Additional data is gathered from documents and internet sources.

Case history Zorgportaal Rijnmond

The idea to install an online health care portal has various backgrounds. In June 2008 the EDBR mentioned a health care portal in their advisory report *Op Kop in Zorg* (Ahead in Care). The report addresses the challenge of an increasing health care demand due to more treatment possibilities, increase of chronic diseases and an ageing population. The report argued that, following the current trend, in 2030 one fourth of the population of Rotterdam would be working in health care, compared to what is now one tenth. In the report the vision is pronounced that self-control and independence of patients/citizens are central topics for future health care development. With more self-control citizens can perform certain tasks that otherwise must be done by the health care provider.

The value of such an online health care portal is compared with internet banking, where the banking sector introduced internet banking. The report also states that health care providers are ought to compete in the market, therefore the local authorities should help investing. Such an online portal should be a clear path for citizens to the most suitable care and provide better insight in health care offering as a whole (EDBR, 2008).

Before the EDBR report, the Erasmus MC and the Sint Franciscus Gasthuis already discussed possibilities to develop a regional electronic patient record (EPD). This was a response to the discussion around the national EPD that proved to be more complex than expected. The EDBR involved important actors of the health care sector in the *Taskforce Medisch en Zorg*, to look for the best health care solutions. Representatives of various organisations that participated in this work group include the Erasmus MC, Sint Fransiscus Gasthuis, Stichting Rijnmondnet, the GGD and others. By involving important regional players in the discussion, the EDBR hoped to not only to formulate a shared focus and vision, but also create support in the market.

Yet, the market was not so eager to pick up the initiative. The local authorities were reluctant, as there were no funds to invest with. In 2008, Anne Marie Weggelaar was program manager of ER program (Economic development Rotterdam health care) of the OBR (Rotterdam Development Agency). The ER wanted to do something more serious with the advice. If Rotterdam was to develop and grow in e-health, certain standards must be set among institutions. From the EDBR work group first contacts where already made as well as an indication of what other organisations would be interested. Anne Marie Weggelaar switched from the ER program to become program manager for the Zorgportaal Rijnmond (ZPR).

In the end of 2008, the opportunity occurred to request subsidy with the *Pieken in de Delta* (Peaks in the Delta) program. The newly formed consortium submitted this request with help of a PhD researcher. For the *Pieken in de Delta* subsidy, half of the amount must be financed by the municipality itself. In search for funds, they contacted the GGD (Municipal Public Health Service) because they had money to invest in e-health and this could be an interesting project for them as well. This was a bit of a hassle, as it is very unusual to combine municipal funds like this. With the Pieken in de Delta program, €1,3 million was granted, of which half paid by the Ministry of Economic Affairs and half by the Municipality of Rotterdam. The consortium co-financed €300.000.

The ZPR is founded in a public-private partnership and strives for, what we could call, a triple-helix collaboration (industry-government-university). The consortium under which the ZPR is constructed includes: the Erasmus Medisch Centrum, Sint Franciscus Gasthuis, Stichting RijnmondNet, Star Medisch Diagnostisch Centrum, Zorgimpuls, instituut Beleid en Management Gezondheidszorg of the Erasmus University, Brink&Zorg, and Leene Communicatie. Each party makes a substantive, technical, organisational and/or practical contribution to the creation of the ZPR[3]. What the criteria are for organisations to take part in the consortium is unclear, rather individual cases are assessed.

In September 2010, the first test phase started with a group of 12 users. This group tested the ergonomics, security, usefulness and necessity of the ZPR. After evaluating this first and small pilot, adjustments were made and a second pilot was set up in October 2011. This second pilot involved 200 patients of the Erasmus MC

[3] https://www.zorgportaalrijnmond.nl

that were connected to the Medisch Kerndossier. It involved three patient groups with: Cystic Fibrosis, haemophilia and head-neck oncology. The group of patients with Cystic Fibrosis also tested the ZorgInfo TV, one of the applications on the portal. Monthly broadcasts on different topics were available to them. The evaluation of this pilot also includes a business case to determine the cots per broadcast. The third pilot phase involves 2000 patients that are connected to their Medisch Kerndossier.

Pilots, applications and other developments of the ZPR are evaluated with the intention to draw lessons from. The ZPR attempts to make the evaluations useful by linking them to the field of e-health research. Collaboration with knowledge institutions and researchers is one way to get new insights and scan for opportunities. The Research Platform Zorgportaal involves e-health researchers from different institutions who meet four times a year and exchange research findings and ideas. The consortium can post specific questions here for future developments.

"We proberen applicaties altijd onderzoekbaar te maken." – Anne Marie Weggelaar

The basis of the ZPR is now in place and it is ready to be used on a larger scale. In September 2011 the ZPR was officially launched with an opening ceremony. Applications for voluntary care are already in use by 500 people around 80 patients. Today, the website has about 100 unique visits every day. The ZPR is set up in a way that three types of users can be distinguished: Patients, citizens and health care providers.

The consortium decided that more citizens and health care providers must be involved to diffuse the ZPR further within the region. To reach more people and organisations, contact is sought at meetings, round table discussions and so forth, to discuss possible options. The focus is still mainly on the Rotterdam region, but there is also involvement in the Medical Delta, a health care initiative based on the synergy between Rotterdam, Leiden and Delft universities.[4] There is also interest from other regions in the Netherlands, as well as from Flanders. The online portal of the ZPR system can easily be copied to other regions and is based on open source software. Organising such regional collaboration can however be very difficult and Rotterdam is a good example where this proved successful. Regions can in the future be linked through networks of local health care portals. Whether this is useful or even desired is not yet clear for the consortium.

The Spider Award of 2011 was granted to the ZPR for being the most innovative ICT project in health care. The ZPR won for being a successful example of regional collaboration among many parties and an example for similar initiatives.[5] This indicates some of the potential it has to further scale in the region, but also diffuse to other regions.

The ZPR itself will never be profitable though. The intention is to make the health care sector more efficient. The benefits will be for the organisations that make use of the portal as well as for citizens and patients. The third and last year of the granted subsidy starts in 2012. The discussion thus started on how to continue the ZPR and who should invest in its future. A new subsidy could be requested, the local authorities can continue to co-invest together with health

[4] http://www.medicaldelta.nl/about

[5] http://www.zorgvoorinnoveren.nl/nieuws/519/zorgportaal-rijnmond-winnaar-van-de-spider-award-2011

care organisations, but there might also lay a role ahead for insurance companies who benefit from reduced health care costs.

Case history Diabetes Station

Eric Sijbrands, internist at the Erasmus MC, identified two specific problems for diabetic. The first is a capacity problem. Diabetes is becoming a more common disease. There are 800.000 diabetic patients in the Netherlands and 55 million in Europe, this number of patients is increasing and we need to reconsider how to offer diabetic care with a limited amount of doctors in the future. The second problem relates to the multi-ethnic population in Rotterdam. In Rotterdam there are 167 different nationalities, a diversity that is also present at the Erasmus MC where 60% of diabetic patients is non-Dutch. Diabetes type-2 occurs more often among people with an African, Asian, Hindustan, Cape Verdean and Turkish background, especially in combination with overweight this is dangerous and occurs more often within these groups[6]. A language and cultural barrier makes it more difficult to communicate treatment. The cultural background of patients is important for treatment of chronic diseases like diabetes. For example: someone with a Moroccan cultural background is less likely to see a doctor unless something is really wrong. With diabetes you don't have to feel sick while treatment is needed to avoid further complications. The multi-nationality of patients involves many different languages, making communication more difficult. Communication is an essential aspect for treatment of diabetes. Often a son, daughter, nephew or friend is brought along to translate the conversation, creating a barrier to communicate complex information. This language barrier can result in failure of the right treatment.

Diabetic patients need to diagnose certain values 4 times a year to determine whether their disease is developing and their treatment must be adapted. For patients that are in a further stage of diabetes, which is often the case at the Erasmus MC, this number is higher. Three out of four times these diagnosis values are stable and no further actions need to be taken. For a doctor with a policlinic full of patients, this is a sub-optimal activity as 'nothing' is done. For diabetic patients it should not be necessary to go to the hospital for such visits. This is also why diabetic care is being moved towards the 1st line in the health care chain (ketenzorg), such as general practitioners. Moving diabetic patients away from the hospital decreases the pressure on the hospital infrastructure and people can be treated more in their own living environment.

Diabetes is a complex disease, but can be approached using clear protocol. Eric Sijbrands wanted to find a solution to the problems that are mentioned above. His plan was to develop a *virtual doctor* that could substitute a *real doctor* in diagnosing patients. This virtual doctor should of course solve the earlier mentioned capacity problem and be able to communicate in someone's own language and cultural setting. The Diabetes Station allows people to make such a personalised diagnosis themselves without seeing a real doctor. This can be done anywhere and is not necessarily bound to a hospital location or any health care institution, but could be placed at train stations, shopping malls or other places where people go anyway.

An earlier idea Eric Sijbrands rejected is giving diabetic patients their own diagnosis devices. Making a diagnosis at home would of course be the perfect location, but also poses some problems.

[6] http://rotterdam.dvn.nl/regionieuws/diabetesstation

Because of the numerous patients, many devices from different suppliers will emerge. It should be very clear what device is used for what results. Processing and interpreting all these different results would be too complex. This creates a lot of work and is prone to errors. Rather a *golden standard* is needed to guarantee the accuracy. Although there is good equipment, it can still be used in the wrong way, causing false measurement results. Diabetes is also a disease more common in a lower social-economic class. The costs for these personal diagnosis devices will probably be for the patients themselves, putting them under more financial pressure.

"Met 800.000 diabeten in Nederland en 55 miljoen in Europa is er een enorme markt en dit leidt alleen maar tot een wildgroei aan verschillende apparaten, neem als voorbeeld maar simpele bloeddrukmeters. Dit zou te complex worden om data te verwerken en interpreteren door een gebrek aan een 'gouden standaard'." – Eric Sijbrands

The best diabetologist is in the machine itself, because the knowledge of different experts can be combined. It does not have to matter whether you are being treated at the Erasmus MC, in Manhattan or East-Turkey. As patients gain more control over their health care and can be diagnosed closer in their living environment their independence is increased as well. The virtual world can solve some problems that are not easily overcome otherwise. For example it would be best if diabetic patients get the feeling they tell themselves to loose weight, take medicines etc. instead of being told to do so by a doctor. Concepts as serious gaming or gamification can help making treatment more playful and can be build into a virtual doctor.

Eric Sijbrands contacted the Erasmus MC Technology Transfer Office (TTO) to look for possibilities to develop such a virtual doctor. The TTO advises about what seems a fruitful route to follow and together they searched for suitable partners. The first prognosis was a development trajectory of 5 years. Through the TTO Eric Sijbrands got in touch with Joop Wallenburg, director of IPT Telemedicine, a daughter company of KPN. Joop Wallenburg was able to build a prototype in half a year, starting in his own garage. The first version was placed in the Erasmus MC for certification. Because health care deals with people's wellbeing and sometimes life or death, quality has a high priority and is monitored strictly. Therefore only *proven* or *evidence based* technologies are accepted (Blankers et al., 2012) and such validation can often take longer time.

"Ik had verwacht dat veel mensen problemen zouden hebben met deze benadering, maar dat is mij eigenlijk zo ongelofelijk meegevallen. Ik heb geluk gehad dat ik een techneut tegenkwam die het probleem begreep, heel snel oplossingen aandroeg en zich heel flexibel opstelde." – Eric Sijbrands

The prototype was first tested in the Erasmus MC, the diagnosis results were compared to those done by the doctor himself. Patients were also involved for feedback in the pilot phase. The user satisfaction questionnaire did not provide any useful feedback, as patients all seemed to be 'very satisfied'. There was only one patient who made a comment and asked for a larger font, which is later issued in an upgrade. The best test for user acceptance of the Diabetes Station was when it was closed for an upgrade. Patients asked at the counter when the station was fixed and went home.

They preferred the diagnosis of the Diabetes Station over the regular doctors consult.

For both the Erasmus MC and KPN the collaboration between an academic medical centre and a telecom provider is new. Both partners are the only investors in the project and have a different task. Eric Sijbrands is responsible for the medical content, while KPN is technically responsible. Both organisations complement each other in this development and there is no direct competition between them, this is fruitful for their collaboration. There are, however, differences in organisational culture. KPN looks at company results over a time-span of one month, while the Erasmus MC focuses on solving the problem on the long term. The TTO fulfils an important bridging function to overcome these differences. An example is how both organisations write a business case. For the TTO this can be 2 sheets long, while KPN preferred a more detailed plan of 14 sheets. Also IPT Telemedicine has a bridging function to increase legitimacy within KPN and overcome organisational differences. IPT was acquired by KPN in 2008, but still has individuality as an organisation. That Eric Sijbrands and Joop Wallenburg understand each other and share a same vision seems very important for success in this perspective. Differences in approaching a business case can reduce mutual trust, which is important for collaborating. Accepting such differences and understanding each other was an important learning process for both parties.

"Samenwerken als je elkaar niet vertrouwd, dat kun je vergeten." – Rob Posthumus

The partnership and management of the alliance cam be depicted as: Eric Sijbrands <–> TTO <–> IPT <–> KPN. Where both the TTO and IPT Telemedicine fulfil a bridging function and have to find a way to collaborate although some organisational differences. Eric Sijbrands is connected to KPN via the TTO. He does have personal contact with Joop Wallenburg, which is mostly substantive about the de development and opportunities for the Diabetes Station. The TTO rather handles the business content.

Although Eric Sijbrands started the idea of the Diabetes Station, it is not so much a solution for him at the policlinic of the Erasmus MC, but rather for the health care chain (ketenzorg). At the Erasmus MC most diabetic patients are in a further developed stage of diabetes and 87% already suffered a first heart attack. These patients need more intense care. The Diabetes Station can help, but not substitute a doctor as well as with less severe cases of diabetes. It is especially functional to increase the capacity of the health care chain.

The Erasmus MC is on the one hand a hospital, but on the other also a knowledge institution being an academic hospital. It is involved in Medical Delta[7], an initiative based on the synergy between Rotterdam, Leiden and Delft universities. The TU Delft is also collaborating for further development of the user interface and ergonomics of the Diabetes Station. At the TU Delft there is room for testing and development similar to a living lab.

The Diabetes Station is now in its implementation and scaling phase. Medical professionals are very important for acceptance. Changes often induce resistance, for example doctors can regard the Diabetes Station as a loss of income, which can be a short-term

[7] http://www.medicaldelta.nl/about/

effect. They are not so eager to perform their profession in another way. Eric Sijbrands is active in an international peer network of medical professionals. Besides following state of the art medical developments this is important to get the Diabetes Station accepted in the professional community. KPN for example also has an extensive network, but is not as convincing being a commercial organisation.

"Een remmende factor is de bereidheid van artsen om hun beroep op een andere manier uit te voeren. […] In het algemeen is de urgentie tot verandering heel laag, dat is ook algemeen zo voor mensen in de medische stand." – Joop Wallenburg

IPT Telemedicine collaborates with over 4000 general practitioners and is in conversation with many doctors. This is necessary to know the market and being accepted. Their strategy is not to only sell products but to provide an integrated service and constantly look for problem solving solutions. The Diabetes Station is put into the market as a 24x7 health care service by which all diagnosis results are processed as well. Users are asked for advice and provide important feedback to improve this service.

The Diabetes Station must of course also be financed. The patient is the end-user, whose care is paid by his or her insurance company. The real customers are the health care providers and they need to make an investment to acquire a Diabetes Station. They must be willing to collaborate and offer diabetes care in this way.

Another very important actor group regarding finance are the insurance companies. They are enthusiastic about the Diabetes Station as they can have much profit, especially on the long term, but don't seem to participate. Although they should be somehow involved with health care innovation they made no primary investments, but redirected a subsidy request to government subsidies. It can be politically difficult to legitimate nationwide investments while costs must be reduced. They are willing to pay, but only in refunding visits to the station.

"Een van de remmende factoren is dat zorgverzekeraars, schadelastverzekeraars zijn geworden. Ze zijn niet meer alleen gericht op zorg, maar ook op winst. Dus de veranderingsbereidheid van een zorgverzekeraar wordt geremd door hun behoefte om toch winst te maken en daar controle over te behouden." – Joop Wallenburg

In other countries the same decision taking process to implement the Diabetes Station appears to be faster. Diffusing the Diabetes Station in the Netherlands thus takes a lot of time and effort, also to get all involved parties in the health care chain aligned. In other countries diffusion might go faster, four stations are for example sold to Ankara and Germany also placed orders.

Because the Diabetes Station is now being implemented, it has not been evaluated yet. Of course the pilot phase with the prototype has been important to make improvements, but this was on a small scale. The Technology Transfer Office of the Erasmus MC evaluates projects like these and will do so at a later stage when there is more to say about successes or failures. For IPT Telemedicine it appears that there is no explicate learning activities. It builds up to their long experience with medical technologies and services.

Case history health care domotics

The Netherlands is facing an ageing population due to post war baby boomers who are retiring now or will be in the near future and people reaching a higher age because of better medical health care etc. Older people require more intensive care and are not always able live independently. Therefore the demand for home care, nursery and caring homes will increase[8]. Health care domotics can assist people in living more independently. This can involve a wide range of supporting services, although central to the system is an alarm function. In case someone needs immediate care by getting injured for example, help can be organised via this alarm. This can involve a professional health care provider or a volunteer.

Although many organisations regard health care domotics as a fruitful development, only few appear to have implemented it. Clearly no standard can yet be identified in the market, although it seems that there is a large potential. The housing corporation SOR (Stichting Ouderenhuisvesting Rotterdam) together with Erasmusbrug and Niko Projects have engaged in a domotics project that is discussed here. The SOR set the goal in 2008 to realise 1000 homes with a health care domotic system. In 2011 600 homes have been realised so far.

The living complexes of the SOR are high-rise buildings. The more regular intercom to the front door of each house was changed to a video intercom. This enabled a more intelligent network among these video intercoms and supply them with additional functions. Tromp Bakker, CEO in 2008, wanted living concepts to develop and adapt to future demand. Technology, in his opinion, cannot be erased from our daily life and neither from that of seniors. A housing corporation can play a role in this perspective by offering technologies in combination with health care to ease living. In 2008 is when first conversations started with other parties to realise such a project. Niko Projects is a technology provider that builds domotic systems. They find it very important that their products do not look like health care technologies. People want to stay independent and do not want to depend on health care.

"Alle producten die we leveren mogen absoluut geen zorg uitstralen." – Joris Teulings

Erasmusbrug is specialised in ICT in the health care sector. They are handling alarm calls as an emergency centre and are responsible for directing these alerts to the right person to follow-up the call. It is their job to guarantee a secure and reliable 24/7 connection between the living complex and the health care provider.

"*De beveiligde verbinding tussen woningcomplex en zorgcentrale zijn duurdere lijnen, geen consumenten internetlijntje. Dat wil je dus ook onder meer mensen verdelen. Alarmering moet altijd werken! Beeldcommunicatie of consult hoeft minder betrouwbaar te zijn. Als dat het een keer niet doet is minder erg."* – Luc van den Heuvel

After more exploratory conversations these three organisations started the project in 2009 and in 2010 the first living complex was completed with domotics. This involves the Niko G5 touch screen including a neck or arm transmitter with an alarm button. When pressed, the system contacts Erasmusbrug and care personnel can be sent. This involves health care providers that are contracted to

[8] http://www.medicalfacts.nl/2008/11/28/scp-tot-2030-groei-van-zowel-publieke-als-particuliere-zorg-voor-ouderen/

react to these alarm calls. The touch screen can be used for additional services and communication apart from a screen-to-screen connection with a health care provider.

Many parties are involved to organise health care from a distance in this way. The contracted health care provider can differ for different living complexes. This has led to some contractual difficulties. By choosing Erasmusbrug, other emergency centres are excluded. Erasmusbrug has invested in hardware and software to be able to handle these kinds of calls and of course wants to get a return on their investment. Different health care providers can have contracts with other emergency centres to handle their alarm calls. Such contracts are not easily opened. The contracted health care provider is often decided by history and location and cannot easily be changed. According to Josephine Dries this is why it takes a lot of time for such projects, too long in her opinion. It happens more often in the health care sector, maybe organisations do not know what they want or dare to make decisions.

"De klant woont wel in een complex van de SOR, maar is ook weer een klant van de zorginstelling. Die zorginstelling moet ook weer afspraken maken met de meldcentrale, niet de klant zelf. De meldcentrale zit daar tussen en je hebt dus verschillende ketens die bij elkaar komen en aan elkaar verbonden zitten. Die onderhandelingen hebben daarom erg lang geduurd, Je hebt niet alleen met technologie te maken, maar ook met verschillende contracten die zorgverleners hebben met andere partijen." – Luc van den Heuvel

By contracting Niko Projects, other technology providers are also excluded from participating. The SOR made these decisions because no one else seemed to take the role of project leader. Other parties do not always appreciate this because it leaves no room for alternative choices. In fact, Josephine Dries indicated that this leads to a very closed system because they are also handed over to the system of Niko Projects. They are already thinking about their next generation of products, while the SOR wants to improve the use of the G5 system that is installed now.

Although the project develops slow, the 600 homes in which the system is now installed was implemented too quickly on a large scale according to Josephine Dries. It would have been better to start with 100 homes. The implementation followed the pilot too quickly, so not all start-up problems could be solved. Scaling this domotic system is therefore slowed down, as they first want to implement it correctly. None of the partners seems really content with the current system. The touch screen is not easily accessible for everyone as it positioned in the hallway and the interface is too complex for some people. The completion of living complexes with health care domotics is however a breakthrough in which most effort went into aligning partners and engaging in a new alliance.

"In 2008 zijn de meeste gesprekken geweest, in 2009 is daadwerkelijk gestart en in 2010 zijn de eerste complexen opgeleverd. Er is lange tijd overheen gegaan voordat we daadwerkelijk klanten konden ontsluiten." – Luc van den Heuvel

The current system does enable alternative services that can be offered via the touch screen. This can include Skype, news feed, ordering a taxi or hairdresser, groceries, etc. Different parties are interested in offering such services that can ease living.

Erasmusbrug for example wants to offer such services, enabling them to get an additional income.

To conclude, this case of health care domotics does not appears to be very successful yet. Some call it a missed case, although all parties recognise that there is a large potential that can support the growing pressure on health care. Domotic systems that can support people in living independently hold advantages for both the residents and the providers. However, there is no standard yet, resulting in high costs and no satisfying system. But different projects start to emerge and many parties in the Rotterdam region are looking for opportunities.

"Het liefst gebruik je zo veel mogelijk standaard elementen en probeer je te standaardiseren. Je wilt niet allemaal aparte dingetjes creëren, dat is niet beheerbaar." – Luc van den Heuvel

DYNAMIC SERVICE CAPABILITY RESULTS

In this section the dynamic service capabilities are used to analyse the cases. The indicators in table 2 are a useful guideline. For each case is discussed how the dynamic capabilities and related activities are present and distributed among the participants. Each capability is concluded separately with a small table to summarise.

Dynamic capabilities Zorgportaal Rijnmond

The case of Zorgportaal Rijnmond (ZPR) clearly involves many parties with different ambitions and different capabilities. In this section the presence of these various capabilities is investigated, as well as how they are distributed amongst the participants. This analysis provides an insight in how they shaped the development of the project.

A. Signalling user needs & technological options

How was signalling accomplished in the ZPR case? A clear example of signalling is the 2008 EDBR report *Op Kop in Zorg*. This report was based on documents, trend analyses, SWOT analyses, interviews and discussions with key persons and representatives of organisations. The report was a landmark in the development of the project and guided further negotiations and plans. In the 2010 and 2011 annual reports of the ZPR, the EDBR report is identified as the background of the project. Yet, the capability signalling in the ZPR case is not exclusively related to the EDBR. In fact, it seems that the EDBR report is based on and embedded in the *numerous small acts* of signalling that occur on an ongoing basis in the network of health care providers, local authorities and other organisations. An example is that the Erasmus MC and the Sint Fransiscus Gasthuis were already looking for the possibility to create a local electronic patient record (EPD). Both became closely involved in the EDBR work group *Taskforce Medisch en Zorg,* involving other representatives of important health care organisations, institutions and EDBR members. The *Op Kop in Zorg* report, as the result of this work group, collected and framed the general assessments of the threats in health care and pronounced a shared vision how to seize opportunities with these challenges at hand.

The EDBR report and surrounding activities seem to be key for signalling in the ZPR case. The number of parties involved in this process is remarkable. Two main aspects of signalling need some more attention however. These are the capability to understand users and to search for technological options (den Hertog, 2010).

- Understand (potential) users and their values

User values are clearly described in the EDBR report. Both patients or citizens and health care providers are identified as users in this case. For patients the main value appears to be greater independence and control over one's health care. Dialogues with patients and trends seem to point in the direction that people are willing take over certain tasks of health care providers in organising their own health care. This is illustrated in the report and compared with the example of internet banking.

For health care providers the value especially lies in the organisational field. Administration related activities consume much time in health care. The trend analysis in the EDBR report shows that by 2030 one on four people in Rotterdam would be needed in health care. There seems to be a consensus that the need for more efficient ways to deliver health care is imperative, although there is not one easy solution. Health care providers are also able to reach many patients in the region through the ZPR as a central portal.

Signalling does not only take place at the start of a project. During the development of a service there are many occasions when valuable information can be gathered and opportunities are identified. Pilots seem to play an important role in developing the ZPR. In three different pilot rounds with an increasing number of people, it is analysed how patients use the ZPR. With the same goal new applications are evaluated to acquire knowledge about users and their values. These activities are organised in a systemic way and pursue the goal to interpret these signals, indicating the capability to understand users.

- Search for technological options

Another aspect of signalling considers interpreting technological options. To get more insight in such possibilities, technological providers or such related actors can be involved. We can see this happening as Stichting Rijnmondnet was early involved in the EDBR *Taksforce Medisch en Zorg.* They handle data transfer between health care providers in Rotterdam and provide the infrastructure for such ICT. One of the advices deriving from a technological assessment is to invest in fibreglass to facilitate a fast internet connection. In a SWOT analysis such pros and cons are analysed for an online health care portal.

To conclude, signalling in the case of ZPR is delegated to the EDBR, but also based on a collective assessment of threats and opportunities for health care by authorities and health organisations that meet regularly. These parties, in their turn, are connected to others, outside the Rotterdam region. Both the capability to understand users and the capability to search for technological options are present in this process. In the collaborating effort of the EDBR report it is less clear which actor is exactly responsible for what contribution. The signalling capability does however not end with the EDBR report, but is present in later stages as well.

Actor	**A. Signalling user needs & technological options**
Service innovator	EDBR initiated the *Taskforce Medisch en Zorg* and formulated vision and opportunities in the *Op Kop in Zorg* report
Patients (users)	
Health care providers (users)	Participate in the EDBR work group
Partners	
Knowledge institutions	
Local authorities	Funds EDBR to advice the Municipal executives

B. Conceptualising

- Translate idea into operational service offering

The vision and concept of an online health care portal are extensively described in the EDBR report *Op Kop in Zorg*. A working service in practice is however a large step further. So how is the idea for an online portal translated into a working service? Although the advantages for the health care sector, the initiative seems to come from the OBR. Considering the EDBR advice as a great opportunity, the OBR wanted to do more with this idea of an online health care portal. The switch of Anne Marie Weggelaar from the ER program to managing the ZPR program looks like one of the first steps in starting the ZPR. She indicated that this choice of the OBR was determining because the market did not pick up the initiative. Forming a consortium appears to be a next milestone in conceptualising the ZPR. Although many contacts were already laid through the EDBR, interested parties still had to form a more official alliance. Anne Marie Weggelaar managed most of this process as an intermediary between the involved organisations.

For realising the ZPR, funding appeared to be very important. The project is expensive and the *Pieken in de Delta* subsidy request offered a solution end 2008. A PhD researcher was contracted to write a request for €1,3 million that was also granted. The different parties in the consortium co-financed a total sum of €300.000.

Clearly pointing to conceptualising is the design of the open source platform. For creating this software, professional companies were hired. Although this is an important example of how the ZPR is translated from paper to a working concept, there is little data on how this actually proceeded. It mainly comprises a software writing process of contracted companies in close relation with the consortium according to Anne Marie Weggelaar. There have been obstacles with juridical issues and security. Even questions have been posted to the minister in the House of Representatives to use the DigiD security. Probably the involvement of influential organisations and the local authorities have been useful to get in this position and exercise lobby power.

Working towards a well functioning service, often includes testing. The pilot phases are therefore another example of conceptualising. The three pilot phases, involving more patients in every round, indicate the capability of developing a working service. High customer intensity of most services makes conceptualising an ongoing process between provider and client (den Hertog, 2010). This interaction is visible with the pilot phases, but also in a later stage where all new applications are evaluated in a similar way. This shows that in the ZPR case conceptualising does not stops after implementation, but is indeed an ongoing process that shapes the portal.

To conclude on conceptualising in the ZPR case, forming the consortium and financing the project were landmarks in getting the idea off paper. Regional collaboration between the many involved parties has proven a time consuming process, but the case is also regarded as a successful example in this perspective. Users, both health care providers and patients played a significant role during the development and participated in different pilot phases. Such conceptualising activities contributed to a working service and are also visible after the implementation. The ZPR was officially launched in September 2011 with an opening ceremony where all partners signed as a token of good will.

Actor	B. Conceptualising
Service innovator	Forming a consortium. Consortium managed by Anne Marie Weggelaar
Patients (users)	Participate in three pilot phases and provide feedback
Health care providers (users)	Entrepreneurs offering health care services and Erasmus MC pilot
Partners	Designing the ZPR software
Knowledge institutions	
Local authorities	OBR provides PiD subsidy with ministry

C. (Un-)bundling

- Architectural reconfiguration to create new service experiences

The capacity to bundle or unbundle service elements is hard to identify from activities alone. The service that the ZPR offers holds more promising answers. It should be kept back in mind that the ZPR is not a health care provider itself. It rather is an intermediary between citizens/patients and health care providers. Citizens can use the portal to organise their health care. This involves both existing and new health care solutions. Through the ZPR citizens can access existing care of different providers. But there are also new health care offerings like the ZorgInfo TV or the Digitale Vraagwijzer. Such different health care offering can all be accessed through the ZPR.

Activities that point to (un-)bundling are not easily exposed. Yet, the online portal clearly bundles both new and existing health care offerings. This is also in line with the goal of the ZPR to become a central portal to organise health care.

Actor	C. (Un-)bundling
Service innovator	Consortium bundles various health care services in the ZPR portal
Patients (users)	
Health care providers (users)	
Partners	
Knowledge institutions	
Local authorities	

D. Co-producing & orchestrating

- Manage innovation beyond the boundaries of the firm

Involvement of different parties and collaboration among them can be identified throughout the whole case. The consortium that initiated the ZPR is an alliance between different regional actors. In an early stage the Erasmus MC and Sint Fransiscus Gasthuis already seem to have found each other, sharing the ambition to develop a regional electronic patient record. Both are also early involved in the EDBR work group *Taskforce Medisch & Zorg*. With the EDBR engaging in the health care sector more parties became involved. The EDBR facilitated a conversation between different executives of public and private actors. In the ZPR case this is seems to be an important start for building relations and offering different parties to take part in the debate. Although the EDBR's activities stopped when the report was finished, their efforts in connecting parties seem to have contributed to the fundaments of the alliance that later formed the ZPR consortium. The EDBR clearly orchestrated this alliance in the start.

The partnership or alliance becomes clearer when the consortium is formed between the Erasmus Medisch Centrum, Sint Franciscus Gasthuis, Stichting RijnmondNet, Star Medisch

Diagnostisch Centrum, Zorgimpuls, instituut Beleid en Management Gezondheidszorg of the Erasmus University, Brink&Zorg, and Leene Communicatie. All executives signed a contract at the ZPR opening ceremonial, although none takes the official lead. The ZPR program and the alliance between the parties in the consortium appear to be mainly managed by Anne Marie Weggelaar.

The national and local authorities have provided subsidy funds, but do not appear to be involved any other way. Although the OBR invested money and participates in some meetings and discussions, they do not get involved with the content of the ZPR according to Pieter van Rijn. They believe that the sector must make this transition itself and the local authorities should not get involved too much.

For technically building the open source platform professional companies are contracted. Anne Marie Weggelaar mentioned that they worked in close contact with these companies, revealing co-design activities.

Patients have also been involved in testing the ZPR. This required management of the pilot groups, involving more users in different phases.

One of the goals of the ZPR is to facilitate a platform for entrepreneurs where they can offer their services. This indicates an open innovation structure that the ZPR says to strive for. The many actors that are involved in this case must also somehow be managed, involving the partners, patients, citizens, entrepreneurs, health care providers, etc. The capability to orchestrate this alliance becomes mainly visible around Anne Marie Weggelaar and her team.

Actor	**D. Co-producing & orchestrating**
Service innovator	Anne Marie Weggelaar orchestrates alliance (taking it over from the EDBR)
Patients (users)	
Health care providers (users)	Entrepreneurs offering health care services via ZPR portal
Partners	
Knowledge institutions	
Local authorities	EDBR orchestrate participants in signal phase

E. Scaling & stretching

Scaling cannot be thoroughly described for the ZPR case. This is simply because the online portal is recently implemented at the time of writing and there is little data available on scaling activities. However, we can address this topic because first efforts are put in increasing the reach and influence of the portal and certain goals are set.

- Diffuse service

For the ZPR the goal is to diffuse throughout the region and perhaps some neighbouring municipalities that are easily connected. To gain more ground in Rotterdam, the ZPR wants to connect more health care providers, patients and citizens. A logical implication is that the more the portal is integrated in the health care sector, the more efficiency is won. Another reason that the ZPR wants to become a standard portal is that entrepreneurs can reach a wider public to offer their services in the form of applications.

Besides strengthening its position in the Rotterdam health care sector, the ZPR can diffuse to other regions as well. The open source software makes it easier to copy the portal to other locations. Other regions in the Netherlands have showed interest in creating such an online health care portal and so did Flanders. The ZPR provides a

good example and test case for starting similar initiatives in other locations. The 2011 Spider Award confirms this notion and recognises the value of the project. The ZPR succeeded especially in collaborating with so many parties in the region, which was crucial in developing the portal. The biggest challenge for other regions might be to bring necessary partners together and manage this alliance. Such possibilities are being discussed, however, the focus of the ZPR is on the Rotterdam area.

- Stretch service portfolio

The ZPR facilitates different entrepreneurs to offer their services through the platform. This can involve a wide range of health care services. For these entrepreneurs this can be an opportunity to reach potential customers and enter the market. The ZPR itself might have some marketing function, not only to *reach* customers, but also through *confidence* people have in the consortium partners that facilitate the platform.

So it can be concluded that the ZPR itself does not stretch their service portfolio very much, but offers an open source platform where entrepreneurs can offer their health care services, extending the service offering. The capability to stretch the service portfolio probably lies within attracting and facilitating these entrepreneurs. For diffusing the ZPR, most efforts are put in strengthening the portal in the Rotterdam region. Initiating a similar online health care portal in other locations is not (yet) their concern, although there are possibilities. In a later stage this will become more apparent.

Actor	**E. Scaling & stretching**
Service innovator	Consortium, Anne Marie Weggelaar in dialogue to involve more participants
Patients (users)	
Health care providers (users)	More health care providers can get connected on the ZPR
Partners	More entrepreneurs can offer their services through the ZPR
Knowledge institutions	
Local authorities	

F. Learning & adapting

- Deliberately learn from how innovation is managed

Regarding learning in the ZPR case, we find that collaboration plays an important role again, characterising the whole project. For learning activities this collaboration is mainly with knowledge institutions. On the one hand evaluation of the ZPR contributes to improvements of the portal, on the other it builds a knowledge base for e-health research and a connection is made to this field of science. A good example where learning takes place is with the user pilots. In three phases the number of users to test the ZPR is increased from 12, to 200, to 2000. These pilots are evaluated in collaboration with the institute of Health Policy & Management of the Erasmus University and the Rotterdam University. Also new applications are evaluated in a similar fashion. It is actively researched whether new applications can also be used for other patients groups or should have another focus. The ZPR tries to keep track of most developments and believes that getting insights through research is very valuable. Therefore there is much collaboration with researchers and students from the universities, as well as a PhD researcher who is working full time on the ZPR.

"We proberen applicaties altijd onderzoekbaar te maken." – Anne Marie Weggelaar

A stronger relation with e-health research is sought through the Research Platform Zorgportaal. Here researchers from different knowledge institutions meet four times a year and discuss e-health developments. The consortium can also post specific questions they are struggling with. The e-health research field appears to be interested in the ZPR case, probably because there are few similar projects to investigate. In this way the ZPR is an interesting source of data. From this interplay, both the ZPR and e-health research benefit.

"Zelfs al zou het Zorgportaal falen, hebben we er heel veel van geleerd." – Anne Marie Weggelaar.

To conclude, several activities clearly indicate the learning capability. Just like the pilots, new applications are also evaluated and reflected upon. With such evaluations, both failed and successful efforts are documented. Insights from such evaluations and research are used to improve the ZPR. The interplay with the e-health research field seems very useful in this perspective. Whether through the learning capability other capabilities are also adapted is hard to reveal, but much lessons have been drawn from the ZPR project, especially on collaborating with many regional partners. The pilots and implementation of the ZPR hold valuable lessons and experiences that are also documented.

Actor	**F. Learning & adapting**
Service innovator	Consortium, how can we do it better next time?
Patients (users)	
Health care providers (users)	
Partners	
Knowledge institutions	University, hogeschool, researchers, students evaluate ZPR pilots and applications. Link to e-health research
Local authorities	

Dynamic capabilities Diabetes Station

The Diabetes Station (DS) case seems to involve mainly two key players, Eric Sijbrands and IPT Telemedicine. However, they are not the only ones involved.

A. Signalling user needs & technological options

How was signalling accomplished in the DS case? The capability to signal and interpret the 'real world' can be explained in two sub-capabilities, considering users and technology. Both are discussed below for the DS case.

- Understand (potential) users and their values

By treating diabetic patients, Eric Sijbrands has much interaction and dialogues with *users*. Years of experience as an internist at the Erasmus MC contributed to understanding pros and cons in diabetic care. Although no clear example can be given of analysing diabetic care, this seems to implicitly take place by experience that is build up over time. Eric Sijbrands explained that language and cultural barriers with patients hamper treatment. Communicating with patients with different cultural or ethnical backgrounds thus seems an issue that Eric Sijbrands identified after close interaction with his patients. The insights of Eric Sijbrands in diabetic care and his interpretation indicate the capability to *emphatically understand users and their (potential) needs*, this is considered as the most important aspect of signalling (den Hertog, 2010).

Eric Sijbrands also experienced a growing pressure on the capacity of diabetic care. Waiting lists are growing and current trends show that the number of diabetic patients will only grow in the future. Although Eric Sijbrands did not made such trend analyses himself, they are very well known in the professional community he participates in. Eric Sijbrands shared that he sometimes feels like wasting time when diagnosing patients. Often diagnosis values are stable and no further actions are taken. Such routine controls that require no further intervention are a sub-optimal activity, especially with full waiting lists.

"Dit heeft er voor gezorgd dat ik thuis zat en dacht: Ik moet iets doen." – Eric Sijbrands

Eric Sijbrands' immersion in diabetic care and the professional community enabled him to identify and interpret flaws in the diabetic care system, both for patients and the provider (Erasmus MC). The signalling activities here do not appear to be installed with the goal to signal problems or opportunities. Rather they are part of Eric Sijbrands' work. Still they clearly point to the capability of signalling.

In a later stage, when a prototype was ready, it was tested in the Erasmus MC. On the one hand this is part of developing and conceptualising the DS, but also to get feedback from users. Such feedback can be very useful to understand how patients utilise the service and to understand their needs and values better. In the case of the DS, this prototyping phase generated little feedback. The only result was the need for a larger font. Nonetheless, the acceptance of patients has probably been a more valuable feedback and a confirmation to continue this path.

- Search for technological options

Scanning for technological options becomes visible when Eric Sijbrands is actively searching for solutions to the problems he identified. In his opinion diabetic patients should be treated as much as possible in their living environment. There are many domotic devices to measure certain values for diagnosis at home. He indexed several existing technologies and devices from different technology providers to look for possibilities. This would however be too complex and prone to errors in his opinion. This convinced him that patients should use one technology with one *golden standard*, leading to his idea of the virtual doctor.

Actor	A. Signalling user needs & technological options
Service innovator	Eric Sijbrands diagnosing diabetic patients as a doctor
Patients (users)	Direct contact with diabetic patients from different cultures
Health care providers (users)	Eric Sijbrands is also a health care provider being a doctor at the Erasmus MC
Partners	
Knowledge institutions	
Local authorities	

B. Conceptualising

- Translate idea into operational service offering

How exactly Eric Sijbrands got the idea of the DS as a virtual doctor is hard find out. It involves a creative process that is not very insightful, even Eric Sijbrands himself cannot explain it in detail. He mentioned to sit at home and conclude that diabetic care is not working this way. Undertaking action to apply changes in the care system shows an entrepreneurial spirit, important for realising

ideas. Being able to take his idea to the Technology Transfer Office (TTO) of the Erasmus MC indicates a business environment where new ideas are encouraged and people know where to go to get support as well. The TTO appears to support Eric Sijbrands on businesswise topics he is not experienced with and judge the feasibility of his project. An *open innovation culture* where new ideas and entrepreneurship are encouraged is favourable for innovation (den Hertog, 2010) and can be identified to a certain extend for the Erasmus MC.

Building the DS required technical skills for which Eric Sijbrands searched a partner and found IPT Telemedicine. Joop Wallenburg, CEO of IPT Telemedicine, started building a prototype in his own garage and did all the technological development. Eric Sijbrands remained responsible for the medical content and in collaboration they developed a first working DS. When the prototype was finished it was tested in the Erasmus MC. The diagnosis results were compared to those of the doctor's in a regular visit. The technological development seems to be accomplished mainly by IPT Telemedicine, who is also involved in handling the diagnosis data results. According to Joop Wallenburg most measuring elements and sensors are acquired on the market because some very good technologies exist and do not need to be reinvented. KPN, owner of IPT, has much experience with data transfer as a telecom provider and is responsible for the connection and uptime of the server.

The DS is now being implemented in the market. This is a slow process because different (often local) providers in the health care chain must be aligned and collaborate. The DS is being offered as a complete service including maintenance and data handling to various health care providers in the Netherlands and will also be introduced in Germany and Turkey.

The TU Delft is researching new interfaces and ergonomics in a living lab environment to further improve the DS.

Actor	**B. Conceptualising**
Service innovator	Eric Sijbrands provides medical content TTO supports entrepreneurship in the Erasmus MC
Patients (users)	Patients involved to test the DS
Health care providers (users)	Health care providers are direct customers to buy DS service
Partners	Joop Wallenburg/IPT developed the DS technologically
Knowledge institutions	TU Delft experiments with interface and ergonomics
Local authorities	NZa came by for a tour and was very enthusiastic

C. (Un-)bundling

- Architectural reconfiguration to create new service experiences

Diagnosing diabetes patients involves measuring different values. The DS combines different devices or technologies to complete the diagnosis by measuring weight, BMI, glucose levels, an eye photo, foot photo and blood pressure. Whether this can really be labelled as bundling can be questioned. Neither can traces be identified of services stripped down to bare essentials. Existing technologies are used from other applications and developments in the ICT sector are reapplied here.

Actor	**C. (Un-)bundling**
Service innovator	Eric Sijbrands bundled all diagnosis features in one station
Patients (users)	

Health care providers (users)	
Partners	
Knowledge institutions	
Local authorities	

D. Co-producing & orchestrating

- Manage innovation beyond the boundaries of the firm

Co-producing seems to play a significant role in the DS case. Eric Sijbrands has the medical knowledge for treating diabetic patients, but he was not able to technically build the DS. The TTO appeared to play an important role in finding a suitable partner. The TTO has a large network with many contacts in the market. Through a personal contact within KPN they got in touch with Joop Wallenburg.

"Ik had verwacht dat veel mensen problemen zouden hebben met deze benadering, maar dat is mij eigenlijk zo ongelofelijk meegevallen. Ik heb geluk gehad dat ik een techneut tegenkwam die het probleem begreep, heel snel oplossingen aandroeg en zich heel flexibel opstelde." – Eric Sijbrands

Although contact for building the DS is directly between Eric Sijbrands and Joop Wallenburg, the business relation is with KPN, who acquired IPT Telemedicine in 2008. For the TTO (and thus the Erasmus MC) collaborating with a telecom provider was new, also KPN never collaborated with an academic hospital before. Although both are interested in building this new alliance, differences also emerged. Especially differences in business culture formed a barrier. Rob Posthumus, manager at the TTO, explained that KPN required a business plan of 14 sheets long to start the project, while they usually work with a smaller business plan of 2 sheets and 'see where it goes'. KPN is used to evaluate projects on a monthly basis. The DS is a longer-term project and is not profitable in such a small time frame, according to Rob Posthumus. With KPN demanding such requirements, Eric Sijbrands would only loose interest, as he is mainly concerned in building the DS as a solution for diabetic care. Not only building mutual trust, but also understanding each other's goals and business culture took more effort than assumed for Rob Posthumus. The new type of alliance between very different organisations partly explains the different approaches of the Erasmus MC and KPN.

"Samenwerken als je elkaar niet vertrouwd. Dat kun je vergeten." – Rob Posthumus

The TTO and KPN seem to be less involved with the content. The TTO is more concerned with formal and juridical aspects of the partnership and regards IPT and KPN as the same company. Although owned by KPN, Joop Wallenburg clearly distinct IPT as an individual company and does not regard themselves as part of KPN. For Eric Sijbrands the TTO appears to be a valuable support, because he does not have to get involved too much with business cases and juridical aspects, but can focus on the content instead. The TTO can advice him on such matters he is not experienced with. From Eric Sijbrands' perspective the partnership is mainly with Joop Wallenburg to build the best virtual doctor for diabetic patients. Because KPN owns IPT Telemedicine they remain an important actor in this partnership. The TTO, as well as IPT, fulfil a bridging function between Eric Sijbrands and KPN.

To conclude, the capability to co-produce and manage the alliance forms a significant element in the DS case. Eric Sijbrands and Joop Wallenburg (IPT) can be identified as the key player in co-designing the DS. The TTO and Joop Wallenburg seem to play an important role in managing the alliance and aligning the vision of Eric Sijbrands and KPN. Eric Sijbrands is in touch with the TTO and Joop Wallenburg, who are on their turn in touch with KPN.

Actor	**D. Co-producing & orchestrating**
Service innovator	Eric Sijbrands collaborates with IPT TTO facilitates and manages collaboration
Patients (users)	
Health care providers (users)	
Partners	Joop Wallenburg/IPT builds the DS in close collaboration with Eric Sijbrands and is a bridge to KPN for acceptance
Knowledge institutions	
Local authorities	

E. Scaling & stretching

- Diffuse service

Although the Diabetes Station is still in its implementation phase some remarks can be made for scaling capabilities. Eric Sijbrands is active in an international peer network of professionals. Joop Wallenburg pointed out that it is important to get the professional community to accept the DS as a new way of providing health care. The DS has more chances to diffuse through the sector when accepted among health care professionals, because this is a very influential group.

IPT Telemedicine and KPN have an extensive network in the health care sector including general practitioners, health care providers, insurance companies, etc. The combination of the Erasmus MC and KPN can in this perspective be valuable. KPN and IPT Telemedicine can approach health care providers from a commercial perspective to offer new solutions to provide a better health care service, while the Erasmus MC can back this up by guaranteeing the medical content as an academic hospital. This increases their legitimacy and credibility. Still the implementation of one DS takes a lot of time and effort. Especially organising collaboration in the health care chain to apply changes is complex. Also insurance companies showed interest, but made no effort yet in contributing to the implementation of the DS. It might not be their responsibility to get involved, but financing the DS proves to be complex due to our financing system in health care. Eric Sijbrands hopes that insurance companies can be more collaborative.

Other regions in the Netherlands showed interest in the DS as well as regions in Germany and Turkey. Remarkable is that Turkey wanted to order 1000 stations which Joop Wallenburg rejected. According to him, to successfully implement the Diabetes Station requires organisation and collaboration among different actors in the sector. He wants to avoid selling expensive products to just diagnose diabetic patients more efficiently. Both Eric Sijbrands and Joop Wallenburg are determined to establish collaboration in the health care chain that can change the way diabetic care is organised.

- Stretch service portfolio

Once the DS is implemented in more locations and has proven its value as a virtual doctor. This concept might very well be used for

other (chronic) diseases according to Eric Sijbrands. There are other situations where a doctor could be substituted by machine or virtual variant. This is however not the case yet and thus no signs of stretching can be identified here.

To conclude, implementing the DS in more locations in Rotterdam as well as in other regions, takes much time. The challenge is to align different actors in the health care chain and establish collaboration between then. KPN and IPT Telemedicine appear to take a commercial role to approach health care providers, while Eric Sijbrands approaches the professional community of diabetic care.

Actor	E. Scaling & stretching
Service innovator	Eric Sijbrands approaches the influential international professional community
Patients (users)	
Health care providers (users)	Regional health care providers must be aligned and collaborate
Partners	IPT is connected to many general practitioners KPN approaches health care providers from a commercial perspective
Knowledge institutions	
Local authorities	

F. Learning & adapting

- Deliberately learn from how innovation is managed

Identifying traces that indicate the presence of learning appears to be difficult in the DS case. IPT Telemedicine builds more experience over time, building on top of their already 15 year history in medical services and devices. They do not appear to explicitly try to improve management of innovation projects, by for example document successful and failed efforts. As CEO Joop Wallenburg is central in the small team of IPT Telemedicine and reflection on projects takes place in meetings and a more informal settings.

For the Erasmus MC and Eric Sijbrands, the TTO usually evaluates projects like this. They will do so in a later stage when more results are available. Eric Sijbrands pointed out that this is a new experience for him. During the project he noticed, to his disappointment, that the decision taking culture in the Netherlands is very slow. This and other experiences are not explicitly documented, but add up to an informal and codified experience that is mostly accomplished by doing.

To conclude, no clear activities of learning and adapting can be identified here. The capability to learn appears to be very informal and is codified in people's experiences. Joop Wallenburg pointed out that because of the long experience of IPT they are good at what they do and know the market thoroughly.

Actor	F. Learning & adapting
Service innovator	New experience for Eric Sijbrands as entrepreneur TTO evaluates the project
Patients (users)	
Health care providers (users)	
Partners	New partnership for KPN and Erasmus MC IPT extends their experience in medical services
Knowledge institutions	
Local authorities	

Dynamic capabilities health care domotics

Different actors are involved in the domotics case. The SOR, Niko Projects and Erasmusbrug form a central alliance, but also depend on other actors in the region.

A. Signalling user needs & technological options

How are user needs and technological options signalled? These two aspects of the signalling capability are discussed here seperately.

- Understand (potential) users and their values

The SOR has most interaction with residents through personnel that is working at location. They talk with residents and get ideas of their needs through random unstructured conversations. Such dialogues can be very personal and hold valuable information. There does not seem to be a system at hand that organises and structures this information however. Through such conversations ideas for additional services can also be gathered according to Josephine Dries. Only a more structured form of communicating with residents should be in place.

Also health care providers like Aafje have very direct contact with their customers because their services often involve someone visiting in person. Although time is very limited for such visits, some signals can be picked up. There does not seem to be a system in place to structure this information, like with the SOR, but employees do sense the needs of their customers by working with them intensely.

The pilot phase for this case was too short according to Josephine Dries. This resulted in unresolved start-up problems when the system was implemented. Joris Teulings indicated that people always find a way to use a product in an unexpected way. This means that there will always be surprises despise of several testing efforts. The use of services is not explicitly analysed, but different interpretations or misuses become clear with problems that arise.

- Search for technological options

Tromp Bakker, CEO of the SOR, acknowledged the importance of technology in our daily lives and that this role cannot be erased. This also applies to senior people in our society. Domotics can in his perspective play an important role to adapt living complexes to future needs. First technological opportunities evolved when the regular intercom was changed to a video intercom. This enabled a network with additional functions through the building. For signalling technological possibilities there seem to have been many discussions with technology providers. In 2008 first conversations started with several parties. Niko Projects is the technology provider that is contracted by the SOR in a later stage.

Luc van den Heuvel indicated that Erasmusbrug started with first domotic pilots already six years ago. The authorities funded pilots to explore this field of expertise. When these funds stopped the involved parties were not able or willing to pay for further development of the project. According to Luc van den Heuvel, Erasmusbrug is often involved with domotic pilots. These are mostly set up in collaboration due to talking with technology providers or customers, visiting conferences and also by actors in the health care chain that approach them. Their manager innovation and product development and their CEO play an important role in this process. All this incoming information and opportunities are bundled and discussed to choose whether to get involved or not.

Actor	A. Signalling user needs & technological options
Service innovator	SOR wants to adapt homes to future needs
Patients (users)	
Health care providers (users)	Employees pick up signals from residents randomly
Partners	Dialogues with tech providers like Niko Projects
Knowledge institutions	
Local authorities	Funding pilots to support development

B. Conceptualising

- Translate idea into operational service offering

The first traces of the real use of a screen-to-screen connection goes back to when the regular intercom was replaced by a video intercom. This enabled a network in the building with new functions. Especially technology providers play an important role in conceptualising the domotic system. In this case Niko Projects is the main technology provider that builds the system. This is their fifth generation of products, including a touch screen that provides access to various applications and services. Their design process seems to mostly rely on technological development and testing in living lab environments. According to Joris Teulings, implementing the system still leads to surprises that could not be foreseen in the prototype phase.

Three years ago health care domotics were underdeveloped according to Wim Nattekaas, now there are many options that lie ahead. Although all involved actors seem to agree that there is no standard yet in domotic systems, recent development in tablet computers and PDAs seem a fruitful direction in their opinion. This can also lead to cheaper screen-to-screen systems since there are better products available on the market. Technology providers like Niko Projects are however benefitting from selling their systems. In this case the SOR has excluded other technology providers and competition between them by choosing Niko Projects and their system.

Niko Projects seems to be responsible for designing and prototype activities. This is part of their product development in which there is collaboration with some knowledge institutions like TNO and Actis. For further experiments they have a living lab environment with the Belgium real estate organisation Riantis. For implementation of their system there was a prior pilot phase with the SOR and at this point agreements with involved parties became very important to realise the complete service offering.

Actor	B. Conceptualising
Service innovator	SOR as project leader implementing the system in their living complexes
Patients (users)	
Health care providers (users)	Contracted to the SOR to provide health care
Partners	Niko develops and provides the domotic system Erasmusbrug receives and redirects alarm calls
Knowledge institutions	TNO and Actis co-developed and co-designed the technology with Niko Projects
Local authorities	National authorities refund screen-to-screen care activities

C. (Un-)bundling

- Architectural reconfiguration to create new service experiences

Clearly different services elements are combined in a complete service offering. These involve services that range from grocery shopping to a hairdresser at home. They are alternative to alarming personnel and other care services. Service providers like

Erasmusbrug are actively searching for alternative services that can be integrated with the domotics. There are more organisations that offer services that ease living like for example Lekker Leven. This allows them to increase their service offering and give a return on their investment. With health care domotics these services seem to be build around the primary alarm function.

Actor	C. (Un-) bundling
Service innovator	SOR encourages ease of living services
Patients (users)	
Health care providers (users)	Aafje, Lekker Leven and others offer additional service packages
Partners	Erasmusbrug wants to offer additional services
Knowledge institutions	
Local authorities	

D. Co-producing & orchestrating

- Manage innovation beyond the boundaries of the firm

In the domotics case collaboration among several parties can clearly be identified. The SOR, Niko Projects and Erasmusbrug seem to form a central alliance. None of the involved actors appears to be able to set up a similar domotics project alone, indicating their interdependence. The SOR took the initiative to pull the project, as no one else would pick up this leading role in their opinion. They offer living complexes for senior people in the Rotterdam region. For implementing domotic technologies they contracted Niko Projects as a technological supplier. Erasmusbrug is handling the alarm calls and direct other calls to the right health care provider. According to these three parties they form a triangle that is central to the collaboration in this project.

These three actors are however not the only ones involved, organisations must be contracted that provide actual health care services. These involve health care providers like Aafje, but also volunteers that can be contacted. Because the SOR, Niko Projecs and Erasmusbrug work together, they exclude other technology providers and emergency centres. Some health care providers are already engaged in a partnership with another emergency centre for example, or are not satisfied with the domotic system, complicating collaboration.

The choice of the SOR for Niko Projects and Erasmusbrug is actually closing the innovation structure according to Josephine Dries. There is no clear standard yet in health care domotics and with this alliance only the system of Niko Projects can be installed. Tablet computers are an interesting development for health care domotics according to Josephine Dries, but at the time of engaging in this partnership tablets were less successful and not yet standardised as they are now. Aafje also wants to use tablet computers and PDAs to offer health care services.

To conclude, collaboration is very important is this case as no party appears to be able to organise health care domotics alone. However, not everyone is happy that the partnership excludes other players. It looks like the collaboration closes the innovation structure further, complicating and limiting developments.

Actor	D. Co-producing & orchestrating
Service innovator	SOR leads the project and choose Niko Projects and Erasmusbrug
Patients (users)	
Health care providers (users)	Are contracted to provide health care services

Partners	Niko Projects is the contracted technology provider Erasmusbrug handles all alarm calls
Knowledge institutions	
Local authorities	

E. Scaling & stretching

- Diffuse service

In 2008, the goal was set to realise 1000 homes with health care domotics. In three years 600 homes have actually been realised. Although all parties seem to agree that the project develops slowly, Josephine Dries mentioned that implementation and scaling followed the pilot phase too quickly. In her opinion the system was simply not ready to be implemented on a larger scale and should have been implemented with about only 100 homes to develop the system better and more successful.

- Stretch service portfolio

Especially with additional services that can be offered on domotic systems, stretching becomes visible. Several actors in the region, like Erasmusbrug, Aafje and Lekker Leven are interested in offering a wide variety of services to ease living. This can involve grocery shopping, a hairdresser at home, ordering a taxi or dog walking service. Many combinations are possible that can be bundled and offered in various forms to residents. In this way organisations can extend their service offering.

Actor	**E. Scaling & stretching**
Service innovator	SOR implemented domotic system in 600 homes
Patients (users)	
Health care providers	

(users)	
Partners	Erasmusbrug want to stretch their portfolio by offering additional services Aafje wants to handle alarm calls themselves in the future
Knowledge institutions	
Local authorities	

F. Learning & adapting

- Deliberately learn from how innovation is managed

The case has not yet been evaluated and according to Josephine Dries this should wait until the SOR knows better how to continue their health care domotics ambitions. In her opinion the services that are now offered over the system are very limited. It was thought too easy of than appeared to be in practice. For example, the system was implemented too quickly after the pilot phase ended. This resulted in unresolved start-up problems.

Residents as end users can be valuable to evaluate the case and they should be involved more seriously according to Josephine Dries. For future efforts the SOR wants to involve residents more in the pilot phase to test certain systems. For example, they did not know what the best way was to test and implement Skype as a service on the touch screen. Both Niko Projects and the SOR learned that this could best be tested with residents that were already known to Skype.

Actor	**F. Learning & adapting**
Service innovator	SOR evaluates the project in a later stage and wants to decide on what route to choose
Patients (users)	
Health care providers	

(users)	
Partners	
Knowledge institutions	
Local authorities	

5. CASE COMPARISON

In this section the three discussed cases are compared. Each case has its individual story and characteristics, but similarities exist as well. The dynamic service capabilities have been insightful for understanding the innovation processes. The distribution of these capabilities among participants indicates how the regional innovation system supports health care service innovation. Therefore it is interesting how different actors are involved in the cases.

A brief repetition: The *Zorgportaal Rijnmond* (ZPR) is an online portal where both citizens and health care providers can organise health care in the Rotterdam region. The *Diabetes Station* (DS) is a 'virtual' doctor that substitutes a 'real' doctor for diagnosing diabetes patients. *Health care domotics* are home technologies through which health care is offered so (senior) people can live longer independently instead of in care homes.

Different set of actors

The researched innovation cases each show a very different constellation of involved participants. For the DS case we can clearly identify two key actors, Eric Sijbrands (doctor at the Erasmus MC) and Joop Wallenburg (IPT Telemedicine). Both appear to be very committed to this project on both a business and personal level. They seem to share the same vision and complement each other in skills and knowledge. They are of course not alone, as they are linked to the Erasmus MC and KPN. In the DS case Eric Sijbrands can clearly be identified as service innovator. In the ZPR case the EDBR, mainly accountable for signalling, already involved many actors in an early stage. By involving many regional actors in the project, the EDBR laid the fundaments for a broad alliance of partners. This created legitimacy among different regional organisations because many had the opportunity to join, as well as legitimacy with the regional (and even national) authorities that were involved. A single service innovator cannot so easily be identified because there are multiple partners in the consortium. Managing an alliance of this many organisations is a challenge where Anne Marie Weggelaar has a key role. In the domotics case the SOR, Niko Projects and Erasmusbrug form a main alliance, but they also depend on health care providers they have to cooperate with. The SOR took the lead in this project and choose to form an alliance with Niko Projects and Erasmusbrug.

Collaborating is beneficial

The three cases show that *collaboration* is an important major part of the process. All interviewees mention this as an important part, forming and managing alliances consumes much time an effort. In the Rotterdam region there seems to be strong interaction in the health care sector. Especially the ZPR case is a striking example where many parties are involved. The project is also recognised for this regional collaboration and received the Spider Award 2011. The EDBR played an important role to involve and connect so many parties.

Embedded in the region

There seems to be a difference in how strong the cases are *bound to the Rotterdam area*. The ZPR for example seems to be

deeply embedded in the region. It involves many regional actors and is developed as a solution for the Rotterdam area only (so far). Health care domotics seem less exclusively related to a region. Niko Projects is a large technology provider that is also involved in projects elsewhere. Yet the SOR, Erasmusbrug and other partners are embedded in Rotterdam and so is the focus of this project. The DS case seems to have less geographical boundaries. Although emerged and prototyped in Rotterdam, the focus is rather national. IPT Telemedicine is also active throughout the Netherlands and abroad. For implementing a DS regional aspects become more important again, because health care providers have to collaborate on a regional scale.

Open of closed structure

Remarkable is the difference between projects with an *open or closed structure*. The ZPR actively tries to facilitate an open innovation structure by giving many parties the opportunity to participate. Also the software for the online portal is based on open source software to make it accessible for various entrepreneurs. In the domotics case this structure is rather closed. Because the SOR chose for Niko Projects and Erasmusbrug other organisations are excluded. This is a barrier for some health care providers that are contracted to other parties. Considering the domotic system, the SOR fully depends on Niko Projects for technological advancements and cannot profit from other developments in the market. In the DS case only two parties develop the DS. Although this might look closed at first, other parties are clearly involved. Eric Sijbrands involves the state-of-the-art knowledge on diabetic care from an international professional community. With implementation of the DS much effort is put in adjusting the DS to the specific needs of health care providers that are buying the service. Health care providers are closely involved to make the DS tailor-made to their needs in that region.

User pilots

Patients/citizens (users) are especially involved in all cases to test the new service. Interviewees in all cases acknowledge the importance of patients and citizens as a user group. The DS for example has been tested in the Erasmus MC with diabetic patients to compare the measurement results with the doctor's, but also to test the usability and acceptance of patients. In the ZPR case three pilot rounds have been organised with an increasing number of patients. These steps have been consciously scaled to a larger group. Lessons from the pilot phase in the domotics case could not be applied so well because it was followed too quickly by implementation. All cases confirm the importance of testing/prototyping with patients as users. Information and lessons from pilots should be taken seriously and used to improve health care services. Not all problems can be approximated before hand and valuable information can be gathered from user feedback.

Although the importance of involving patients in developing new services is acknowledged, they have no decision power in innovation projects. Basically patients follow what they're offered and do not have much choice. The pilots are (logically) organised by innovators and their partners. So the role of patients and citizens as a user group looks rather passive.

Patient independence

Yet, patients and citizens are able and willing to take more control over their own health care according to service innovators, this seems a general trend in health care developments. In all researched cases, greater independence from health care providers

is a central theme. Note that this is an incentive for innovators to act and not part of the process itself, still it remains a given of how patients/citizens fit in this picture. In the DS case diabetic patients can be diagnosed closer in their living environment, avoiding hospitals. They can also communicate in their language of choice, not depending on someone to translate the information. In the ZPR case patients or citizens can organise their health care in one portal and have easier access to various health care offerings. In this way they can more actively take control. Health care domotics enable elderly to live more independently instead of in care homes, increasing their idea of freedom (Sonsolee et al., 2008; Lockhorst, 2010).

More efficient service solutions

Health care providers also form a user group. The cases have in common that they contribute to a more efficient health care offering, saving money and work for health care providers. They can be customers buying the service to offer better health care more efficiently. The DS substitutes doctors by a *virtual doctor* to diagnose patients, health care providers buy this service to offer diabetic care. This should increase the capacity of diabetic care and can save costs. The ZPR focuses less on a certain health care field, but involves the whole Rotterdam region. Through one central portal health care can be organised more efficiently. This saves health care providers administrative work and certain applications can reduce costs as well. E-health and self-management have much potential to make health care more efficient (Blankers et al., 2012). In the domotics case health care providers are rather partners than customers because residents directly buy the services. By enabling people to live independent with domotics, costs are saved compared to expensive care homes.

Knowledge institutions

Knowledge institutions seem to play a role more in the background. They are involved in research for improvements of services and technologies. This can be in living lab environments, but also by connecting to an international research field like e-health, as in the ZPR case. Researchers are more closely involved in the ZPR by investigating applications and doing evaluations. Knowledge institutions are a good example of a RIS actor group that enables and supports further development of services by facilitating their research possibilities and educated researchers. In the DS and domotics case, knowledge institutions co-develop technological aspects to improve the service offering.

Local authorities

The *local authorities* indicate health care as one of the key sectors and strengths of Rotterdam. They try to support interaction among regional actors, by for example having an innovation broker to connect actors in the health care sector and an economical development program. They don't want to take all responsibility however and expect the sector to take more initiative as well. In the DS and domotics case the local authorities do not seem to play a role directly. While in the ZPR case they played a considerate role by subsidising start-up money and installing someone to manage the program.

EDBR

The *EDBR* is a striking example for stimulating regional collaboration. They are an independent party, but are initiated by the local authorities and have the task to advice the municipal executives. By having members representing the business community, local authorities and institutions many parties are

involved. This can create much regional support and involvement for which the ZPR is a good example.

National authorities

The *national authorities* play a role considering legislation and the insurance structure by which our health care is financed. In the Netherlands people are not used to pay their own health care costs and are not easily willing to. For example by refunding screen-to-screen connections from 2012, incites innovators to further develop such services. Also providing subsidies like *Pieken in de Delta* can provide important start-up capital.

Insurance companies

The role of *insurance companies* is not focussed on particularly in this research, but they have been mentioned throughout several interviews. Health care innovators are displeased by how insurance companies position themselves, especially because they depend on them to finance new services. Insurance companies seem very absent in the innovation process and are not identified in any of the cases. It can be discussed whether they should participate in innovation projects. Especially in times of less financial resources it is difficult to legitimise investments in new health care services. Yet with more efficient services they have much to benefit considering costs. Insurance companies could show more interest in new efficient health care initiatives. Maybe on a regional scale exceptions could be made to stimulate innovation.

6. CONCLUSIONS

This enquiry has aimed to investigate how service innovations in the health care sector proceed from the perspective of a regional innovation system. Three cases in the Rotterdam area have been examined and the following answers have been found:

User pilots are important

Testing services with users (both patients and health care providers) beforehand proved important for developing new services. Health care services seem more successful when lessons from pilots are used in new service propositions and further developments. If implementation follows the pilot phase too quickly, opportunities can easily be missed and results can be disappointing. It is not strange that innovators want to implement their services as quickly as possible, because service innovation projects in the health care sector take very long.

Service innovators collaborate

Innovating in the health care sector is not easy on your own. There is much effort put in *collaboration* in service innovation projects. Especially for developing new services and implementation forces are joined. Managing an alliance of partners and sharing the similar goals is decisive for the success of a project. *Finding complementary partners* that are committed is thus important. Stimulating interaction among regional organisations is useful because alliances are formed that engage in innovation projects.

Open structure favours innovation

Service innovations develop better with an *open innovation structure*. An open attitude towards potential partners and customers creates more support. By involving them in the project, decisions are not made for them beforehand. If potential partners are closed out of this process they are more likely to resist collaboration in a later stage. When customers, especially health care providers, are closely involved with the implementation, a

service can be developed more accurate to their needs and even be tailor-made.

Role of RIS actors

Considering the regional innovation system, the following conclusions can be drawn for how various RIS actors are involved and support the service innovation process.

Service innovators want to develop qualitatively better and more efficient health care services to cope with current challenges. It is frustrating for them that service innovation projects in the health care sector take very long. In their opinion it takes unnecessarily long, for which the slow decision taking culture in the Netherlands is mainly responsible.

Patients/citizens (users) their needs and values are an important incentive for service innovators to act. Patients want to be more independent from health care providers and are willing to take more control. They play an important role in user pilots to test service concepts, but have no decision power in the projects themselves.

Health care providers (users) are also users of new services who benefit from more efficient health care service solutions. In this case they are customers for innovators. They are also involved with pilots and can be partners that are involved in developing new services.

Partners are often complementary to the service innovator. They are for example involved for their technological expertise or designing software. Partners are involved because innovators are not able to develop complete services alone. In the health care sector parties are interdependent to each other and need to collaborate.

Knowledge institutions test service concepts in living lab environments with partners and innovators, but also evaluate services by doing research in a specific field like e-health. Researchers and students from universities and universities of applied science can be involved to research service propositions.

The *local authorities* identified health care as a key sector in Rotterdam and try to connect regional actors. The EDBR is a good example how the industry and government are collaborating. It proved successful to involve many regional partners, which also creates more legitimacy among both health care providers and the local authorities. The local authorities (with the national authorities) also subsidise new projects that otherwise would very likely not have started.

Insurance companies are absent in innovation projects in the health care sector. They do not invest in new projects and it can be discussed whether they should. Nonetheless insurance companies are an influential group. They benefit themselves from more efficient solutions to deliver health care as well and could therefore show more interest in health care service innovations. Because they are by definition involved in health care, insurance companies have some responsibility to cope with current challenges of rising costs.

Support of the RIS

Support from the RIS does not depend on individual actors alone, but rather on the synergy between them and their collective act as a result. A general idea of how important the RIS is for each case is presented in table 3. With one, two or three stars the support is indicated respectively as: *little*, *moderate* or *much*.

To answer how the RIS enables and supports health care service innovations table 3 provides a simple overview. The RIS is especially

supportive for *conceptualising* new health care services and *co-producing & orchestrating* the innovation process. Especially for these two capabilities various RIS actors are involved and collaborate. This research indicates that parties depend on each other for innovating services in the health care sector. Regional interaction and collaboration can have great advantages in this perspective to develop new health care service innovations. Local authorities can play an important role by encouraging new initiatives and facilitate regional collaboration.

RIS support	A. Signalling user needs & technological options	B. Conceptualising	C. (Un-)bundling	D. Co-producing & orchestrating	E. Scaling & stretching	F. Learning & adapting
ZPR	***	***	**	***	**	**
DS	*	**	*	**	**	*
Domotics	**	**	**	***	**	*

Table 3. Support of the RIS per dynamic service capability.

RIS support differs per case

The support of the RIS has also not been the same in all cases. Especially the ZPR and the domotics case are strongly embedded in the Rotterdam region and the RIS also appears to be more important here. Still these two cases differ as well. One main difference is the *open structure* the ZPR strives for and the rather *closed structure* the domotics case seems trapped in. Although the potential of both cases is widely acknowledged, this seems a fundamental difference. The ZPR seems to benefit more from the Rotterdam RIS due to this open innovation structure.

The DS case is less embedded in the region and the *wider context* in which Rotterdam is situated becomes more relevant. Yet the strong health care sector in Rotterdam is not unimportant. The service innovation emerged in the Erasmus MC and profits from the facilities and connections this large academic hospital has.

POLICY RECOMMENDATIONS

As the conclusions show, the regional innovation system can be very supportive to health care service innovations. The RIS matters even more when a project is deeply embedded in a region. The Zorgportaal Rijnmond is a prominent example of various regional actors collaborating in an open innovation structure. To encourage such initiatives, interaction among regional actors is very important. In this case the EDBR played an important role to involve various actors and formulate a shared vision.

Articulate a regional vision

Intermediaries and economic development boards can contribute by involving various parties from both industry and local authorities to articulate a regional vision and identify shared ambitions. This triggers organisations to participate in alliances, creates regional support and builds relationships and trust. Local authorities can facilitate such initiatives if the market is reluctant.

Only formulating ambitions is not enough, also agreements must be made how to follow up and realise ideas. The situation should be avoided that no one is willing to take the lead and promising plans are not given a chance.

Stimulate an open innovation structure

An open innovation structure is important to give different parties the opportunity to participate and not to exclude them beforehand. If a shared vision is formulated, the (potential) alliance must be managed and orchestrated to achieve the best results. Involving multiple actors in an open innovation structure is especially beneficial if a service innovation project is embedded in a certain region. Articulating a regional vision can be a useful guidance to involve various actors.

Stimulate joint-conceptualising

In the health care sector actors are interdependent to each other and co-developing proves beneficial and even necessary. Especially *joint-conceptualising* is fruitful for innovators to develop new services. Conceptualising is transforming an idea into a working service. This involves a creative process that is stimulated by an open innovation culture within and among organisations, as well as designing, experimenting and prototyping. Because innovating is hard on your own, finding complementary partners can be very valuable.

DISCUSSION

This research uses theories that are mainly derived from cases in the private sector. Yet here they are used to investigate the health care sector, which is considered public. Generally these insights in service innovation processes proved very useful. The integration of dynamic service innovation capabilities with the RIS approach is experienced as a useful combination. The RIS approach is moreover a static description of present actors, but combined with dynamic capabilities it provides more dynamic insights from a multi-actor perspective.

Three cases are investigated for this research, it is attempted to get as much insights as possible by providing a rich in-depth case description. Interviews have been very useful in this perspective and fun to gather the data. Although these are only three cases in the vast health care sector, they reflect a general tendency for service innovations in this complex playing field.

The dynamic service capabilities den Hertog et al. (2010) propose have been very useful for understanding service innovation. Although service and product development have some fundamental differences, these dynamic capabilities provide an accurate insight in innovation in general. Like innovation phases they cut the process in smaller understandable parts that require specific attention. They emphasize the *evolutionary nature* of innovations. Other innovation management literature also stresses this notion, but is still represented in more linear phases, like in for example Tidd et al. (2005).

The dynamic capabilities originally focus on single firms instead of a variety of actors. Especially the *learning* capability seems strongly firm related. Still, as this research confirms, innovation is not just an individual act and should not only be regarded from one firm's perspective.

The *(un-)bundling* capability has been less accurate for this research because related activities could not be identified very clear. This capability seems closely intertwined with the service concept itself and is not found very useful to identify separately.

Interesting is the difference between an open or closed structure that is identified for the *co-producing and orchestrating* capability. Den Hertog (2010) argues that this could even be "the capability to

organise and act in open service innovation systems". This is especially visible in the ZPR case and confirms the notion of den Hertog (2010).

Also the importance of user pilots found in this research points to intense interaction between the service provider and client. This also confirms earlier findings by den Hertog et al. (2010), who argue that this is an important aspect of service innovations and that "the majority of service propositions are co-created by the client and provider".

FURTHER RESEARCH

Research to health care service innovation is not very extensive yet. This research therefore has a broad and open focus to capture many insights. Hopefully this enquiry raises valuable points of attention for further research and more specific topics can be addressed. For example what the role of insurance companies can be to stimulate health care innovations. Or how the innovation process can be quickened in a multi-actor environment. Also other regions can be investigated to find new successful or maybe hampering aspects of a present RIS.

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APPENDIX 1 – INTERVIEW SCHEDULE

Date in 2011	Interviewee	Organisation / Function
June 16th	Aernout Visser, Yvonne Theuns	Innovatiemakelaar Zorg Rotterdam
June 22nd	Anne Marie Weggelaar	Zorgportaal Rijnmond
July 28th	Rob Posthumus	Erasmus MC technology transfer office
August 19th	Roel Hooiring & Rehana Reyers	Syntens
August 29th	Frans van der Meché	Former board Erasmus MC and EDBR member
August 30th	Joop Wallenburg	IPT Telemedicine
August 30th	Pim den Hertog	Dialogic
September 1st	Joris Theulings	Niko Projects
September 13th	Josephine Dries	SOR
September 27th	Melissa Lockhorst	Zorggroep Rijnmond
September 28th	Luc van den Heuvel	Erasmusbrug
September 29th	Yvonne Theuns	OBR
October 4th	Rob Posthumus	Erasmus MC technology transfer office
October 6th	Aernout Visser	Innovatiemakelaar Zorg Rotterdam
October 17th	Eric Sijbrands	Internist at Erasmus MC
October 18th	Anne Marie Weggelaar	Zorgportaal Rijnmond
October 19th	Wim Nattekaas	Aafje
December 20th	Frans van der Meché	Former board Erasmus MC and EDBR member
December 22nd	Pieter van Rijn & Nick van den Berg	OBR