DEVELOPING INNOVATION SYSTEMS IN THE E-HEALTH DOMAIN

Implementing Europe’s Digital Agenda

Fransien de Ruijter
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DEVELOPING INNOVATION SYSTEMS IN THE E-HEALTH DOMAIN

Implementing Europe’s Digital Agenda

MASTER THESIS

Submitted in partial fulfillment of the requirements for the degree of Master of Science in Management of Technology at Delft University of Technology

By

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EXECUTIVE SUMMARY

European Digital Agendas are launched every 2-5 years by the European Commission. They focus on the economic and social benefits that ICTs will bring Europe. In the Netherlands, national and local governments are working on the implementation of 2015.eu’s agenda (2010-2015). As it is difficult to satisfy all stakeholders, the implementation process of former European Digital Agenda’s in EU Member States did not go smoothly. TNO, one of Europe’s largest Research and Technology Organizations, is taking a role with realizing 2015.eu agenda’s objectives. The difficulties with EDAs’ implementation provide an opportunity for TNO to prove its added value with realizing European level initiatives.

This research wishes to contribute to structuring the implementation process of 2015.eu agenda’s objectives. To do so, a systematic approach for establishing innovation systems in the Dutch e-health domain is provided. The e-health domain is selected as urgency for change is enormous due to rising costs of treatments, a rising demand for healthcare, and a reducing active population [Flim et al., 2010]. Innovation systems can develop service innovations for the future e-health domain by 2020, to which 2015.eu agenda’s objectives can contribute. 4th generation innovation systems have proven their usability to map complex systems of stakeholders.

First a desk research is done to develop the theoretical framework. Documentation on EDAs reviewing the implementation processes was used. Moreover interviews were conducted with senior management formulating relevant, interesting opinions on how to link e-health and 2015.eu. From the list with obstacles on implementing former European Digital Agendas, a list with selection criteria for an innovation model was developed. We concluded the Cyclic Innovation Model developed by Berkhout (2000), to be most suitable as it is an actor-oriented model, considering multi-levels of abstraction and considering the need for entrepreneurial activities. CIM approaches innovation processes in a cyclical way, describing the interactions between actor groups in different nodes: Science, technology, market and business.

The main research question is: How to develop innovation systems in the Dutch e-health domain, based upon 2015.eu’s agenda?

The analysis shows that innovation systems for the Dutch e-health domain can be developed by means of the following counterclockwise order of steps at CIM level 1: (1) Vision development, (2) Cyclic process model development, and (3) Transition path development.

We start with (1) the vision formulation. At CIM level 1, an agenda should be developed, such that players in the care domain know what direction to go. TNO can be the entrepreneur of CIM level 1, as it has a reputation of being independent. To develop visions, TNO still needs to position in the care domain, to increase its credibility and lead by example.

Next (2) the cyclic process model establishment. At CIM level 1, in-house knowledge should be inventorised and based on what required knowledge is missing, other partners should be asked to join the consortium (described at CIM level 2). Based on the comparative case study eight factors followed, influencing the innovation system development steps: 1. Project organization, 2. Party’s expertise, 3. Party’s corporate policy, 4. Development stage of the innovation process, 5. Parties’
trustful relations, 6. Personal relations, 7. Personal commitment, and 8. Consortium innovation. In pre-competitive development stages the uncertainty is high, making the consortium power the main factor to join. For follow-up innovation processes trustful personal relations dominates, and for scale up parties reason from their expertise and portfolio.

We end with (3) engineering the transition path. First the goals should be set at in-between stages of the transition path resulting in the image of the future vision. Next new e-health service innovation processes can be developed, fulfilling these goals at in-between stages. From this the e-health service innovation processes to be included in the transition path are selected, aligned with the internal ambitions of the consortium partners and the ones still confirm alignment with the initial idea of (1).

In this research the CIM has been applied for illustration purposes to the current e-health domain, the future e-health domain, and the innovation systems of the case study. The following conclusions were drawn on the applicability of CIM. CIM can be applied to determine the system errors of the current and the future e-health innovation domain. CIM has proven its added value as heuristic to prescribe the steps to develop innovation systems, as well as that CIM can structure the process to translate 2015.eu’s agenda to enhance its implementation. CIM can be applied descriptively to show TNO’s in-house knowledge. Therefore new uses of the CIM have been proven.

Recommendations for TNO are to aim for the roles advised to it at the different development stages of innovation processes, as well as its recommended role with establishing innovation systems, and with lifting the implementation obstacles of European Digital Agendas. TNO’s advised roles at CIM level 1 are to translate 2015.eu’s agenda, prioritize innovation fields in e-health and develop an agenda with concepts for care field partners. At CIM level 2 TNO plays a role during each stage of the development cycle of innovation processes, either as entrepreneur or as technologist or pilot executer. Content-wise TNO should furthermore aim to improve its capabilities as advised, to be capable to perform these roles. Since not only TNO wishes to clarify its position with 2015.eu agenda’s implementation, and wishes how to set up innovation systems and building consortia, the practical relevance of this research goes beyond.

Further research is recommended to improve the CIM innovation system theory, since it criteria like consider institutional factors, prescribing best practices, and paying attention to money flows, were not considered. Furthermore the importance of viable business models was often emphasized, but a limitation of CIM is that it does not explicitly pay attention to finances. The limitations of this research result in other further research possibilities. We not yet gained empirical evidence for the step-by-step plan of establishing innovation systems, only four cases were used limiting external validity so a larger case study should be performed. Thirdly, only one sub-domain (e-health) was used. Finally, the prediction only goes up to 2020, while by using a larger time frame radical system innovations are more likely to come up with.

Keywords: European Digital Agenda, service innovation, innovation process, innovation model, e-health, the Netherlands, cyclic innovation model, implementation, strategic positioning
ACKNOWLEDGEMENTS

Before you lays my master thesis, with which I complete my master degree’s program of Management of Technology at the faculty of Technology, Policy and Management, TU Delft. I decided to start this program almost three years ago. My motivation was based on personal development and the desire to get more in-depth knowledge on how to manage technologies, besides developing them. Only after I have fully dedicated the past months onto this thesis, I feel that I finally master this subject and have improved my “managerial skills”.

Up from here, I would like to take the opportunity to show my gratitude to several people that contributed to realizing this work.

In the first place I would like to thank Erik Fledderus, for giving me the opportunity to perform this research internship at TNO. I have met many enthusiastic colleagues, showing interest in my research topic, and making my time at the TNO office a very pleasant, unforgettable experience. Furthermore, without TNO’s network and Erik’s contacts in particular, I would not have had the chance to reach the same in-depth level of data collection to use for this research’s analyses, which has been of great added value to my final results. Last but not least, I thank Erik for the interesting conversations and constructive criticism, as well as that there was always room for some humor during our meetings.

Secondly my thanks go to all the people that have contributed to my interviews both from inside and outside TNO, and have given their valuable feedback on the results afterwards. Conducting this qualitative research would not have been possible without their cooperation.

Moreover, I am grateful to my graduation committee at TU Delft. Particularly to Patrick van der Duin, my first supervisor, for guiding me through this process and putting me on the right track whenever necessary. He encouraged me to look at the innovation system model I had selected for this research in a creative way, which has resulted in a more managerial- and less technical approach of dealing with the problems of this research.

In the last place I would like to thank my friends and family for their support and contribution as far as possible. Particularly to my boyfriend who has tried to be by my side although he has been in South-Korea for the past six months, and to my parents who have stimulated me to start studying in the first place, always believing in my capabilities.

The answer to my research was not obvious to me upfront. This has kept me motivated till the end, although the work load turned out to exceed my initial estimation. I would like to share with you therefore the following citation which represents the way I felt about this research’ process, and which is also aligned with the content of this research itself, exploring TNO’s opportunities:

"In the middle of difficulty lies opportunity."

Albert Einstein

Fransien de Ruijter
Delft, the Netherlands
March, 2012
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<td>2015.eu</td>
<td>Europe’s Digital Agenda 2010-2015</td>
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<td>AAL</td>
<td>Ambient Assisted Living</td>
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<td>CIF</td>
<td>Care Innovation Forum</td>
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<td>CIM</td>
<td>Cyclic Innovation Model</td>
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<tr>
<td>CoE</td>
<td>Center of Excellence</td>
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<td>CTTR</td>
<td>Center for Care Technology Research</td>
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<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>INFSO</td>
<td>Information Society and Media</td>
</tr>
<tr>
<td>IP</td>
<td>Intellectual Property</td>
</tr>
<tr>
<td>LDA</td>
<td>Local Digital Agenda</td>
</tr>
<tr>
<td>MS</td>
<td>Member State</td>
</tr>
<tr>
<td>NFU</td>
<td>Umbrella organization of the eight Dutch University Hospitals</td>
</tr>
<tr>
<td>NPCF</td>
<td>Umbrella organization of the Dutch patient federations</td>
</tr>
<tr>
<td>PEST</td>
<td>Political, Economic, Social and Technological</td>
</tr>
<tr>
<td>PHR</td>
<td>Personal Health Record</td>
</tr>
<tr>
<td>PM</td>
<td>Project Manager</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Private(R&amp;D) Partnership</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>ROI</td>
<td>Return On Investment</td>
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<tr>
<td>RQ</td>
<td>Research Question</td>
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<tr>
<td>RTO</td>
<td>Research and Technology Organization</td>
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<tr>
<td>SC</td>
<td>Smart Coaching</td>
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<tr>
<td>SE</td>
<td>System Error</td>
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<tr>
<td>SME</td>
<td>Small Medium Enterprise</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities, Threats</td>
</tr>
<tr>
<td>TNO</td>
<td>Netherlands Organization for Applied Scientific Research</td>
</tr>
<tr>
<td>TU Delft</td>
<td>Delft University of Technology</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VWS</td>
<td>Health, Welfare and Sport (Ministry of)</td>
</tr>
<tr>
<td>ZN</td>
<td>The umbrella organization of the Dutch health insurance companies</td>
</tr>
<tr>
<td>WP</td>
<td>Work Package</td>
</tr>
</tbody>
</table>
CHAPTER 1: INTRODUCTION

In this chapter we state the problem, research objective, and corresponding scope. After this the research questions (RQs) and conceptual framework are given, aligned with answering the objective. We continue with the practical and scientific relevance of this research. Next the Netherlands Organization for Applied Scientific Research (TNO), where we have performed an internship, is introduced. We end this chapter with the master thesis’ structure.

1.1 PROBLEM STATEMENT

Every 2 to 5 years the European Commission (EC) defines a strategy for Europe in the field of Information and Communication Technology (ICT) and telecommunications, to maximize the social and economic potential in this field [COM (2010) 245, 2010]. For the period of 2010-2015 this strategy is called Europe’s Digital Agenda (EDA) 2010-2015, indicated with “2015.eu” [Del Castillo-Vera, 2010]. The Agenda outlines priority areas for action to be taken by the EC and European Union (EU) Member States (MSs), to spur innovation, economic growth and improve daily life for both citizens and business [COM (2010) 245, 2010].

2015.eu’s agenda is recommended for implementation to all EU MSs. In the Netherlands, national governments are working on this, and regional/local governments’ initiatives are rising as well. Regional digital agendas (RDAs) are developed (e.g. a digital agenda for North Netherlands [Flim et al., Sept 2010]), and local digital agenda’s (LDAs) (e.g. a digital agenda for Province of Friesland [DAF2020, 2011]). These bottom-up agendas emphasize the quality of life improvements enhanced by ICTs, while the top-down initiatives by the EC and Dutch government, are stronger emphasizing economic prosperity. Since the recession particularly the need has increased for a long term focus to stimulate the economy. As stated by Ministry of EL&I (2011), the focus of DigitalAgenda.nl is: “How can ICT be deployed smartly for growth and prosperity to give a strong pulse to innovation and economic growth”. To succeed with 2015.eu’s implementation, both social and economic objectives should be taken into account, since the implementation must be feasible for all stakeholders ranging from industries to governments to society. As it is difficult to satisfy all stakeholders, the implementation process of former EDAs was not smooth. As a result not all objectives, including 2015.eu’s agenda’s objectives¹, have been reached. Possible explanations are given in section 3.3.

TNO, one of Europe’s largest Research and Technology Organizations (RTOs), is taking a role with realizing 2015.eu agenda’s objectives, and wishes to get insight in the knowledge/skills it needs to be capable for that. TNO’s strong European oriented focus makes it aim to conquer a strong position in the European Framework Program [Mengelers, 2011]. The difficulties with EDAs’ implementation provide an opportunity for TNO to prove its added value with realizing European level initiatives. In section 1.5 TNO is introduced, including its innovation fields of particular interest to this research.

RESEARCH OBJECTIVE

To contribute to structuring the implementation process of 2015.eu agenda, by providing a systematic approach for establishing innovation systems in the Dutch e-health domain, such that

¹ The progress report on action points by December 2011 [EC, Dec 2011]: From the 101 action points, 26 have been completed, 54 are on track, 1 has possible risk of delay and the remaining 20 have been delayed.
those innovation systems can develop service innovations for the 2020 future e-health domain, to which 2015.eu agenda’s objectives can contribute. This can therefore be seen as the research objective of this practice-oriented research in which a practical problem is solved [Verschuren and Doorewaard, 1999]. By means of this objective we aim to produce prescriptive knowledge [Verschuren and Doorewaard, 1999]. Since 2015.eu’s agenda ends by 2015, 2020 is chosen for the future prediction as we may expect its objectives to be fully implemented by then. The choice for and definitions of the italic words: “e-health domain”, innovation systems” and “service innovations” respectively, are explained in next section.

1.2 SCOPE AND MAIN CONCEPTS

SELECTED DOMAIN: E-HEALTH DOMAIN
As it is not feasible to focus on all domains in the Netherlands, the healthcare domain is selected as the scope of this research. Besides personal interest, the urgency for change is enormous in this domain due to rising costs of treatments, a rising demand for healthcare, and a reducing active population that should fill the gap between healthcare supply and demand [Eikelboom, 2011]. The trends reflecting this urgency for change are further explained in Chapter 5. We narrow down in the healthcare domain towards the e-health domain, which is aligned with 2015.eu agenda’s objectives: “e-Health is the use of new ICT technologies, mainly internet technologies, to support or improve health and healthcare” [RVZ, 2002].

SELECTED THEORY: INNOVATION SYSTEM FRAMEWORKS
As EU-level, national, and local stakeholders are involved with the implementation, innovation models can contribute to map the complex systems of stakeholders, in particular 4th generation open innovation models, referred to as innovation systems [Van der Duin et al., 2007]. The following comprehensive definition of innovation systems is used in this research:

“A heuristic attempt, developed to analyze all societal subsystems, actors and institutions contributing in one way or another, directly or indirectly, intentionally or not, to the emergence of innovation” [Hekkert et al., 2007].

By focusing on the systems of innovation and with that on the innovation processes to arrive at new innovations, there is no need for much knowledge about the technology involved. Therefore technical specifications of the ICT innovations are out of this research’s scope. Berkhout et al. (2007) define the idea behind innovation to bring new product-service combinations to the market to generate new business. They consider the economic perspective of innovation by stating “innovation established itself as a fact of life for firms” and consider the social perspective of innovation by stating “innovation has become an important instrument to influence the quality of life by influencing the way business is done” [Berkhout et al., 2007]. This is aligned with the economic and

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2 Appendix A: list of terminology gives an overview of more definitions of e-health.
3 See Appendix A: List of terminology
4 Appendix A: List of terminology gives an overview of more definitions of innovation systems.
5 Innovation processes describe the activities that are performed at each stage of the development of an innovation” [Ortt and Van der Duin, 2008].
social aims of 2015.eu’s agenda, making innovation system frameworks\textsuperscript{6} interesting to apply to this research.

**SCOPE OF INNOVATION TYPES: SERVICE INNOVATIONS**

In the Netherlands the service sector industry is responsible for 70\% of the Dutch economy, making the Netherlands a service economy [Ministry of Economic Affairs, 2008]. For that reason big social and economic challenges, require an approach in which service innovation is a central issue. Therefore the competitiveness strategy of the Netherlands defined by Innovation Platform Netherlands in April 2010, focuses on the importance and added value of service innovation for both productivity growth (economic prosperity) and quality of life (social well-being) [Van den Toren, 2010]. By linking the economic and social benefits service innovation brings, misalignment between economic and social stakeholders can be reduced to smooth the implementation process of 2015.eu’s objectives in the Netherlands.

**1.3 RESEARCH QUESTIONS**

The research questions (RQs) to be used to fulfil this research’s objective are given. We start with the main RQ:

*How to develop innovation systems in the Dutch e-health domain, based upon 2015.eu’s agenda?*

Seven sub-RQs are used to answer this main RQ. We divide them into phases.

1. **Theoretical framework development**

   RQ1. *What are the main obstacles and indicators derived of previous implementation of EDAs?*

   RQ2. *Which innovation system framework is most suitable for this research?*

2. **Application of the theoretical framework**

   RQ3. (a) *What are main trends in the e-health domain in the Netherlands, and (b) what activities does TNO perform?*

   RQ4. *How does an image of the desired\textsuperscript{7} future of the Dutch e-health domain and its service innovations look by 2020, based upon TNO’s perspective of 2015.eu agenda’s objectives?*

   RQ5. *What transition path can guide the change from the current e-health innovation domain in the Netherlands towards the envisioned state in 2020?*

   RQ6. *Which roles can or should TNO play in different innovation systems in the e-health domain?*

3. **Evaluation**

   RQ7. *What insights are gained from implementing the selected innovation system framework?*

The first two RQs aim to develop the theoretical framework used for this research. From RQ1 we derive what can go wrong with the implementation process of EDAs. From this we retrieve selection criteria to select the innovation system framework (RQ2). RQ3 continues with the current e-health innovation domain in the Netherlands, including a description of which innovation systems already exist. The theoretical framework derived at in RQ2 is applied to develop a comprehensive map of the innovation system. We confirm the trends bothering e-health implementation provide corresponding

\textsuperscript{6} In this research innovation system framework is used to indicate the theoretical framework by which we perform our analysis.

\textsuperscript{7} We aim to describe a *desired* but *feasible* future of the e-health domain by 2020.
obstacles to e-health implementation as the EDAs’ implementation obstacles. Next the e-health future domain by 2020 is described, and the service innovation processes of the case study (RQ4). Again the theoretical framework is used. During the case study of service innovation processes we verify if activities are focused on Demolishing the implementation obstacles are present, to avoid repetition of mistakes. RQ5 focuses on defining the transition path between the current e-health innovation domain and its future, including the e-health service innovation processes of the case study. The different roles TNO can or should play during the innovation system development, and within the innovation systems, are finally emphasized in RQ6. RQ7 explains an evaluation of the insights gained from implementing the innovation system framework. We furthermore evaluate if we expect the indicators measuring progress on demolishing the obstacles, will be a proper list to evaluate the progress on implementing 2015.eu’s agenda, based upon new insights retrieved from applying the selected innovation system framework in this research.

1.4 PRACTICAL AND SCIENTIFIC RELEVANCE
As this research is performed at TNO the practical relevance is to give insight into its role within a systematic approach of the implementation process of 2015.eu’s agenda in the Netherlands, as well as TNO’s role with developing innovation systems, and finally TNO’s role in the e-health domain. The research aims to contribute to the efficiency and effectiveness of the implementation process of 2015.eu’s agenda, as well as to the efficiency and effectiveness of innovation systems to enhance economic growth and improve quality of life.

The scientific relevance is that we will analyze if the selected innovation model can contribute to developing the steps in establishing innovation systems. This represents the gap in the existing body of knowledge on the selected innovation model. With that, we detect and understand the limitations of the selected innovation model when applied to this research to fulfill the objective stated before.

1.5 ORGANIZATION PROFILE TNO
TNO is a Dutch Research and Technology Organizations (RTO) with a not-for-profit policy, founded in 1932 [TNO WEBSITE, 2011]. The mission for 2011-2014 is “To connect people and knowledge to create innovations that sustainably boost the competitive strength of industry and well-being of society” [TNO, 2010]. TNO develops knowledge, applies knowledge and valorizes knowledge [TNO Corporate, 2011]. Furthermore TNO performs legal activities commissioned by both governments and enterprises. As TNO stands for open innovation, knowledge sharing is referred to at every core activity. Since TNO acknowledges the complexity of innovating in current dynamic innovation environment, TNO’s interest for knowledge on how to set up innovation systems in the current environment has increased as well. As explained before the themes and innovation areas selected for 2011-2014 are strongly European oriented. Therefore TNO acknowledges the need to contribute to implement 2015.eu’s objectives.

In 2003 an external evaluation of RTOs including TNO in the Netherlands concluded that performing solely the intermediary role of bridging the gap between academic research and industry’s application is reduced in relevance due to the high dynamic situation nowadays [Gijsbers et al., 2005]. Therefore new ways of cooperation and competition between different actors are introduced, including direct linkages to the key actors in the innovation system to support commercialization and valorization. Due

See Appendix A: List of terminology
to the high level of competition, TNO was advised to only focus on areas where it can become dominant [Gijsbers et al., 2005]:

1: “Become more demand-driven in its funding and operations”.
2: “Establish direct linkages with key actors in the innovation systems, especially the private sector”.
3: “Play its intermediary role in dynamic networks of knowledge organizations”.
4: “Increase its impact in society”.
5: “Increase its support to Small and Medium Enterprises”.

It is difficult for TNO to simultaneously focus on demand from the market, public interests, the dynamics of the science and technology system, and still follow their roots of application-oriented research. Choices are required here.

Since 2005 multiple reorganizations have taken place. TNO has aimed to improve its project-steered research, therefore its focus on complex interdisciplinary research problems had increased [TNO, 2010]. Three expertise centers (columns) all employable in one or multiple of the seven themes (rows) were defined (Figure 1) [TNO WEBSITE, 2011]. This makes TNO a multidisciplinary organization, suitable for cross-disciplinary research. The seven themes are selected as they cover both societal issues and contribute to the competitive strength of industry [TNO WEBSITE, 2011].

As the e-health innovation domain is positioned at the interface of ICT and healthcare developments, the themes TNO Healthy living and Information society cover this subject. Healthy Living consists of four innovation areas: Vitality for life, Health and safe food and nutrition, Healthy, safe and productive at work and Biomedical Innovations [TNO, 2010]. Particularly the field of biomedical innovation focuses on e-health innovations. In Information Society, three innovation areas can be distinguished: Future Internet Use, Societal Impact of ICT developments and Vital ICT infrastructures [TNO, 2010]. The ICT developments are used to support other themes, amongst which healthy living.
1.6 OUTLINE OF THE MASTER THESIS

To present the outline of the thesis Figure 2 describes the five development stages that can be distinguished, of which 3-5 have been defined when explaining the RQs. The relations between the RQs as explained in section 1.3 are also given.

Figure 2: Outline of the master thesis
CHAPTER 2: METHODOLOGY

The second chapter explains the research approach and methods used. The relevant research strategy is described. A research framework illustrates which chapter deals with which research question, explained in the research steps at the end.

2.1 RESEARCH APPROACH

The research approach we have used is qualitative research. For qualitative research perspectives of various experts are considered, while quantitative research restricts the point of view into data collection directly useful to accept or reject the hypotheses. To answer the RQs, a detailed description of the complexities in the e-health innovation domain is needed, which can only be covered with analyzing qualitative data, not by means of quantification. Conducting interviews or content-analysis of documents can provide the required depth of the qualitative data. Surveys or experiments would have been more suitable when aiming to generalize to a broader target group, as statistical research is not able to take full account of the many interaction effects that take place in social settings [Hoepfl, 1997]. With qualitative research attention is paid to all aspects of the data, to clarify, understand and extrapolate to similar situations, not only considering those aspects contributing to causal determination, prediction and generalization [Hoepfl, 1997]. Since interpreting the data was highly important to assure all aspects of the data are considered, we can derive at well-founded steps prescribing how to set up innovation systems.

Next several characteristics of qualitative research are given and how they were applied to this research to enhance reliability and validity [Hoepfl, 1997; Patton, 2002]:

1. **Empathic neutrality.** As a researcher we attempted to observe, describe and interpret real world situations as they are, non-manipulative and non-controlling, with openness to whatever emerges. The outcome of the research was not preset. Interviewees’ answers and opinions were not influenced, as open questions in semi-structured interview settings provided them with the freedom to answer open-minded. Therefore we balanced objectivity and subjectivity.

2. **Holistic perspective.** We understood the e-health innovation systems to be complex systems demanding for a holistic approach of this research. Therefore we considered the complex interdependencies and system dynamics and searched for linkages between all components of the innovation systems. This research could not be reduced meaningfully to a few discrete variables, so system thinking was required. The innovation model selected in Chapter 4, enabled this system thinking approach and contributed to the holistic perspective.

3. **Qualitative data.** In this research qualitative data was used from observations, inquiry in depth, detailed descriptions, semi-structured interviews capturing direct quotations about people’s personal perspectives and experiences, and a careful document content analysis.

4. **Personal experience and engagement.** In this research we had direct contact with the people from TNO as we performed an internship there. Therefore we could include our personal experiences and insights in the inquiry and have a critical point of view towards understanding TNO’s recommended role in different innovation systems as well as with 2015.eu’s implementation.

5. **Unique case orientation.** Qualitative researchers pay attention to the idiosyncratic (personal) as well as to the pervasive (universal), seeking the uniqueness of each case while trying to find similarities. This came back in this research as for each of the service innovation process individually the development of the innovation system has been mapped, afterwards by means of comparative
case study similarities were given. The individual case level is important, as the quality of the individual case studies determines the quality of the comparative case study.

2.2 RESEARCH STRATEGIES

Research strategies can be classified according to two dimensions: The degree to which the researcher intervenes and the degree to which the researcher wants to make generally valid conclusions [Van der Velde, 2004].

![Diagram of research strategies]

Figure 3: Classification of research strategies [Van der Velde, 2004].

With this qualitative research we aimed to analyze the specific e-health domain, and intervene as least as possible. Therefore this research takes place in quadrant four (right bottom).

The third phase of the research defined in the thesis outline Figure 2, is the first phase that requires a clear research strategy to select a theoretical framework. The research strategy used for this part is mainly a desk research (theoretical research), for which documentation on EDAs reviewing the implementation process of former EDAs, are analyzed to determine the most important obstacles bothering implementation of EDAs. This strategy was selected here since a large amount of data can be used quickly [Verschuren and Doorewaard, 1999]. It costs relatively little in terms of time and costs to gather and use them. The difficulty is however selecting the relevant documents.

In the fourth phase of the research as defined in the thesis outline Figure 2, the application of the theoretical framework, a comparative case study was used. An appropriate way of approaching a research with a “how” or “why” question, is using the case study strategy [Yin, 2003]. A case study can provide in-depth information on the ways in which people respond to each other, have mutual expectations and accommodate their behavior to each other, particularly when in-depth interviews with open questions are used. The future images of the service innovation processes have been given and how the innovation systems used to manage and execute them can be developed. The characteristics of the case study defined by Verschuren and Doorewaard (1999), applied to this research, are as follows:

1. Analysis of a small domain; more depth than breadth. We selected as the domain a small number of e-health service innovation processes, suitable for in-depth analysis. Depth is reached by using various

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9 Service innovation projects are the cases that will be analyzed in the case study. In this research “case” and “service innovation process” are arbitrarily used so can be perceived as synonyms.
methods of data generation.

2. **Intensive data generation.** Intensive methods for data generation were used, like intensive face-to-face interviews with open questions, costing a lot of time, funding and availability of people to collect the data, however bringing a true and overall picture of the cases [Van der Velde, 2004].

3. **Selective sample.** Next section explains the case selection procedure, giving the selection criteria.

4. **Assertion concerning object as a whole.** Often applied to a case study is the use of triangulation of data collection methods a comprehensive analysis, in our case resulted in an overall and holistic picture of the e-health service innovation processes.

5. **Open observation on site.** Empirical research is chosen over desk research, since we intend to stick to reality. Especially for practice-oriented research this is relevant, since this research often aims at changing existing situations. The results are more readily accepted by the field when using a case study, caused by the more close involvement of the researcher (less distant), and identifiable results due to the everyday nature of the data types and methods used. Finally the service innovation processes were studied in their natural context as internal project documents were used as well as face-to-face interviews with project participants.

6. **Qualitative data and research methods.** Conducting semi-structured interviews and performing content analysis on all sorts of internal and external documents results in a profound insight in the way e-health service innovation processes take place and why. Not much pre-structuring was required for conducting the interviews, characterizing again a practice-oriented research project. Not counting and calculating on the basis of observation units, but comparison and interpretation play a great role, pointing at qualitative analysis.

The research methods contributing to the research strategies are explained in section 2.3.

By approaching this comparative case study we followed the case study protocol as defined by Yin (2003), starting with selecting the cases and developing the data collection protocol and ending with a comparative case study after which the conclusions can be given. The case study research framework of Figure 4 overviews the contents of each chapter and illustrates the research methods used to collect information to answer the RQs dealt with in each chapter.

![Figure 4: Research framework. Based upon [Yin, 2003].](image-url)
The summarized contents of each of the chapters are explained in the boxes. The RQs per chapter are indicated in orange. The information sources used were internal documents, internal and external interviewees, literature, field and mental notes. At the bottom we have displayed the phases distinguished in chapter 1. Chapter 3 - 6 are displayed in blue since they deal with the theoretical framework selection phase, for which the desk study research strategy was used. Chapter 7 and on deal with the current and future e-health domain and case study, defined as the application phase. First individual case studies have been performed, and next a comparative case study.

2.2.1 CASE SELECTION

“There are no strict criteria to determine the sample size in qualitative research, as this typically employs multiple sources of evidence and there is no significance test to determine if results are credible” [Hoepfl, 1997]. Detailed information on a small number of cases provides more information to this research than to analyze many cases superficially. Therefore we selected four e-health service innovation projects as the units of analysis to analyze the process from. We selected different illustrative cases for which the innovation systems were compared, and the steps with establishing those innovation systems. Furthermore the roles of TNO per service innovation project in a different phase were determined and compared. Purposive sampling was applied to ensure a wide variety of specific information was gathered. The selection criteria that were used for this are:

1. Information-rich service innovation projects. To perform an in-depth analysis, information richness is required [Verschuren and Doorewaard, 1999]. Therefore we decided to analyze existing projects, instead of upcoming ones. As this research has been performed at TNO, it benefited the information-richness to exploit TNO’s knowledge, information and external contacts by using projects in which TNO is yet involved.

2. Service innovation projects to which 2015.eu’s agenda can contribute, so with a focus on ICTs.

3. Distribution between projects currently running and that have been ended. We have aimed to determine innovation system errors (SEs) in the ended project to avoid these will occur again in the currently running or future projects.

4. Different stages of the innovation process. For an interesting comparison, the cases were positioned in different stages of the innovation process.

5. Diversity of participating parties in the Netherlands involved.

6. The service innovation projects focus on e-health service innovations.

Based on these six criteria we had selected the following four cases: 1. Smart Coaching (SC) project, 2. WeCare project, 3. eHealthNu project, 4. eCardioCare project. The first two were currently running and the last two cases are rounding off. Besides the selection criteria, representatives of the candidate projects had to be willing to cooperate. Therefore, for case 3 and 4 only the TNO project manager had been interviewed. This will influence the internal validity as discussed in section 10.4.

2.3 RESEARCH METHODS

To assure completeness and confirmation of findings data collection took place until findings were confirmed by the different research methods. The most important disadvantage of using these

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10 At the time of our data collection (August – October 2011), eHealthNu project was expected to last till November 2011, eCardioCare project till March 2012.
Qualitative data collection methods is information overload [Van der Velde, 2004], which we aimed to 
minimize by a structured qualitative data analysis method, given at the end of this section.

2.3.1 DESK RESEARCH
Secondary data sources from inside TNO (e.g. annual reports, presentations and minutes from 
meetings), outside TNO (e.g. 2015.eu’s agenda reports and governmental reports on the e-health 
domain, publications about TNO in journals and other external media), and literature sources were 
used. The internal- and external document content analyses were used in the desk study to clarify 
main concepts like e-health, 2015.eu’s agenda, and to perform an internal and external company 
analysis on TNO. During the case study reports were used to get insight to map the parties in the 
innovation system. The literature has been retrieved by studying internet sources, archives and TU 
Delft Library. Scientific search engines like Scopus, Google Scholar, JSTOR have been useful sources to 
find articles, books and journals. The goal of the literature study was to put the RQs in a broader 
thoretical perspective by analyzing multiple innovation system frameworks and investigate what 
researches have been performed on similar topics. Results from the Google Scholar (retrieved on 
April 12, 2011) on the following key words for articles/books:

- “Innovation system”, “Innovation system theory”, “Innovation system framework”, “Innovation model”, 
  “generations of innovation systems”: The theory and academic material available on innovation systems is 
  limited. We focused on five 4th generation models from between 2000 and 2008, to select one.

Results from European Commission database to find documentation on EDAs (retrieved on April 14, 
2011) on the following selection of key words for documentation:

of European Digital Agenda”, “European Digital Agenda Benchmarking report” “eEurope2002”, 

We used TNO’s website to find documentation on TNO (retrieved October 27, 2011), and to find 
interviewees. We used the following selection of key words for documentation:

- “TNO’s themes”, “Information society,” “healthy living”, “reorganization”, “centers of expertise”, “health 
  projects”, “vitality for life projects”, “European Digital Agenda”. We searched for recent activities (from 
  2010 on), and analyzed TNO’s organization structure how it currently is (since reorganization January, 
  2011).

2.3.2 INTERVIEWS
In-depth interviews had been conducted with internal TNO senior managers and external senior 
managers, active in the e-health field and/or well up in the matter of 2015.eu’s agenda. Semi-
structured interviews with open questions allow informants the freedom to express their views in their 
own terms resulting in reliable, comparable qualitative data [Cohen and Crabtree, 2006]. The frame of 
reference of interviewees is considered by asking open questions [Van Engeldorp Gastelaars, 1998]. 
The emphasis of semi-structured interviews can differ per interview. The interview protocol is given in 
Appendix B: Interview protocol exploration, providing detailed information on why the interviews 
were conducted, the selection of interviewees, interview questions and the data analysis. Besides the 
terviews plane discussions with experts were held inside TNO. This is particularly useful for analyzing 
the organization to state what roles we expect them to be capable to fulfill. When referring to this 
interview protocol in this thesis’ remainder we state this as “interview part 1”.
For the service innovation projects semi-structured interviews with open questions have been held as well. The contact persons of the cases were asked for the names of other participants of the project interesting for the case study, preferably at least one representative from each party involved. From now we will refer to the interviews conducted for the case study with “interview part 2”. The interview protocol of interview part 2 is given in Appendix E: Interview protocol e-health service innovation.

2.3.3 FIELD RESEARCH
We have attended the EU-wide Conference “Digital Agenda Europe goes Local”, organized by the Province of Friesland in Brussels on April 4 and 5, 2011. This Conference had two objectives [Province of Friesland, 2011]: (1) To get regional input from cities, regions and localities on improvement of the social and economic goals of 2015.eu’s agenda, (2) To develop Local Digital Agenda’s (LDAs) that support integral regional development and with that connect to 2015.eu. The information sources for this research have been the records of what has been observed on the day: Field notes and mental notes. These were retrieved by means of focusing on two main observational categories: (1) The process during the Conference day, and (2) To understand how stakeholders from different levels and disciplines work together to make progress on the implementation of 2015.eu’s agenda on regional level. Since our role as observer was not made public upfront, the “intruder effect”, defined by Verschuren and Doorewaard (1999) was minimized.

2.3.4 QUALITATIVE CONTENT ANALYSIS
The qualitative content analysis includes extracting information from the data retrieved from any of the primary sources (observations, interviews) or secondary sources (documents, literature). Temporarily labeling and roughly classifying data is characterizing for qualitative content analysis, as interpreting and understanding are most important [Verschuren and Doorewaard, 1999]. For the secondary sources we have extracted the information of value to the different RQs. This could be to explain new concepts or to support the interview results. For the interviews the data analysis is explained in the Appendices B and E. The use of the evaluation phase was to discuss the theory of the selected innovation system, to develop recommendations on TNO’s role in the innovation systems of different cases, recommendations on adaptation of 2015.eu’s agenda to enable implementation, recommendations on future research.

2.4 RESEARCH FLOW
Figure 5 shows the research flow diagram to illustrate the purpose of the research methods explained in previous section. The data requirements are provided on top of each box as the input, in the box the research methods are given, and the output is the deliverables of the research method. This output is again (part of) the input for next method. This proceeds until at the end the answer to the main RQ becomes visible. Colors represent corresponding RQs.
Figure 5: Research flow diagram
CHAPTER 3: EVALUATION OF EUROPEAN DIGITAL AGENDAS

ABSTRACT

Current implementation activities on EDAs such as Conferences and descriptive projects, proved to be insufficient, since 2015.eu’s agenda is perceived only as inspirational document. A translation into policies and actions will increase commitment by social and economic actors. The contribution of 2015.eu’s objectives to implementation is divided into e-health building blocks, such as enabling interoperability and standards, and e-health service enablers, such as reinforcing Ambient Assisted Living. Obstacles that may lead to innovation system failure, such as lack of social adoption and well-founded business cases, are given to show how the implementation of EDAs can be improved.

3.1 2015.EU: EUROPE’S DIGITAL AGENDA 2010-2015

2015.eu’s agenda describes the key enabling role ICT has to play to arrive at high levels of employment, productivity and social cohesion by 2020 [COM (2010) 245, 2010]. The virtuous cycle of the digital economy shown in Figure 6 displays the processes by which mobilizing the great potential of ICTs can be realized according to the EC.

Figure 6: The virtuous cycle of the digital economy [COM (2010) 245, 2010]

The outer circle displays the movement of services from physical into the digital world. Three processes are indicated to develop this. By creating content and borderless services, the service demand will increase. This will result in the roll-out of high-speed networks to support these service developments that are acknowledged as an important and growing area of the EU economy. When faster networks are available, one can think again of new contents and borderless services based on this. So implementing the objectives of the EDA will give incentives for new business.

In the inner ring of Figure 6 the seven main obstacles for mobilization are displayed [COM (2010) 245, 2010]. The seven obstacles are translated into seven action areas from which 100 action points have been derived. These action areas are:

1. A vibrant digital single market, which deals with opening up access to services which are now limited to be accessed in one country and not across borders [EC-INFSO, 2010].
2. Interoperability and standards, which is focused on open and interoperable ICT-products and services to let people create, combine and innovate [IP/10/581, 2010].
3. Trust and security, as Europeans should first trust new technologies by feeling confident and safe
online before they adopt them [IP/10/581, 2010].

4. Fast and ultrafast internet access, with a target for 2020 to provide all European citizens with internet speeds above 30Mbps and half of European households with speeds of 100 Mbps or higher [COM (2010) 245, 2010].

5. Research and innovation by increasing research funding and leveraging private investments in ICT [IP/10/581, 2010].

6. Enhancing digital literacy, skills and inclusion as more and more commerce, public, social and health services, learning and political life are moving towards online services [IP/10/581, 2010].

7. ICT-enabled benefits for EU society by investing in smart usage of technology and exploitation of information to seek solutions to reduce energy consumption, support the ageing population, empower\textsuperscript{11} patients and improve online access for disabled people [COM (2010) 245, 2010].

3.1.1 LEVELS OF ABSTRACTION 2015.EU’S AGENDA

When analyzing 2015.eu’s agenda it can be noticed that three different levels of abstraction are given (Figure 7). The highest levels are the action area level and sub-action area level which offer general concepts. We describe these levels as the vision levels, as targets are defined for the future. However the process of reaching these targets is left out. Patrick Strating (EIT ICT Labs\textsuperscript{12}) states that digital agendas (DAs) often point at performance, like the amount of people that should be connected and how fast the connection should be. But they do not clarify what should happen, what the following steps are to reach this higher performance. He argues: “2015.eu’s agenda states there should be more standardization. But in which fields and why? 2015.eu’s agenda does not clearly prescribe this. I cannot think of a solution right now neither. Some fields are too complex and too heterogeneous so you cannot just say let’s standardize”. Therefore we draw two related conclusions: (1) Many different interpretations can be given on how to reach 2015.eu agenda’s goals, and even by whom, (2) Output indicators are used to evaluate progress on 2015.eu, instead of process indicators, which would be of better use to this. The action points provided within the (sub) action areas are the third (bottom) level of abstraction. When accomplishing the action points, the goals of the action areas will not directly be reached. So bottom up system initiatives do not result at the desired situation where the top down initiatives start at. Different actions need to be performed on national-, regional- and EU-level, while strongly monitoring alignment between those actions, in order to bridge this implementation gap. A party supervising is needed, who is active in each of these levels of abstraction.

De Bruijn et al. (2004) defined a paradox applicable to the different levels of abstraction of 2015.eu’s agenda: Narrow formulated long-term goals, provide clarity and indicate a direction. On the other hand, broadly formulated long-term goals are more flexible, appeal to more parties and as a result create more commitment. However, if the long-term goal defined too broadly, it becomes meaningless and is not able to commit anybody. Applied to 2015.eu’s agenda, the action points are very narrowly defined and therefore do not create full commitment to do something with them. Except to those that feel directly challenged by those goals, as no free interpretation is possible. The action areas are very broadly defined and more flexible; however result in no meaning and

\textsuperscript{11} See Appendix A: list of terminology

\textsuperscript{12} European Institute of Innovation and Technology (EIT) ICT Labs is a knowledge and innovation community consisting of companies, research centers and technical universities in Europe, aiming to accelerate innovation, accelerate valorization of ICT services, and accelerate the growth of spin-off companies [EIT ICT Labs WEBSITE, 2011]. It aims to integrate research, education and business.
committing nobody. To diminish this problem, it should be indicated which action areas should get a priority as they are most likely to become main problem areas. Erik Fledderus (TNO) explains this by stating: “It is not only about improving digital skills in the well-being field, as there are many other fields disadvantaged by a lack of digital skills. Therefore it is logically and necessary that the action areas of 2015.eu’s agenda focus on specific topics like improving digital skills in general. However at a certain point it is necessary to prioritize the fields according to where problems are most likely to occur”.

We have explained before bottom-up initiatives are focused on implementing these processes. Since the local initiatives are relatively new, no evaluation of the effectiveness of on the implementation of 2015.eu’s objectives is available yet. However prospects are high. Patrick Strating (EIT ICT Labs) states: “The national government currently pulls back from orchestrating digital agendas, as the Ministry of EL&I has stated this is the job of regional and local governments. There is something to say for this as the insurance companies, public housing corporations, regional authorities, and municipalities that can make the difference are located at local level. They have to develop plans and infrastructures and take care of realizing the prescribed preconditions/e-infrastructures in their regions”. By developing LDAs the municipalities can bring in their own social perspective, giving incentives to them and other social actors to start doing something with digital agendas. So creating awareness of the possibilities to develop and implement LDAs and RDAs with a different approach than EDA, can contribute to implementation of Das in general.

3.1.2 COMMITMENT TO IMPLEMENTATION OF 2015.EU’S AGENDA

Neither social nor business stakeholders perceive full commitment and responsibility to the implementation of 2015.eu’s digital agenda. We start with clarifying this lack of commitment by social stakeholders. In the introduction we have already explained the strong emphasis of 2015.eu’s agenda on economic stakes. This is confirmed by the majority of the interviewees interview part 1. However according to Erik Fledderus (TNO) a strong emphasis on economic stakes does not have to go at the cost of considering social stakes: “It is interesting to see if something that is a high ranked social priority, can be translated into steps perceived interesting by business stakeholders”. So the economic focus of 2015.eu’s agenda gives new challenges to combine both. But in terms of committing social parties, it can be hard to imagine the added value of ICTs to society’s quality of life, if not explicitly pointed out.

We continue with the lack of commitment to 2015.eu’s implementation by commercial stakeholders. First of all there is still uncertainty if the objectives of 2015.eu’s agenda will be reached by 2020. So it is risky to base a business case on this. This risk is particularly hard to take by SMEs, as large companies have a larger R&D budget and often work with long term oriented programs already. Jean Gelissen (Philips) confirms this for Phillips: “We (Philips) take into account ‘access for all’ with all of our innovations, therefore we anticipate at the fully implemented 2015.eu’s agenda”.

Another explanation for the lack of commitment and responsibility to the implementation process is that 2015.eu’s agenda is not practical enough for policy makers to develop policy plans based on it, and for industry to directly do something with. The majority of interviewees think 2015.eu’s contents are practical enough to translate by policy makers, if priority fields are set first. So they see 2015.eu’s agenda more as an inspirational document providing direction to public and private actions, requiring
translating first. On the other hand, for the industry the majority of interviewees only sees possibilities to anticipate on the situation after the implementation of 2015.eu’s agenda has been realized. “The failing harmonization of laws and regulation within EU context resulting in that Philips has to make a different product for every country due to different national frameworks, is not an obstacle Philips itself can lift” [Marc van Lieshout (TNO), 2011]. This has been confirmed by the previous statement by Jean Gelissen (Philips) on Philips innovation activities.

### 3.2 CONNECTING 2015.EU’S AGENDA AND THE E-HEALTH DOMAIN

The aim of 2015.eu’s agenda to focus on e-health can be illustrated with the following statement by Flora Giorgio EC’s ICT for Health unit, at the e-Health Forum in Hamburg at October, 25 2010: “The European Commission’s EDA is a flagship initiative of the EU 2020 strategy. e-Health is a key part of it, as EDA will develop the necessary infrastructure”.

![Figure 8: 2015.eu’s action points beneficial to e-health challenges. Based upon [Eikelboom, 2011; EC-INFSO, 2009; Koopmanschap et al., 2010; Stroetmann et al., 2011; COM(2010) 245, 2010](image)](image)

In Figure 8 we see the comparison between what 2015.eu’s agenda focuses on and what the challenges in the e-health domain are.

A complete analysis of all action points of 2015.eu’s agenda in this research would create an information overload and reduces the possibility of providing an in-depth analysis. The action area “Enhancing digital literacy, skills and inclusion” [COM (2010) 245, 2010] is left out. This research does not limit to the target group seniors (65+) or disadvantaged people in the Netherlands. Therefore skills for accessing the potential of the digital era are left out of this research. When considering the whole Dutch population only 2% had no internet skills by 2009, and this percentage is expected to decrease even further up to 2020 [Statistics Netherlands, 2010]. From the remaining action areas shown in Figure 8, we directly explain the contribution to e-health challenges.
• Affordability challenges: Research towards new medical innovations relies on the willingness of society to pay for health plus an increase of the national GDP, as no clear evidence of beneficial impact of medical technologies is proven (yet) [Koopmanschap et al., 2010].
• Privacy challenges: Not enough privacy protection is offered, making patients reluctant to use e-health services [Eikelboom, 2011].
• Security challenges: The electronic ID card for patients (eNik) as well as the EHR had a low standard of security level [EC-INFSO, 2009].
• Usability challenges: Healthcare professionals lack interpreting telehealth services [Stroetmann et al., 2011].
• Liability challenges: Uncertainty on legal liability and ethical issues when mistakes in data transmission happen, makes health providers reluctant to participate [Eikelboom, 2011].
• Funding challenges: The structural financial model causes problems of funding as this can be by regular healthcare finances or private funding [Flem et al., 2010].
• Innovation challenges: Needs of disadvantaged people are not clear [EC-INFSO, Oct 2010].
• Interoperability challenges: Interoperability issues occur as individual information and infrastructures being developed without looking at choices made in other projects [Flem et al., 2010]. This results in a lack of economies of scale of companies offering e-health related services and products.
• Standardization challenges: Standardization of technology is required to enable interoperability. However commercial parties put a lot of effort to make sure the e-health systems cannot communicate [Eikelboom, 2011].

We see that more than six out of eight action areas of 2015.eu’s agenda can contribute to e-health, and the other way around the action points focus on eight out of nine e-health enabling challenges, indicated with corresponding colors. Next we evaluate if the theoretical focus of 2015.eu’s agenda on e-health is supported by interviewees of interview part 1.

Amongst the interviewees of interview part 1 two major perspectives existed on the usability of 2015.eu’s agenda to the e-health domain.

1. The first group of interviewees sees direct contribution of 2015.eu’s action points to developing e-health services. The action area “ICT enabled benefits for EU society” is considered relevant as it includes action points directly related to the e-health services. It focuses on smart use of technology and exploiting information to better address the challenges faced by the society, to enable a society with better prospects for all [COM (2010) 245, 2010]. Appendix C overviews the action points related to 2015.eu’s agenda. The main example pointed at by this group of interviewees is action point 78, focused on reinforcing the Ambient Assisted Living (AAL) initiative. The aim of the AAL initiative is to enhance the quality of life of seniors and strengthen the industrial base in Europe using ICTs [AAL WEBSITE, 2011].

2. The second group of interviewees sees 2015.eu’s agenda as enabling building blocks for e-health services. They doubt the effectiveness of the sub-action area sustainable healthcare and independent living, as the reliable infrastructure and other preconditions are required first. Therefore this group emphasizes action areas focusing on e-health building blocks like standardization, privacy, safety and interoperability. Patrick Strating (EIT ICT Labs) explains: “Under condition that we have realized the required infrastructure and other preconditions, we
can develop healthy products”. Related action areas focused on e-health building blocks are “interoperability and standards”, “trust and security” and “fast internet access,” of which the action points are found in Appendix C. Working on these action points fulfills preconditions of ICT innovations for many problem areas amongst which the e-health domain.

With Figure 9 we explain abovementioned connection between 2015.eu’s agenda and e-health. Translation is highly recommended to do something sensible with 2015.eu’s agenda, as well as setting up consortia on a European, national or local scale. Because the majority of the interviewees perceive 2015.eu’s agenda as an inspiration document, no sanctions happen if actors do not cooperate on implementing it. Therefore incentives should be given to stimulate willingness to participate. We recommend the translation to be performed by parties with high credibility amongst the actor groups involved, anticipating on their interests, such that it is made tempting to contribute to 2015.eu agenda’s implementation, or anticipate on a situation after which the implementation has been completed, to enable fast usage of the infrastructures by 2020.

![Figure 9: Link between e-health and 2015.eu’s agenda](image)

### 3.2.1 ACTIVITIES PERFORMED ON IMPLEMENTING 2015.EU’S AGENDA

We look into the implementation process focused on realizing 2015.eu’s objectives. A desk study shows that current implementation processes of 2015.eu’s agenda are enabled by focused Conferences and descriptive projects, and monitored by means of quantitative data on investment and activities. A database is available that stores all the activities performed on each of the three processes defined above. With that is shown what is done to make the processes more concrete. We explain this for the services demand, but similar information is found for the networks and creation of contents. In “the demand for services statistics” database, the data is kept on all investments and all activities performed in this field [Eurostat, 2011]. The European Service Directive aims to remove legal and administrative barriers to enable cross-MSs service provision. A descriptive project on the demand for services aims to give a deeper understanding of services in the EU economy by providing information on for example service providers, types of services purchased and barriers to purchasing. The EC has organized EU Conferences on each process, bringing together stakeholders from different MSs, and conducts surveys within the MSs [European Commission, 2011]. Considering the current implementation state of 2015.eu’s agenda explained in the problem statement these Conferences, projects, and databases do not work optimally to enable the implementation.

As explained before, the Digital Agenda (DAE) goes local Conference focused on two goals: To improve 2015.eu’s agenda based on regional input, and secondly to develop LDAs that connect to
2015.eu’s agenda to get the input for practical implementation. From our field study particularly the second goal was not reached, as no practical implementation was developed. Conference participants only came up with the same generic concepts as can be read in 2015.eu’s agenda itself. For example, “We should enable interoperability between different EU MSs”. We confronted participants with the question what they thought the aim of this two-day active working conference was, and they responded that “Within those two days the challenges 2015.eu’s implementation is facing had to be defined, such that the concrete steps in the implementation process were for a next time”. It became clear that the group of experts present at the Conference was not able to clearly identify a future resulting from 2015.eu’s concepts, and the process to realize this future. Whether this was due to a lack of creativity in translating and interpreting 2015.eu’s agenda, or due to a lack of understanding the contents (even by those who should understand best) we can only speculate based on the results of the Conference Day. The unfulfilled goals of the Conference emphasize the relevance of this study, as we observed one of the tools used by the EC to implement EDAs proved to be unsuccessful.

Initiatives contributing to exploiting opportunities anticipated on the implemented 2015.eu’s agenda, are explained by Jean Gelissen (Philips): “Supportive activities on 2015.eu’s agenda are aiming to reveal possibilities on which new applications can be built. For example by the Public Private Partnership (PPP) Future Internet, that focuses on revealing application fields of ICT. The aim of the PPPs is to show what requirements for core projects follow from these application fields”. Involved with the PPP Future Internet are research institutes, the industry and the EC. Based on the requirements set by them, other actors can execute service innovation processes. “Public Private R&D projects serve as important carrier projects to the EIT ICT Labs activities, especially in health and well-being and smart energy systems” [IPN, 2011]. Top-down we therefore determined the following stakeholder levels focused on preparing for the applications supported by 2015.eu’s agenda: (1) The EC, (2) PPP Future Internet programs, (3) EIT ICT Labs, (4) consortia of public/private organizations in the Netherlands. The coordinator of realizing the e-infrastructure in the Netherlands is SURF, consisting of scientific and applied research organizations [IPN, 2011].

3.3 IMPLEMENTATION OBSTACLES AND CORRESPONDING INDICATORS

We end this chapter with the obstacles bothering the implementation of EDAs in the Netherlands, based on the reviews of the following EDAs: eEurope 2002, eEurope 2005, i2010’s agenda and 2015.eu’s agenda. By doing so, we use innovation system thinking, such that we can arrive at obstacles that would cause system errors of the innovation system.

As we can see in Appendix D: Summary list of proposed indicators by the EC, 2015.eu’s measures contain indicators measuring the completion of the action points and not the execution of the process that results in accomplishing these action points. Examples are the percentage broadband coverage and the take up of internet services [EC-INFSO, May 2011], which can be summarized as quantitative output indicators. So 2015.eu’s evaluation only contains output indicators. Indicators proposed by us in Table 1 below, focus mainly on the implementation process. In Table 1 we name first the obstacle, next the consequences of this obstacle for the implementation process of EDAs, next we give the indicators with which progress on demolishing the obstacle can be monitored. From these implementation obstacles we will develop in next chapter selection criteria to select an innovation model.
### Table 1: European Digital Agenda’s implementation obstacles, consequences and indicators

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Consequences</th>
<th>Indicators</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of evaluation during the course of the action plan of the implementation process</td>
<td>Due dates of action points are not reached</td>
<td>• Amount of in-between reviews • Variety of information sources used for evaluations/timely data collection</td>
<td>The review of eEurope2002 highlights a lack of in-between reviews [COM (2002) 263, 2002]. For 2015.eu’s agenda an EDA governance cycle(^{13}) has been initiated, emphasizing in-between reviews [COM (2010) 245, 2010].</td>
</tr>
<tr>
<td>2. Lack of social adoption of ICT services by society</td>
<td>No service innovation opportunities; Difficult to commit private parties</td>
<td>• Amount of reviews by end-users during different stages of the service life cycle</td>
<td>eEurope2002’s review states in Europe there is a high internet penetration rate, but slow adaption of society [COM (2002) 62, 2002]. The coverage of high-speed internet in the Netherlands is amongst highest in the world [COM (2010) 245, 2010]. However Statistics Netherlands (2010) concludes only a few percent of the Dutch population had high speed internet at home by 2009.</td>
</tr>
<tr>
<td>3. Lack of overarching EU wide policy frameworks</td>
<td>Difficult to commit multinational private companies</td>
<td>• Amount of EU-wide laws accepted • Amount of EU-wide policy frameworks adjusted</td>
<td>The review of i2010’s agenda highlights the functioning of EU MSs with different regulatory systems does not contribute to the adoption of best practices [COM (2007) 496, 2007]. Lack of interoperability between markets results in high costs and slowly interchanged experiences [European Communities, 2007]. Furthermore i2010’s review highlights privacy and security concerns, which can be overcome if greater legal clarity is given on rights and duties within existing legal framework [COM (2007) 694, 2007].</td>
</tr>
<tr>
<td>4. Lack of strategic efforts to stimulate cooperation between stakeholders around common goals</td>
<td>Problematic collaboration amongst different level stakeholders (EU-national-regional)</td>
<td>• Amount of collaborations between different level stakeholders • Amount of collaborations between stakeholders from different specialism</td>
<td>From i2010 agenda’s review follows unaligned ideas and efforts are performed, due to the lack of strategic efforts to stimulate cooperation between stakeholders around common goals [COM (2007) 694, 2007]. A Taskforce entrusted with examining how to exploit broadband networks in the Netherlands, concluded in March 2010 that the organization and coordination of...</td>
</tr>
</tbody>
</table>

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\(^{13}\)This governance cycle consists of internal coordination mechanisms of the Commissioner group, secondly a governance mechanism focused on close cooperation between MSs, European Parliament and other stakeholders and finally a progress mechanism by publishing annually a Digital Scoreboard [COM (2010) 245, 2010].
### 5. Lack of insight into the added value of ICT to improving quality of life

<table>
<thead>
<tr>
<th><strong>Difficult to realize</strong></th>
<th><strong>Qualitative indicators:</strong></th>
</tr>
</thead>
</table>
| Social adoption; Difficult to develop well-founded business cases; difficult to commit social parties to take responsibility for the implementation | • Amount of in-field trials (questionnaires sent)  
• Variety of test groups  
• Variety of data collection methods |

**Quantitative indicators:**

- Percentage of income spend on ICT based healthcare/well-being tools
- Number of face-to-face visits by carers an independent living person has had in past three months

The EC has acknowledged this obstacle.

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### 6. Lack of well-founded business cases for private sector

| **Difficult to commit private parties to take responsibility for the implementation** | **Amount of business cases developed**  
**Amount of PPPs initiated** |

The EC aims to actively involve private investors to contribute to 2015.eu agenda’s implementation. However, obstacles 3, 5, and 7 do not contribute to getting the business case feasible. When a success story occurs, this will attract new investors again. So, 2015.eu’s agenda can spur innovation.

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### 7. Complexity of the EU financing structure

| **No transparency on accessible public money for private parties; difficult to develop feasible business cases; difficult to develop Public-private partnerships** | **Amount of EU level instruments available**  
**Percentage of EU financial instruments known** |

The EU financial system is complex since there are three financial instruments for which ideas for innovations contributing to implementing 2015.eu’s agenda: The Seventh Framework Program (FP7), the Framework Program on Competitiveness and Innovation (CIP) and Instruments of Cohesion Policy [COM (2007) 474, 2007]. Due to the many financial instruments the EU offers, coordinated use has to be facilitated very well [COM (2007) 474, 2007]. The EC launches so-called “Calls for proposal” for the innovation fields they perceive urgent.
CHAPTER 4: SELECTING A THEORY ON INNOVATION SYSTEMS

ABSTRACT

4th generation innovation models prove to be most suitable for mapping the complex e-health domain to be analyzed in this research, containing many actors. The Cyclic Innovation Model has been selected since it contains most characteristics of innovation systems suitable to create transparency on demolishing the EDAs’ implementation process obstacles. It describes the innovation processes in a cyclical way by connecting science, technology, market and business. The illustrative use of the model is to map the innovation systems of the current and future e-health domain, and indicating system errors of these innovation systems, such as inter- and intra-cyclic barriers. The use to be verified in this research is if the CIM can prescribe the steps to establish innovation systems in the e-health domain.

4.1 GENERATIONS OF INNOVATION MODELS

We start this chapter by explaining the generations of innovation models. The generations and their focus are listed in Table 2. Four generations are distinguished, since a fifth generation is only an implementation of the fourth [Ortt and Van der Duin, 2008].

<table>
<thead>
<tr>
<th>Generation</th>
<th>Innovation Model</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation 1: 1950s - mid 1960s</td>
<td>Technology Push</td>
<td>Linear innovation chain process pushing new products into the market without performing market research. The innovation process starts at scientific discovery lacking feedback from market needs.</td>
</tr>
<tr>
<td>Generation 2: mid 1960 - late 1970</td>
<td>Market Pull</td>
<td>Linear market pull model. New innovations result from customer demand. Multidisciplinary teams work on the projects. As a long-term strategy is neglected only incremental innovations are the result.</td>
</tr>
<tr>
<td>Generation 3: late 1970s - early 1990s</td>
<td>Coupled Innovation Processes</td>
<td>Innovation processes are linearly performed but include multiple feedback loops. Continuous feedback combines techno-push and demand-pull. Innovation projects are linked to long-term strategic company goals by means of a project portfolio.</td>
</tr>
<tr>
<td>Generation 4: early 1990s – early 2000s</td>
<td>Innovation in Systems or Networks</td>
<td>Open innovation, system integration (with key suppliers/customers), parallel development processes, early interaction between science and business, innovation management of networks/research links.</td>
</tr>
</tbody>
</table>

The evolution of the next generation innovation models is driven by taking away the disadvantages of the previous generation models, the changing environment and finally an increased understanding

14Innovation management is the governance and organization of innovation processes; managing research links and external research environments [Ortt and Van der Duin, 2008]
of this environment [Ortt and Van der Duin, 2008]. First there were linear tech-push (1st generation), and demand-pull (2nd generation). After the second generation it became clear that there was need for the right balance between need-pull and scientific-push resulting in the third generation. An important change was that innovation processes were linked to long-term strategic company goals by means of a project portfolio [Berkhout et al., 2007]. As changes in organization structure and market innovations were not fulfilled by the 3rd generation, main focus was process- and product innovations, another evolution arose. The focus of 4th generation innovation models is on exploiting innovations in a large network of internal and external partners\textsuperscript{15} cooperating, while 3rd generation innovation models are limited to exploring innovations. The large amount of parties involved resulted in parallel development, which together with the partner networks led to fast product development.

After this short chronology, we continue explaining the need for the 4th generation innovation models for the theoretical framework of this research. “At the fourth generation, innovation processes have become innovation systems” [Van der Duin et al., 2007]. Innovation does not occur at an individual base anymore, but in networks of actors (consortia), and innovation processes therefore become more flexible. 4th generation innovation models aim to visualize the complexity of the organizational cooperation processes in the innovation system, to show what relevant knowledge is needed, what actors can provide this, and show how those actors should participate in a complex innovation system to keep it running. Not only product innovation is therefore relevant, but also process-, market-, and organizational innovation [Trott, 2002], as well as innovation management to manage these innovation systems. Although the main objective of this research is to recommend an approach to establish innovation systems, we also look into what characteristics the innovation manager should possess to manage the selected 4th generation innovation models, and if TNO can/should take such a role. At the end, we will verify the use of the selected 4th generation model for prescribing the steps to establish innovation systems in the e-health domain.

After clarifying the choice for a 4th generation innovation model, different variants of these innovation systems are explained.

### 4.2 DIFFERENT TYPES OF 4TH GENERATION INNOVATION MODELS

Five 4th generation innovation system frameworks are explained, with potential to serve this research. The pre-selection was made based upon the following: 1. Preliminary research, 2. Information richness, meaning that the innovation system framework should be clear enough to perform this research with, 3. Diverse variety of innovation systems, and 4. Fulfillment of the 4th generation innovation model characteristics, such that linear models like Chesbrough (2003)’s Open innovation system, were excluded.

#### 4.2.1 THE CYCLIC INNOVATION MODEL

The CIM model consists of two different levels of abstraction [Berkhout et al., 2007]: Business development Framework (BDF), Cyclic Innovation Model (CIM). The first level shown in Figure 10 provides a future image and shows how the organization can realize this future. The internal ambitions are focused on the areas in which an organization wants to excel. The main function of the image of

\textsuperscript{15} In this research is referred to a partner when a potential party has committed to join a consortium.
the future is to inspire actors and point out their interdependencies [Berkhout et al., 2007]. The vision is often formulated by upper management with an open leadership style. Iteration and moving forward and backward are continuously performed. The innovation strategy is defined how to move along the long term transition path (roadmap) to the desired future vision. The combination of external trends (desired technological breakthroughs) and internal goals (company vision) will result in a focus that provides a way for companies to gather commercial and sustainable business processes [Berkhout et al., 2007]. The capabilities are crucial for successful execution of the service innovation processes developed by means of a sounded process model. Success along the transition paths depends on the quality of the service innovation processes developed to guide the short-medium-long term innovations, and the choice for short versus long term projects, closed versus open networks and producer versus user solutions which determines the innovation strategy [Berkhout et al., 2007].

Figure 11 shows CIM level 2, a systematic, cyclic view of change and interactions: “The circle of change” [Berkhout, 2000]. This model aims to reach the future by continuous improvement by providing an arena of complex, boundary crossing innovation processes [Berkhout et al., 2007]. Value creation is accumulated due to the cyclic interaction processes between neighboring nodes in which information is exchanged in both directions (action and reaction). Van der Duin et al. (2007) state “A cycle consists of a succession of connected processes that take place repeatedly, each time with new starting conditions and a shifting context”. The hard sciences cycle connects fundamental knowledge with new technology. The integrated engineering cycle turns technologies into new product innovations. The differentiated valorization cycle develops products-service combinations with great impact on society. In the soft sciences cycle fundamental knowledge is used to better understand changing social/market needs and transitions. In the middle node cross-cyclic entrepreneurship guides the circles of change.

4.2.2 Functions of innovation systems approach

Hekkert et al. (2007) state that knowledge on the kind of activities progressing or delaying innovation can help to outline innovation processes. Therefore the functions of the innovation system approach, is a systematic map of all functions that take place in innovation systems resulting in technological change. The functions of innovation systems can be defined as [Hekkert et al., 2007]: “Activities to contribute to the goal of the innovation system, which is the generation and diffusion of innovations”. The functions are as follows:
Function 1 - Entrepreneurial activities: New entrants are turning the prospective of new knowledge, networks and markets into actions to exploit new industry opportunities.

Function 2 - Knowledge development: Learning by searching and doing.

Function 3 - Knowledge diffusion through networks: Learning by interacting and using.

Function 4 - Guidance of the search: Selecting the technology variety and determine the allocation of resources. It enhances visibility and clarity of wants among technology users.

Function 5 - Market formation: New technologies have to compete with the embedded technologies. The focus is therefore on creating niche markets with specific tax regimes for new innovations and environmental standards for improved chances for new innovations.

Function 6 - Resources mobilization: Financial- and human resources are a basic input to all activities within the innovation system.

Function 7 – Support from advocacy coalitions: Development and diffusion of new technologies requires them to become part of the current regime first or takeover.

The seven functions are likely to interact and influence each other directly. The entrepreneurs in the Function of Innovation System Approach will initiate three different dynamic cycles indicated with the motors of change as shown in Figure 12 [Hekkert et al., 2007].

A. Entrepreneurs will lobby for market creation as competition by existing technologies is high.

B. Entrepreneurs lobby for more resources to perform R&D resulting in knowledge development and higher expectations about what should be technological possible.

C. Societal problems are identified and government goals set. The results are new resources and knowledge development and increasing technological expectations.

Figure 12: Motors of Change [Hekkert et al., 2007]

The process approach is applied to collect information about the functions. Activities are mapped over time and give insight in the dynamics of innovation systems. The map of the functions of innovation systems over time, will give insight into patterns in innovation system dynamics related to technological change.

4.2.3 ERA OF THE TECHNO-PRODUCER

Figure 13 represents a highly advanced technological platform based on market mechanism: The Era of the Techno-Producer [Kameoka et al., 2001]. The different flows (information-technology-human) between the actors in the innovation system are displayed. The techno-producer is a new type of technologist who plays the important role as an innovator in a highly advanced technological knowledge flow platform infrastructure, well designed for complex future innovation processes. This
technologist does not only generate new concepts and constructs new strategies, but also leads the practical programs of the process of innovation [Kameoka et al., 2001]. Therefore we can say the techno-producer is a real entrepreneur: (S)he creates, coordinates and executes the objective target. The techno-producer plays a part inside their organization’s structures and across corporate boundaries among industrial-, governmental-, and academic sectors worldwide. A country therefore needs an innovation platform (the technology stock). In this platform many producers are sharing strategic concepts and strategic goals so that the flow of technological knowledge across organizational- and national borders is enhanced [Kameoka et al., 2001]. The common objective including strategic goals and practical programs will be formulated together with an Industrial Science and Technology Competitiveness Committee consisting of supervisors of experienced intellects, business executives specialized in practice, and managers’ workgroups to develop strategic programs. The techno-flow market enhances technology transfer based on the market mechanism.

4.2.4 DYNAMIC MULTI-LEVEL PERSPECTIVE MODEL

Transitions\(^\text{16}\) cover different fields, involve linking multiple technologies and therefore transition processes often take very long [Geels and Kemp, 2000]. Different scales and levels of aggregation can be distinguished in a transition: Industry-level, sector-level, society-level and world system-level. In order to function technical systems need networks of organizations, law and regulation and infrastructure, so to say social systems. The Multi-level Perspective on transitions as defined by Geels and Kemp (2000) consists of three levels (Figure 14): Micro level - technological niches, 2. Meso level - socio-technical regimes, 3. Macro level - socio technical landscape developments. We shortly explain each of the levels now.

![Dynamic Multi-level Perspective Model](image)

**Figure 14**: Dynamic Multi-level Perspective Model [Geels and Kemp, 2000]

At macro level the landscape forms the broad context of multiple regimes. Some developments of the landscape stabilize the regimes, others put pressure. Examples are the political culture, social values, macroeconomic aspects, demographics and the natural environment. The extent in which each of the elements plays a role in developing the transitions is dependent on the selected domain. The meso level consists of rules, assumptions and distribution of roles that influence and determine the socio technical system. Multiple actors are involved providing stable social networks and inertia to the technology. Therefore most technology development is incremental and focused on optimization. At micro level new alternative technologies are under development in the niches. There they are

\(^{16}\) See Appendix A: list of terminology
protected from regular market dynamics. Five kinds of niches can be distinguished [Geels and Kemp, 2000]: Technological-, market-, non technological-, systems of governance and trade, and society outline niches. If there are prospects of market potential of the new technology, but no proven potential, technological niches are created. If market relationships take an important role, market niches are developed. At the niche level social networks are instable.

4.2.5 DYNAMO APPROACH

The Dynamo approach of Butter and Hoogendoorn (2008) states that three different communities of stakeholders have to be considered with an innovation process: Academic community, industrial community and societal community. Butter and Hoogendoorn (2008) make use of OECD’s definition of innovation: “An application of a new scientific insight or technology in an industrial way to fulfill a societal need” [OECD, 2005]. The three different stakeholder communities of innovation and their interactions are schematically shown in Figure 15: Academics (research), industry (community) and society. As the level of information those actor groups use can be different per level of abstraction, the innovation process is divided into three phases: Vision, strategy and tactics. In the vision phase the context of the organization is analyzed in order to create a vision on its position. In the strategy phase a plan to reach the organization’s goals is made. Those strategies can be on national-, organizational- or individual level, respectively macro-meso-micro level. At the tactics phase operationalization of the strategy takes place, resulting in practical actions.

Figure 15: Different stakeholder communities [Butter and Hoogendoorn, 2008]

Figure 16: Dynamo 6 X 3 Framework [Butter and Hoogendoorn, 2008]

The different levels of abstraction can be combined with the stakeholder communities of Figure 15 resulting in Figure 16. The different grey styles here represent the vision, strategy and tactics level. To give an example, if one is looking at strategic level of macro-oriented organizations one ends up at the second level of network crossing business, resulting in the box of innovation themes.

4.3 SELECTION OF THE 4TH GENERATION INNOVATION MODEL

We will now proceed with the selection of the innovation model most suitable to this research.

4.3.1 SELECTION CRITERIA

From the obstacles a list with selection criteria for the 4th generation innovation model has been developed, by pointing out what characteristics the innovation system model should explicitly contain, that can contribute to transparency on Demolishing EDAs’ implementation obstacles. The
selection criteria are listed below. Weights are based upon the amount of characteristics contributing to transparency on Demolishing the implementation obstacles, the innovation system framework possesses. Since Table 1 contained seven obstacles, weights range between 1 and 7.

1. ACTOR-ORIENTED MODEL
Insight into actors and their interrelations in the innovation system will contribute to transparency on Demolishing all the obstacles of Table 1. Insight is gained in for example the financial structure, in the added value of ICT, insight into who should evaluate the implementation process during the course of the action plan, the situation in which the innovation manager wishes to lift the cooperation and communication obstacle. Therefore this selection criterion gets weight 7.

2. CONSIDER MULTILEVEL OF ABSTRACTION
The highest level of abstraction is often the vision development level, while lower levels often form the strategy and tactics level [Butter and Hoogendoorn, 2008]. Transparency on actors and activities in the highest level of abstraction can result in EU wide policy frameworks and clarity on the financial structure determined there. It also contributes to transparency on formulating the common goals around which actors’ cooperate. Business cases and social adoption are dealt with at the lowest level of abstraction, however a strategy of consumer-oriented innovation should be formulated at the vision level already. This selection criterion is weighted 6, only missing a contribution to the lack of insight into the added value of ICT.

3. SPECIFYING ENTREPRENEURIAL ACTIVITIES
We see transparency on entrepreneurial activities to be performed to lift EDAs implementation obstacles, in the first place to enhance communication and cooperation around common goals. The lack of evaluation during the course of the action plan can be worked upon by the entrepreneur, as well as development of feasible business cases to attract investors, and overcome failure to market and adoption by involving the social actors at an early stage of the innovation process. The overarching EU wide policy framework can be initiated by an entrepreneur operating at different layers of abstraction. Five obstacles benefit from entrepreneurial activities, so it receives weight 5.

4. ITERATIVE INTERACTIVE MODEL
The influence of developments, acts and decisions from one actor on another actor can be specified (interactions). Iterative feedback loops are highly important also to realize social adoption of ICT innovations, as well as for regular evaluation during the course of the action plan. If the model supports iterations and interaction, feedback from end-users can be taken into account to improve insight into the added value of ICTs to improve quality of life. Well-founded business cases can be based on the proven added value of ICT, requiring interaction between business developers and product innovators. Interactions can align the vision and process execution level. Four implementation obstacles of EDAs benefit from this selection criterion, so the weight is 4.

5. CONSIDER INSTITUTIONAL FACTORS
Institutional regulations shape the interactions between different actors. In case of this research, 2015.eu’s agenda prescribes institutions the MSs and EC have to implement. Standardization, interoperability and privacy are important to realize e-health innovations. Previous section showed the lack of overarching EU-wide rules in a uniform regulation system obstacle plays a significant role,
as well as lack of social adoption and insight into EU wide financial instruments. Transparency on European institutions will be relevant to lift these three obstacles, giving weight 3 to this selection criterion.

6. SPECIFYING BEST PRACTICES
To bring transparency on the transition path between a current and future image, it is useful to map the activities prescribed by the innovation processes. Best practices for the innovation manager can contribute to strategic efforts to stimulate cooperation around common goals, but also enables transparency on the mutual expectations as with social adoption. We weight this criterion 2, contributing to transparency on Demolishing these implementation obstacles of EDA.

7. MULTILEVEL OF AGGREGATION
Transparency is created if the same framework can be used at national-, firm level-, and sectorial level. This to avoid communication and cooperation obstacles on EDAs implementation, between different levels of aggregation. This research limits to the Dutch e-health domain. This selection criterion is only important for the prospects of cross-border continuing with this research (weight 1).

4.3.2 WEIGHTED SUM SELECTION
In an innovation system framework is selected. To develop comparable criteria scores, we judge the innovation system frameworks at an ordinal scale to the extent in which they fit the criteria: For example full, half or not. These are quantified into 0, 0.5 and 1. The weights of the selection criteria are given at an interval scale (1-7), multiplied by the criteria scores. The CIM has highest score.

Table 3: Selection of the innovation system framework

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<td>1. Cyclic Innovation Model (Burkhour)</td>
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<td>2. Function of Innovation System Approach (Hekkert)</td>
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<td>3. Era of the Techno Producer (Kameka)</td>
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<td>4. Dynamic Multi-level Model (Geels)</td>
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<td>5. Dynamo Approach (Butler)</td>
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1. ACTOR-ORIENTED
The Era of the Techno-Producer, the Dynamo Approach and the CIM are all based on the principle that actors and their interactions are the central building blocks of an innovation system. The Function of Innovation System Approach is a function-oriented model, so values functionality highest [Hekkert et al., 2007]. Geels and Kemp (2000) state landscapes cannot be directly influenced by actors nor be changed at will. So the second level of socio-technical regimes is actor-oriented but the macro landscape development level is not, partially fulfilling criterion 1.
2. MULTILEVEL OF ABSTRACTION
The CIM, the Dynamo Approach and the Dynamic Multi-level Model consist of multiple levels of abstraction. The Era of the Techno Producer works with a common objective besides describing the process, so partially fulfills this criterion. The Function of Innovation System Approach represents only micro level.

3. SPECIFYING ENTREPRENEURIAL ACTIVITIES
CIM level 1 and 2 both have an entrepreneurial node in the middle, and provide some characteristics of the entrepreneur role. The Era of the Techno-Producer has the techno-producer that manages the innovation system. The Function of Innovation System Approach is focused on entrepreneurial activities that need to be performed. Both the Dynamic Multi-level Model and the Dynamo Approach do not specify overarching actor(s) coordinating the innovation process and acting as entrepreneur.

4. ITERATIVE INTERACTIVE MODEL
Interactions between different actors in the Dynamo Approach Model and the CIM is both integral and iterative, as the cycles link different fields of expertise and information exchange including two way interactions between the nodes. The Function of Innovation System Approach and Era of the Techno-producer do not fulfill this criterion as the influence of developments, acts and decisions from one actor on another actor are not clearly specified. The Dynamic Multilevel Model has no feedback loops as it is focused on transitions. Two way interactions takes place between not within different levels.

5. CONSIDER INSTITUTIONAL FACTORS
With the CIM and Dynamo Approach institutional factors can be considered as influencing on the interaction cycles, however these models do not explicitly pay attention to this. Hekkert et al. (2007) consider institutions: “The explanatory power of the theoretical innovation system framework lies mainly in the part of institutions, and less on the actions of the entrepreneur.” In the Era of the Techno-Producer the government is displayed, therefore institutions exposed by the government will be dealt with. For the Dynamic Multi-level Model the influence of institutions is considered on each of the levels.

6. SPECIFYING BEST PRACTICES
The Function of Innovation System Approach is the only function (or activity)-oriented innovation system. Therefore this framework can give more details on the activities to be performed. Other models assume that the transition path indicates the direction of changes required to reach the future states. The Era of the Techno-Producer specifies the different flows (information, human and technology) making a first step in direction of specifying the activities to realize these flows.

7. MULTILEVEL OF AGGREGATION
The CIM model is able to express different levels, as the nodes can represent many different things. The Function of Innovation System Approach is focused on micro level, but the functions can be applied to higher level scale as well. For the Era of Techno-Producer, the flows can take place between different level actors. The Dynamo Approach considers seven different stakeholder levels. Finally the Dynamic Multi-level model considers Industry-, sector-, society- and world system-level.

From this table it can be concluded that the CIM is most suitable for this research. The CIM is more complete in terms of mapping actors than the Era of the Techno-Producer as nodes may include many
actor groups. CIM lacks however capability to specify best practices, and to consider institutional factors. Since their weights are the top 3 lowest, we not expect great negative impact to this research’s results. In the scientific implications section of chapter 10 we will reflect on this.

### 4.4 SYSTEM ERRORS IN TERMS OF THE CYCLIC INNOVATION MODEL

We assume that when we determine in upcoming chapter the innovation systems of the current and future situation, these will show some deficiencies. By describing SEs in terms of CIM, and providing suggestions to lift them, CIM can contribute to the success of innovation models. Figure 17 represents the CIM with the nodes filled in with how they should be interpreted for this research’s applicability. Furthermore it displays the system errors CIM level 1 and 2.

![Figure 17: System errors in terms of CIM level 1 and 2](image)

At CIM level 1 and 2 the following SEs might occur:

- Inter-nodal barriers.
- Deficiencies like one way information and knowledge exchange (only action or only reaction).
- Bias of the system like one or multiple nodes or feedback loops dominate; no balanced investment.
- Lack of an entrepreneur; unaligned ideas on formulating and executing the vision (red marks).
- Intra-nodal barrier. No unified actions or reactions come from the actors in one node.
- Gap between CIM level 1 and CIM level 2. As we determine the e-health future and after perform a case study on service innovation projects, the e-health future and e-health service innovation processes can be unaligned.

Only at CIM level 2:

- The vertical innovation paradox is indicated with the grey dividing line. It is a result of different actions of organizations on the left (scientist) and organizations at the right (commercial companies). The time horizons and dynamics are far apart. “The two worlds make their own choices and plans, and throw their wishes and results over the fence to the other side” [Berkhout et al., 2007].
- The horizontal innovation paradox is indicated with the blue dividing line. The technological functionality is high just as societal needs for transition, but independently plans are made.

In upcoming chapters the CIM model is used for illustration purposes to map the innovation systems, determine deficiencies (SEs), and determine the steps in establishing certain innovation systems.
CHAPTER 5: THE CURRENT E-HEALTH DOMAIN IN THE NETHERLANDS

ABSTRACT
Factors are defined for the e-health domain to show the need for innovation, such as aging and market dynamics, indicating urgency for change or influencing the e-health implementation. Due to similar obstacles bothering EDAs’ and e-health’s implementation, a single approach can benefit demolishing both. System errors in the current e-health domain are detected like no entrepreneur at CIM level 1 and vertical/horizontal communication barrier at CIM level 2, demanding improvement. No awareness exists of innovation systems and main actors in the e-health domain, therefore creation of awareness is advised. TNO’s activities in the current e-health domain are not transparent. TNO did not commit with its propositions to care innovation, influencing TNO’s future position in the e-health domain.

5.1 TRENDS IN THE DUTCH E-HEALTH INNOVATION DOMAIN
The aim of this section is to provide insight in the environment driving the developments in the e-health domain. Besides proving urgency for change in the healthcare, we identify what main factors are influencing the e-health implementation process. A PEST analysis (political, economic, social, technological) can help to identify main trends [Fahey and Narayanan, 1986]. By evaluating factors over time, trends can be determined. Besides a literature and document study, we used interview part 1. As a last step we confirm if the factors determined are aligned with the implementation obstacles of EDAs. If this is the case, we assume that Demolishing the implementation obstacles of EDAs, will contribute to implementation of e-health, and vice versa.

5.1.1 POLITICAL ANALYSIS
FACTOR 1: LAW AND REGULATION
The first factor with impact on the implementation process of e-health is law and regulation. Lack of standardization is bothering digitization in the healthcare. Each SME is developing their own system, therefore bothering the development of an overall platform on which systems can be connected [Eikelboom, 2011]. So interoperability needs to be enabled.

Regulation should force uniformity. Due to the uncertainty about legal liability issues when data transmission occurs incorrectly, many health providers are reluctant to get involved with e-health products [Eikelboom, 2011]. Additional liability insurances can take away this uncertainty.

FACTOR 2: PUBLIC AND PRIVATE FUNDING
The second factor also influences the implementation process of e-health. Decisions regarding investments in new technologies and inclusion of medical technologies in health insurance packages were made at Dutch governmental level before healthcare was privatized in 2005 [Koopmanschap et al., 2010]. The government was responsible for affordable, accessible and high quality healthcare [Asveld et al., 2009]. Since then the government lost grip on the health insurance packages. Investments in new technologies still require public funding as risks are too high for private funders to fully takeover. This has resulted in problems, which we refer to as the opposite Valley of Death [Markham et al., 2010]. Enough public investment is given to discovery and research and to early clinical trials (demonstration phase) however after the pilot phase the required private funding for
scaling up, acceptance and transfer is hard to find. This is a consequence of high risks to be taken by private investors at the early stages of the development process.

Furthermore Public Private Partnerships (PPPs) are hard to initiate. Regulation is changing so often that gains can be retrieved by others than those who have invested [Koopmanschap et al., 2010]. This is particularly the case when private parties are operating on the border of receiving money from social public instruments or medical public instruments.

In the last place, activities on e-health innovation are fragmented in the Netherlands. Jean Gelissen (Philips) states: “Although many parties are involved with e-health and the amount of try outs is enormous, no common denominator can be identified as in every village other initiatives are taken. This dispersed field is partly caused by the fragmented financial instruments as many different governments are involved at different levels”.

5.1.2 ECONOMIC ANALYSIS
FACTOR 3: % HOUSEHOLD INCOME SPEND ON CARE
The first factor proving the urgency for change in the healthcare domain, is the % of household income spend on (health)care. The average household expenses for healthcare differ between 7 and 10% of the household’s income and are expected to grow exponentially [CBS Statline 1, 2010]. Therefore individual income limitations need to be considered to make healthcare services affordable to all. Besides possibilities to pay for care, it also concerns willingness to pay for care. Jean Gelissen (Philips) explains that in the United States it is commonly accepted by the citizens they should pay for healthcare and well-being services, perceiving it as normal, while in Europe this is not the case.

FACTOR 4: MARKET DYNAMICS
Large companies are interested in investing in the healthcare sector since its privatization. They have the financial means to broaden their product-service portfolio. Recently SMEs are often the driver of growth and development of new products and underlying technologies in healthcare, often in cooperation with those large companies [Fonville et al., 2011]. Small companies can launch products with a short time-to-market fully adjusted to customer demands at that point in time. Large companies perceive more difficulty to adjust to strong market dynamics.

Health insurers’ power has increased since healthcare privatization. They are in charge now of which medical treatments to include in healthcare insurance packages. With the demand driven healthcare, furthermore patients are expected to get more critical, make choices, compare care solutions and ask questions [Eikelboom, 2011]. All of the interviewees agree that despite it is written everywhere, end-user generated healthcare in practice hardly happens. Besides end-users are not always qualified to judge on their health and lifestyle, they are often forgotten until a late stage in the innovation process. More than sixty percent of the persons over fifty years old in Europe feel that their needs are not adequately addressed by current ICT equipment and services [EC-INFSO, Oct 2010].

In next chapter we will explain in more detail the debate around privatization of the healthcare and how the market dynamics will influence the way in which the e-health domain can develop up to 2020.

FACTOR 5: ACTIVE POPULATION
The active population is reducing, giving the second factor showing urgency in the healthcare. The gap
between labor supply and demand in the healthcare by 2025 is illustrated in Figure 18 [ECP-EPN, 2010]. This means hundreds of thousands extra people are needed to fulfill the demand for care.

Figure 18: Healthcare labour supply [#] (grey) and demand (red) by 2025 [ECP-EPN, 2010]

To compensate for this active population shortage in the Netherlands the average age of retirement will increase to 66 years old by 2020 [Central government, 2011]. Another solution is stated by Marc van Lieshout (TNO): “Treatment protocols are often tailored to a single syndrome, while many diseases like heart failure and diabetes often occur at the same time. Therefore we should break through this mono-disciplinarily by collaborating in treatment teams in which experts are working together to improve the efficiency”. E-Health can contribute as well as the healthcare and welfare are very labor-intensive sectors (76% of the costs is labor costs) [Statistics Netherlands, 2010].

5.1.3 SOCIAL ANALYSIS
FACTOR 6: AGING
A final factor proving the urgency for change in the field of healthcare is the aging population. In 2009 15% of the Dutch population was above 65 years old, this amount is expected to increase up to 20% by 2020, as shown in Figure 19 [de Bakker et al., 2005].

Aging has two main causes valid for the Netherlands [Butter et al., 2008]: The retiring baby boom generation from after Second World War, and the improved quality of medical treatments, resulting in an increased average age of the eldest people. The aging population will cause an increased amount of people with chronic diseases, requiring continuous and better healthcare which will induce healthcare costs to rise significantly [COM (2008) 199, 2008]. In the Netherlands, 4.5 million people suffer from chronic diseases and this will increase with more than 15% by 2020 [Fonville et al., 2011].

FACTOR 7: PRIVACY AND SECURITY CONCERNS
The implementation of e-health in the Netherlands is bothered by privacy and security concerns. Primarily patients demand safe, good treatments and might be skeptical at the beginning of a new introduced technology. As Marc van Lieshout (TNO) states: “Telemedicine is not an established term in the Netherlands, as ICT driven innovations are not socially accepted”. Main arguments for this are that the ICT device is watching you 24-7 so there is no privacy, uncertainty on what happens with the private information the ICT device collects, and finally uncertainty how invasive the ICT device is on an individual’s daily life. So Marc van Lieshout (TNO) stipulates the great uncertainty of the contribution
of the ICT components. The large majority of the interviewees of interview part 1 confirm that if the gains for end-users are strongly emphasized tech-push innovations may succeed, even in the privacy sensitive field of healthcare.

**FACTOR 8: UNHEALTHY LIFESTYLE**

Another trend is that people maintain an unhealthy lifestyle [Fonville *et al.*, 2011]. Therefore a current upcoming strategy enabled by new service innovations is to prevent instead of to cure [Asveld *et al.*, 2009]. The majority of the interviewees confirm this. Creating healthy lifestyles is however not so easy, Nico van Meeteren (TNO) explains: “We have developed an indifferent and passive society towards health and hygiene. Hygiene comes from the water tap and health comes from a pill box. People do not know anymore how to lead a healthy life”.

We conclude from this that technological innovation cannot compensate current lifestyles, the society should invest themselves. Health insurers are not triggered neither, as the costs of lifelong monitoring a person are equal to one-time surgery.

### 5.1.4 TECHNOLOGICAL FIELD ANALYSIS

**FACTOR 9: KNOWHOW AND ICT DEVELOPMENTS**

The Netherlands is one of the leading countries in the world in the field of e-health use [Dobrev *et al.*, 2008]. As technology is getting smaller, this results in smaller products, integration of functionalities and opening up new opportunities [TNO, 2010]. The Dutch e-health deployment index as defined by Codagnone and Lupiañez-Villanueva (2011) states the Netherlands emphasizes clinical imaging, EPR, patient management, patient access and safety, a Personal Health Record (PHR) and telemonitoring. Specific attention is paid to the Dutch national infrastructure for healthcare AORTA which enables digital exchange of information by a standardized infrastructure [EC-INFSO, 2011].

E-Health is expected to bring from 2014 on a yearly cost reduction of 3 billion euro in the Netherlands, and 50% reduction in avoidable deaths or hospital visits [Eikelboom, 2011]. Therefore it contributes to all three main trends proving urgency for change in the healthcare: High costs, lack of healthcare personnel, and increasing demand for better quality.

Different e-health service categories can be distinguished. *Figure 20* provides the six main categories of e-health, subdivided into e-health service applications:

- **e-Education:** The first category e-education consists of systems for health education and promoting to live healthy. Examples are health portals or simplified access to knowledge services.
- **e-Prevention:** The second category e-prevention consists of specialized systems for researchers and public health data collection and analysis. Moreover the health of a specific target group (e.g. seniors) can be monitored by remote in-home monitoring and preventive care can be applied. Statistical process control monitors care processes, to change their direction in time.
- **e-Consult** is focused on early and more accurate diagnostics to prevent patients from (long) hospital stays. These can be tools for outside hospitals like remote diagnostics and teleconsults.
- **e-Therapy** includes telemedicine systems and services as well as telesurgery and online therapies.
- **e-Care** includes e-monitoring, remote care and homecare management services applicable both within care institutions as well as at home.

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17 See Appendix A: list of terminology
• e-Support can be divided into e-Record, e-Admin and e-Quality. By applying e-Support solutions in care more informed decision-making is enabled, as well as that the quality of care is enhanced.

Figure 20: Categories of e-health services [Fonville et al., 2011; NICTIZ, 2010; eHealthNu et al., 2011]

Next we confirm to what extent the implementation obstacles of EDAs detected in chapter 3, are similar to the factors having a negative influence on the implementation of e-health. For almost all of the factors explained, we can find corresponding implementation obstacles of EDAs. The only one not, is the last factor on technical knowhow and ICT development, since the e-health services named in Figure 20 can be developed by means of the current technological knowhow available. The majority of the interviewees of interview part 1 state that there is a trend of adopting non-medical technologies into the medical field, like using specific sensor technologies from the gaming sector. Next we give some examples of the other factors.

Problems with the structural funding of e-health innovation in the Netherlands, as explained in the factor public and private funding, is aligned with the funding obstacle caused by the complex European financial structure. The Dutch healthcare system again consists of many different financial instruments. The e-health market dynamics factor, is aligned with the lack of well-founded business cases for the private sector. End-users should be actively involved in the decision making process on new e-health innovations, so the lack of social adoption is another related obstacle. Furthermore insight into the added value of ICTs to the quality of life, can contribute to adequately address target groups’ needs. The privacy and security concerns e-health service innovations induce, are similar to the lack of added value ICT brings to quality of life, and the lack of social adoption, and a lack of overarching EU wide rules, like on privacy and security. The factor law and regulation influencing e-health service implementation due to lack of uniformity, interoperability, standardization and liability, is also found as the obstacle bothering the implementation process of EDAs: Lack of overarching EU-wide rules.
In next section we define for the e-health trends of this section with a negative impact on the e-health implementation in the Netherlands, the challenges the actors in the e-health domain will face. Furthermore we define the actors that are active in the current Dutch e-health domain, and map them in terms of CIM. The system errors of the current e-health domain determined in this and next section, are explained in terms of both CIM level 1 and CIM level 2.

5.2 INNOVATION SYSTEMS IN THE CURRENT E-HEALTH DOMAIN

The Dutch Life Sciences and Health (LS&H) sector provides products and technologies to improve quality of life, human’s productivity and sustainability of healthcare [Fonville et al., 2011]. The Dutch LS&H sectors have developed an action agenda of which a selection is of positive influence on e-health developments [Fonville et al., 2011]: Actions to develop and realize a test-ground, arrange regular meetings between patients, health insurance companies and care providers on what products are needed, facilitate the care sector with replacing old treatments, stimulate efficient law and regulations and demand health insurance companies to act as the launching customer.

The LS&H domain includes more than 300 companies focused on the development of new and improved pharmaceutical products and medical devices and technologies (Figure 21). More than 85% of these companies are SMEs, the other 15% are big multinationals. This corresponds to what we have explained in the market dynamics paragraph of previous section.

Figure 22 shows the system errors in terms of CIM level 1, the current e-health domain faces. Figure 23 shows the challenges actors are facing in the current e-health domain, as well as the system errors in terms of CIM level 2. We have mapped the different partners participating on medical technologies (Figure 21) in Figure 23. Besides, this we also give the relevant actor groups of the e-health domain, per node of change. We group the system errors according to the factors we have determined in previous section.

We start with the analysis at CIM level 1.

18 Since no separate e-health domain is distinguished within the LS&H top sector, medical technologies is most closely related domain.
Market dynamics; knowhow and ICT development

Currently SMEs are often the driving force behind new innovations in the healthcare [Fonville et al., 2011]. This is mainly due to their quick time-to-market of products, making them flexible to adjust to changing market needs. Furthermore, SMEs are passing the scientist when launching a product with short time-to-market. Therefore the SE at CIM level 1 is the lack of a unified vision (SE1) in terms of time, particularly between SMEs and scientist.

Aging

Furthermore we explained before the seniors did not feel their needs were adequately addressed by current e-health innovations. End-users should be involved from an early stage, however all interviewees confirm this hardly happens. This indicates an internal ambition error CIM level 1 (SE2), as parties value their internal strategy higher than the overall consortium goals including customer-oriented design. Since this group of people of above 65 years old is only increasing due to aging, this problem will increase in significance upcoming years.

Law and regulation

In terms of law and regulation we state that regulation is required to force uniformity. If all product developers will develop a system without an overall platform it will bother the full Dutch e-health domain. Therefore we detect an internal ambitions error CIM level 1 (SE3), as all actors prefer to have their own system and gain most, although this negatively influences the overall consortium goals on a common platform on which all systems are compatible.
PUBLIC AND PRIVATE INVESTMENT

Attracting public and private investment is both a problem. Due to high risk, the industry is reluctant to invest before a proof of concept is shown (SE4). The government plays an important role in order to raise PPPs, by aiming to get actors from the different expert nodes around the table. However the majority of the interviewees of interview part 1 state the government is not the suitable entrepreneur, since it cannot represent commercial stakes. All interviewees confirm that a lack of clarity on who is the entrepreneur, results in a lack of overall leadership at CIM level 1 (SE5) and therefore uncertainty on who should develop an agenda with a common vision for the care domain.

We continue with the system errors of the current e-health domain in terms of CIM level 2.

MARKET DYNAMICS

First of all we determine an intra-nodal barrier in the product innovation node if every party works individually (SE6). This is caused by the internal ambitions errors SE3. In medical technologies’ field we see again a group of SMEs and a group of large companies in the product-service developers’ node, individually operating. Another SE in terms of CIM level 2 is the vertical communication barrier, as the product-service developments solely take place in the right half of CIM neglecting the scientific discoveries (SE7). Furthermore in Figure 23 there is no party representing the patients’ interests (only medical professionals are displayed). So the social actors in the social transition node are highly underrepresented compared to the market players (SE8). Since we emphasized the importance of health insurers after privatization of healthcare, it is remarkable that the social transition node contains no health insurers neither.

KNOWHOW AND ICT DEVELOPMENT; PRIVACY AND SECURITY CONCERNS

There is clearly a bias in the amount of partners in the scientific node (SE9). Challenges in the hard sciences cycle for the e-health domain are small. This is not surprising as e-health applications enabled by ICTs already exist. The need for a large amount of scientist can be explained as these include social or gamma scientists as well, and the soft sciences cycle includes many important challenges.

The technological analysis states the ICT infrastructure is advanced in the Netherlands, so the technology is developed without taking into account end-users interest and involving end-users from an early stage to emphasize the opportunities the infrastructure will bring. This indicates a horizontal communication barrier CIM level 2 (SE10), in which a product is developed and only after launching it end-users get aware of its existence. This lack of a social adaptation phase was the case with the introduction of the HER, as [Patrick Strating (EIT ICT Labs), 2011] explained, which resulted in product failure due to privacy and security concerns.

UNHEALTHY LIFESTYLES

Another important challenge given is to motivate citizens to improve their unhealthy lifestyle. The end users are passive towards their own health, while some of the other actor groups in the social transition node (e.g. the healthcare professionals), are expected to deal with the consequences of unhealthy lifestyles. Therefore we detect an intra-nodal barrier in the social transition node, due to unaligned perceptions (SE11).
5.2.1 INNOVATION SYSTEMS AT DIFFERENT LEVELS OF THE E-HEALTH DOMAIN

We analyze next if the interviewees of interview part 1, knowledgeable in the e-health field, acknowledges innovation systems in this domain. From this analysis we conclude that uncertainty exists on the existence of innovation systems in the e-health field, as answers were dispersed. We recommend the entrepreneur to create awareness of the added value participating in innovation systems can bring. Marc van Lieshout (TNO) states: “There is always an innovation system, the question is if the actors\textsuperscript{19} themselves recognize it as such”. If this is indeed the case, emphasizing the existence of an innovation system, can help actors already cooperating in a consortium but not acknowledging this as an innovation system, to structure their innovation processes and predict any unforeseen system errors. We will illustrate this in the case study chapter.

The majority of interviewees gave examples of ecosystems\textsuperscript{20}, clusters\textsuperscript{21}, or consortia, so were aware of the fact that these concepts are similar to innovation systems. Patrick Strating (EIT ICT Labs) states: “There are multiple healthcare clusters in the Netherlands, which can be seen as innovation systems. Some are more horizontally oriented (resource sharing), others more supply chain oriented. When considering the healthcare domain, for each of the service innovation fields (patient at the center, medical technologies, medical innovations) a separate cluster can be distinguished which each consist of its own ecosystems.”

Literature distinguishes supply chain clusters for the LS&H sector in the Netherlands, as shown in Figure 24 [Fonville et al., 2011]. Horizontally oriented clusters are also mentioned, for example the umbrella organization of the eight Dutch University hospitals (NFU), the umbrella organization of health insurers in the Netherlands (ZN), and the umbrella organization of Patient federations (NPCF).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{clusters.png}
\caption{Clusters in Life Science and health sector [Fonville et al., 2011]}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{netherlands_cluster.png}
\caption{North Netherlands cluster in terms of CIM level 2. Based upon [CIF, 2011]}
\end{figure}

\textsuperscript{19} See Appendix A: List of terminology
\textsuperscript{20} See Appendix A: List of terminology
\textsuperscript{21} See Appendix A: List of terminology
Figure 26 displays the different levels of the innovation systems of the current e-health domain we have discussed, based upon the explanations of this section.

Using innovation system frameworks to guide the consortium development is not a widely adopted approach in the Dutch e-health domain. Interviewees had already difficulties naming the main players of the Dutch e-health domain, and could only do this by first mentioning a project, and next mentioning the parties involved in this project. We therefore conclude they do not have a transparent idea on who to approach for consortium building so knowledge and experience in the field of e-health are not optimally implemented. This is aligned with the uncertainty on whether innovation systems can be distinguished. One can question the importance of implicitly naming innovation systems, if clusters are distinguished by the majority of interviewees.

As a cluster not only describes geographically concentrated networks of actors, but resource sharing and supply chain clusters as well, we see a great similarity with the definition of innovation system...
we use for this research as given in chapter 1. In ecosystems actors use each other’s waste materials and energy as resources, while in innovation systems a comprehensive iteration process of action and reaction is based upon each other’s knowledge- and information flows. Therefore ecosystems are less comprehensive.

To compare regional and national innovation systems in the e-health domain, we will now show the cluster of North Netherlands and compare this to the partners working on the medical technologies domain of Figure 23. In Figure 25 we have zoomed in on the cluster north Netherlands in terms of CIM. This cluster was initiated by the Care innovation Forum (CIF) [CIF, 2011]. It is an initiative of twenty care providers, insurance companies and research institutes and is focused on structural changes in care. So on regional level innovation systems exist as well and more importantly health insurers are included, being the sources of new innovations. The CIF acts as the entrepreneur of the innovation system as they establish new innovative projects by identifying market opportunities, acquiring (international) co-funders, inviting experts and market parties to join the initiative, coordinate the activities performed in the innovation system and monitor the progress. Only two out of four expertise nodes are covered, therefore no radical innovations can be expected to result from this innovation process [Berkhout et al., 2007].

As we can see the actors involved are all positioned in the bottom half of CIM level 2. For that reason, strong demand-pull takes place as what is technologically feasible is initially not considered. Possible explanations for the absence of parties in the technology node and product-service development node are first of all that the CIF is a social player with a large network in the social transition node, secondly that they fear the horizontal communication barrier will occur if technology and product developers are involved, and tech-push solutions will be introduced without considering social needs. A last possible explanation is that as EU-level and national level agenda’s are mainly economic oriented and have only limited social focus, the cluster North Netherlands aims to stick up for the quality of life of the society in their region as their distance to their inhabitants is small. We expect this innovation system with only two expert nodes covered, to fail after a while as radical improvement is needed. It is impossible to avoid a horizontal communication barrier by only involving scientific- and social partners, as the horizontal communication barrier works in two directions: Tech-push solutions are not desirable, but demand-pull solutions neither.

When we compare the actors positioned in this regional innovation system to the full Dutch innovation system on medical technologies, shown in Figure 23, we see that on national level technology and product developers are considered. However, we have also explained besides the government, SMEs are involved in the middle node. The majority of the interviewees state that middle node should be fulfilled by one actor from each expert node, to avoid a bias towards one of the expert nodes. So when we turn this the other way around, by having the SMEs as the entrepreneur of the innovation system, we may expect them to make sure the technology and product development nodes will not be underrepresented as this is where their internal ambitions lie. For that same reason the government will make sure the social transition node and the scientific exploration node get sufficient attention.

22 The care innovation forum (CIF) is an independent network foundation in the field of health care aiming to develop a common vision, stimulate cooperation, reduce fragmentation and economically exploit care innovation in the northern part of the Netherlands [Flim et al., Sept 2010].

23 See Appendix A: List of terminology
5.3 TNO’S ACTIVITIES IN THE E-HEALTH INNOVATION DOMAIN

This section explains the activities TNO is currently performing in the e-health innovation domain. This analysis makes use of TNO internal documents and the results from interview part 1 and part 2, and can be used in upcoming chapters when determining a position for TNO in the future e-health domain.

As we have seen in chapter 1 TNO is a multidisciplinary application-oriented research organization, with researchers in technical sciences, behavioral sciences but also organizational sciences, the activities are not easily listed. When looking at the kinds of activities TNO performs, this ranges from consultancy jobs on the execution of policies and improving products and processes, towards performing contract research on behalf of governments, companies and organizations, the testing and certification of products and systems, providing licenses on one of the 450 TNO inventions, and finally performing statutory assignments [TNO Corporate, 2011]. The missions for TNO are “Innovation for Life” and Innovation with Impact” [Mengelers, 2011]. Therefore only ICT solutions that aim to improve people’s well-being, and therefore innovate with impact, are acceptable for TNO to work upon.

The innovation area Vital for life aims to get the Netherlands back in the top five in terms of health [TNO, 2010]. Nico van Meeteren (TNO) explains how ICT can contribute to this: “If ICT contributes substantively to the contents of care, under condition that it is accepted by the population, it can bring a significant added value.” Healthy Living is focused on healthy participation in society, physical and mental health to enable personal well-being as well as quality of the whole society [TNO WEBSITE, 2011]. Therefore part of TNO’s activities in the e-health field is to perform policy focused research to promote ICT in healthcare. TNO got involved with large projects like Alice E, eHealthNu, eCardioCare, Smart Coaching, Rosetta.

By not only contributing to the seven top sectors policy of the government, but actually helping to select the top sectors, TNO is one step ahead and can easily align its activities to obtain public funding [Mengelers, 2011].

The innovation area biomedical innovations, has as main propositions personalized prevention, diagnostics and therapy [TNO WEBSITE, 2011]. We conclude that TNO has not included care innovation as one of its propositions, making it not (yet) part of the core activities. This is confirmed by [Monique van Blijswijk (TNO), 2011]. This clarifies why no transparency on TNO’s activities in the e-health innovation domain is found.

Erik Fledderus (TNO) states that TNO does not have the skills to synthesize its in-house knowledge, to make a standing story out of it. This is confirmed by other TNO employees, and gives another reason why no transparency on TNO’s activities in e-health was found. We have therefore mapped the Centers of Expertise (CoE) TNO consists of in terms of CIM level 2, to illustrate what knowledge they possess. By providing examples for each of the cycles of change, and nodes of change, we aim to circumvent the lack of transparency on activities TNO’s performs. We mapped the Centers of Expertise relevant to e-health in Figure 27.
5.3.1 NODES OF CHANGE

TNO performs activities in the field of e-health innovation by combining expertise from the themes of TNO Healthy Living and TNO Information Society, as it works with a domain-specific solution approach [TNO WEBSITE, 2011]. Besides knowledge development, inter-disciplinary knowledge sharing is therefore important for TNO. Due to its domain specific solution approach TNO CoEs are highly specialized like on chronic diseases, life style, child health, or on the ICT applications in these fields.

TNO Healthy Living is closer related to the market and the end-users, as well as exploration of very specific scientific questions related to healthy living. Healthy Living has its own technical experts, but when highly advanced ICT solutions are demanded, as with e-health solutions, Information Society contributes. Therefore they are positioned respectively in the social transition node and in the scientific exploration/technology development node (Figure 27).

TNO Information Society is more specialized in product innovation, technological research but also technology- and market assessment [TNO WEBSITE, 2011]. Information Society does not create products but advises on the product composition, as well as how up-scaling can be realized in a complex domain like care [Marc Steen (TNO), 2011]. Actual product development is the task of

\[\text{BD = Business Development} \]
\[\text{PM = Project Management} \]
commercial parties, but TNO can provide direction on which components to use for a demonstrator or how to develop it. In terms of Figure 27 TNO Information Society is positioned in every node, except for the social transition node. Main challenges are to support the innovations in a certain way so that they are sustainable, boost productivity and social welfare and this while keeping up the good image of the products by the society [TNO Corporate, 2011].

In the cross-cyclic entrepreneurship node the main activities emphasized most often are the business development (BD), quality management (QM) and project management (PM). Furthermore knowledge management, contract management, and so on will also be executed at the middle node at TNO however here is not referred to as much. Amongst TNO employees, there are BDs solely focusing on initiating new business, either based on external trends and/or internal ambitions. Not only BDs are nowadays expected to raise new opportunities for business, but TNO experts as well [Marc Steen (TNO), 2011]. Another activity TNO performs in the healthy living domain is project management. Friso van der Meulen (TNO) confirms this by stating that you can see PM as one of TNO’s core expertise. In terms of QM, TNO adds to the e-health testing systems. TNO was the first in the world to launch a European quality standard for medical websites, called Quality for Medical Information and Communication (QMIC) [QMIC, 2011]. Furthermore managing the quality management activities in a project is often done by TNO as well, but this falls under the PM activities.

5.3.2 CYCLES OF CHANGE

SOFT SCIENCES CYCLE
In the soft sciences cycle the business models are developed by the Strategic Business Modeling department. The vision for e-health is determined by the strategies for the Information Society department. Policies on standardization, interoperability and specific alpha and gamma scientific challenges are explored by the other departments.

HARD SCIENCES CYCLE
In the hard sciences cycle departments perform applied scientific research into new sensor technologies, technical interoperability by means of vital ICT infrastructures and network technologies, all enabling to e-health.

DIFFERENTIATED VALORIZATION CYCLE
In the differentiated valorization cycle TNO’s social and behavioral departments go in-field to co-design, contribute to implementation and valorization, evaluate end-users’ satisfaction and analyze how to overcome scale up barriers.

INTEGRATED ENGINEERING CYCLE
Finally, in the integrated engineering cycle the technology assessment takes place, as well as the demonstrator development. Actual product development is left to the commercial parties, currently mainly SMEs as we have seen in previous sections.

In next chapter we state how the future e-health innovation system should look taking into account the SEs of current e-health innovation domain detected in this chapter.
CHAPTER 6: THE FUTURES OF THE E-HEALTH DOMAIN IN THE NETHERLANDS

ABSTRACT
The analysis shows that to arrive at the futures of the e-health domain by 2020 in terms of CIM level 1, the vision should be formulated first, the process mode next, and finally engineering the transition paths. Aligned but no unified futures were found describing different levels of detail for the e-health domain by 2020. Characteristics of an entrepreneur that could develop such a unified vision were given, showing an opportunity for TNO. High expectations exist for health insurers at CIM level 2, to develop process models. The debate related to the future healthcare system is given. The eHealthNu and eCardioCare project have been selected for the transition path towards e-health building blocks. In terms of e-prevention these were Smart Coaching and WeCare project.

6.1 THE E-HEALTH FUTURES IN TERMS OF CIM LEVEL 1

The relevance of implementing 2015.eu’s agenda in the Netherlands is that awareness of its existence is created, and with that awareness of the opportunities the digital infrastructure brings. In Chapter 3 we concluded 2015.eu’s agenda can be interpreted in different ways, given that some interviewees see 2015.eu’s agenda’s focus on e-health building blocks, others see a direct contribution to e-health service innovations. As explained in Chapter 3 in the Netherlands the infrastructure possession rate by households is not the problem, but to have everyone using it. For the definition of the concept vision as interpreted in this research we refer to vision24.

In Chapter 3 we have seen that organizations will be triggered to focus on after 2015.eu’s objectives are implemented and start up new e-health services that can work under condition that the infrastructure by 2020 is realized.

6.1.1 THE PROCESS AT CIM LEVEL 1

We start with the order in which the process of vision formulation, consortium development and transition path development take place. When asking for a vision, interviewees tempt to refer to the projects that they were currently working on. This again points out the uncertainty on what to expect in future with the healthcare system, even by the senior managers we have interviewed. Furthermore the majority of interviewees found it easier to translate their e-health vision first into tangible projects (indicated with arrow 1 Figure 28), finally to determine which parties to ask for the consortium to work in these projects (indicated with arrow 2 Figure 28).

This is aligned with previous chapter in which we concluded it was difficult to name the main players active in the e-health domain. Patrick Strating (EIT ICT Labs) supports this thought by stating that in the care domain everybody acknowledges there will be a problem for the healthcare provision in 10 years but this problem has no clear owner, as a result nobody takes responsibility. In section 6.3 we clarify the debate in the healthcare domain, so by clarifying the problem it becomes clear why there is no owner. Currently, it is perceived as difficult by the players in the care domain to determine and attach the actors to cooperate with on the care innovation processes. This is probably the reason why the establishment of the consortium is performed as the last step. Secondly we noticed they select

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24 See list of terminology
examples of e-health service innovation processes to get to this vision. Finally before they can start the service innovation process, the process of searching for parties to cooperate with in the consortium needs to be performed. As this is performed as last step, the ideas need to be aligned again to arrive at a common result. Iterations could have taken place more efficiently by using the interactions between all three nodes.

Due to the absence of transparency on who are the major players in the e-health domain, our advice even goes one step further by stating that when most of the issues occur in the consortium development, this step should be performed secondly, before engineering the transition path. After the parties in a consortium agree on the vision they aim for, it is easier to arrive at aligned projects to execute to transit to this vision.

One can argue that if our research follows the steps of CIM (Chapter 4), why the order of the sections in this chapter does not meet this requirement. As this chapter’s contents are mainly based on interview part 1, in which the interviewees have used the order vision-transition path-process model development in the reasoning of their answers, we have decided to still use the order vision-transition path-process model development in this chapter’s explanation.

6.1.2 FUTURE VISIONS

From the interviews part 1 we conclude that no unified vision for the 2020 e-health domain was found. This is not surprising as in previous chapter we found a SE CIM level 1 in terms of absence of an entrepreneur to define a common agenda for the e-health domain, and stimulate on a common platform to enhance interoperability. Erik Fledderus (TNO) states: “Currently in the field of care the case is the one that can pay can decide. Understandably this is not always the most qualified party in terms of expertise and synthesizing”. In section 6.3 we define the characteristics an actor capable of taking the entrepreneurial role should have. As shown in Figure 28 there are five statements about the future images of e-health. We detect no external trends error, as the e-health vision of Figure 28 takes into account the trends of previous chapter.

The conclusion on these five statements about the future images of e-health is that they are aligned, only describing a different level of detail. The lower level visions enable the higher levels. For example e-coaching tools will enable self-empowerment as no personal coach is needed, and self-empowerment again contributes to the independent living and increased well-being.

From bottom up, first of all an increased attention for new developments is expected, not only by policy makers but by patients and healthcare professionals as well. Healthcare professionals as their healthcare workforce cannot fulfill demand, policy makers as they see the seriousness of the situation, and patients as they feel the need for self-empowerment. Due to this increased awareness, there will be an increased transparency on what fields to prioritize in the care domain. According to the interviewees this will be in the fields of unobtrusive and uncompromised care solutions, as these have the highest chance of societal adoption.

Furthermore an increased role of coaching tools is expected, as preventive treatments will dominate curing treatments, to extend the duration of well-being and independent living, contributing to a high quality life. The increased role of the community and social networks, also aims to increase social inclusion to increase independent living and reduce the heavy burden that rests upon the shoulders of the care providers.
However we have already explained the paradox of de Bruijn et al. (2004) stating that a narrow formulated long-term goal restricts the flexibility and the amount of parties it appeals to, just as a too broadly formulated long-term goal becomes meaningless and cannot commit parties. So by having a balanced combination of both, we expect the actors in the care domain to be able to control the transition towards the images of the e-health future.

Another conclusion is that we do not clearly see back 2015.eu’s agenda in those images of the future in of Figure 28. Jean Gelissen (Philips) clarifies this by stating that 2015.eu’s agenda does not develop the domain-tailored privacy solutions prescribed in the privacy and security action area, but it establishes the mechanisms to develop those solutions. This same counts for the other action areas.

6.1.3 ENGINEERING TRANSITION PATHS

Desired breakthrough innovations in the e-health innovation field will take place in e-prevention services and e-support service categories, as defined in Figure 20. This is concluded from which categories most often were emphasized by both interview part 1 and literature by Asveld et al. (2009), Eikelboom (2011) and Butter et al. (2008). Interviewees see high expectations in the field of early diagnostics and coaching solutions, both examples of e-prevention services. The PHR and continuous monitoring are furthermore emphasized, both by Eikelboom (2011) and interviewees. Therefore the e-health service innovation processes selected for the transition path should consider the direction these visions of the e-health futures prescribes.

When aiming to find e-health service innovation processes for defining the transition path, we again comment on TNO’s in-house knowledge management, since no overview of TNO’s projects could be found. This again points out the lack of transparency inside TNO’s organization, which we have pointed out in section 5.3 as well.
We distinguish between service innovation processes aiming to support the implementation of e-health (e-health building blocks) and secondly service innovation processes focused on when the e-health building blocks are implemented (e-health services). In terms of e-health building blocks the eHealthNu project is focused on removing barriers for scale up in the e-health domain, as well as the eCardioCare project.

The WeCare project offers e-prevention services, preventing elderly from social exclusion. The Smart Coaching project offers preventive e-coaching services, stimulating a healthy lifestyle.

Figure 29 illustrates the transition paths resulting in the two e-health future images e-Prevention and e-Support most often referred to. When we analyze to what extent the e-health service innovation processes suitable to include in the transition path, are aligned with 2015.eu’s agenda, we conclude the following: All e-health service innovation processes can be related to 2015.eu’s agenda.

A possible explanation given by Erik Fledderus (TNO) for which we have found support amongst all interviewees is: “Business as usual stays aligned with every new European Digital Agenda. At some points 2015.eu’s agenda is as broadly defined that existing projects will always fulfill what is said. This is necessary as you cannot start all over with every new EDA”.

By means of the transition paths we indicate that the selected service innovation processes for the case study connect the 2011 and 2020 e-health domain. As an example, the SC project will end by 2013, however the SC program includes follow-up e-health service innovation processes to widely implement coaching devices by 2020. This will bring radical improvements to the e-prevention field by 2020. These on their turn will contribute to the future visions of improving quality of life, well-being and self-empowerment, human oriented services, and unobtrusive, uncompromised measuring devices.

6.1.4 E-HEALTH FUTURE’S SYSTEM ERRORS IN TERMS OF CIM LEVEL 1

As explained before no unified vision was retrieved from the interviews. The SE we determine here is that the large parties in the care domain that aim for a common result, each individually start with developing a vision. Therefore we state there is lack of overall leadership to guide the vision development process (Figure 28 SE1). This also followed from previous chapter. In the actor analysis of section 6.3 this should be taken into account.

The 2015.eu strategy is not explicitly enough to derive a unified vision based upon it (Figure 28 SE2). However one can question if it is desirable to base the e-health future upon an ICT oriented digital agenda like 2015.eu. As we have seen before ICT based innovations often fail in the Dutch health domain, so ICT will work as an obstacle in programs of healthcare [Marc van Lieshout (TNO), 2011].

Moreover translating the vision into the cyclic process model CIM, including all actors that should take part in it, was perceived as difficult and not a common group of parties was given (Figure 28 SE3). This was the same as with the current e-health innovation domain, that the main actors active in this field are simply unknown. Transparency needs to be created first. As explained before we recommend focusing on the process model node from an initial stage, not only after transition paths have been developed.
Internal ambitions errors occurred as to come up with e-health service innovation processes, interviewees only referred to their own fields of expertise (Figure 28 SE4). We expected that open-minded senior management interviewees would think from a broader perspective, considering e-health innovations which they do expect to make the difference in future, despite their own organization is actively involved with them or not. However, in order to stay competitive an organization should have a clear innovation strategy and its employees will have mainly knowledge in their particular e-health working areas.

A final SE indicated in Figure 28 with the (1) vision (2) transition path (3) consortium development, is that this represents a linear process, so there is a lack of iterations by using the interactions between all three nodes, as defined by Berkhout et al., (2007).

6.2 THE E-HEALTH FUTURES IN TERMS OF CIM LEVEL 2

Figure 30 gives an overview of the 2020 desired breakthroughs in the field of e-health and the main actors in the expertise nodes that logically will play a role in realizing e-health innovations. We discuss the breakthroughs per cycle of change.

6.2.1 HARD SCIENCES CYCLE

From Figure 30 we conclude that difficulty with innovations in the field of beta sciences and technology are not expected to cause trouble on realizing the e-health future. Each of the breakthroughs is mentioned a single time. This also follows from previous chapter. The strategic value of ICT to the care processes still needs to be exploited, just as what supportive technologies can be used for independent living. Due to the demand for continuous care, continuous care models should be developed [Asveld et al., 2009]. Furthermore a single open platform compatible with systems of different suppliers needs to be developed. By doing so, the lack of an overall platform mentioned in previous chapter is considered, which contributes to the removing the intra-nodal barrier in the product-service innovator’s node.

6.1.1 SOFT SCIENCES CYCLE

Institutional innovations in the field of law and regulation are needed, as well as the development of feasible business models. In the social sciences a breakthrough is expected in insight to change the mindset of the population to accept new innovations. Insight in society’s adoption patterns are emphasized (Figure 30, amount of references 4). By means of co-design end-users can provide their input as well. New needs for health applications in terms of interaction and feedback can be determined. This to overcome the SE of previous chapter that needs are not adequately addressed by the e-health innovations. Interoperability between the technical and the care system should be researched to enable a fast implementation.

Nico van Meeteren (TNO) and Bria and Finn (2009) state by 2020 everybody will be health literate and self-manage their health as from birth health is emphasized as being an important aspect of life. From both literature and interviews it follows feasible business models should be made first. This breakthrough removes the obstacle on lack of private funding due to big uncertainties. Furthermore a breakthrough in integrating the financial structure between sports, care and healthcare will create more transparency both for companies to get funding and for end-users on the three Acts in the Health and well-being system. This contributes to remove the barrier of previous chapter that is hard to get public funding.
6.1.2 INTEGRATED ENGINEERING CYCLE

The majority of the interviewees referred to the implementation of a PHR to enable service breakthroughs (Figure 30, amount of references 3). A PHR contributes to people’s access to their health situation at any time. As this is highly desired since Dutch citizens value health management higher than financial management [Nico van Meeteren (TNO), 2011], the end-users are even willing to forget privacy issues. So the reason why the EHR has failed adoption in the Netherlands is because the entrepreneur could not emphasize the benefits strongly enough to outweigh the privacy and security concerns. As a consequence of the failed EHR, the demand for a PHR came up. This confirms that we can expect an important breakthrough in the field of safe e-support by 2020, and this supports the transition path formulated in previous section resulting in e-support. Houses, cars, working spots should be equipped with sensors to get the input for the PHR.

The biggest challenge in the integrated engineering cycle is to make the currently available technology, which is clumsy, user friendly, unobtrusive and uncompromised [Jean Gelissen (Philips), 2011]. Therefore breakthroughs are needed from first to small add-on sensor measuring devices, towards embedded diagnostics. A last important issue is the use of Privacy Enhanced Technologies, in order to support the privacy-by-design approach. This will contribute to social acceptance.
6.1.3 DIFFERENTIATED VALORIZATION CYCLE

In terms of e-health service breakthroughs preventive solutions are referred to most often, confirming the transition path of previous section. The two desired breakthroughs referred to most are the smart coaching and smart houses for independent living. Patrick Strating (EIT ICT Labs) states: “If houses are equipped with new sensor technologies, expectedly residents will start to think about new applications, resulting in user-generated healthcare.” Many different applications to coach healthy people and risk-groups can enable this, both to change their unhealthy lifestyles and live independently longer. This can be in fields of sports, monitoring and feedback (Figure 30, amount of references 3). If in future medical information will be collected and stored in a database, like a PHR or EHR, improvements can be expected in terms of the data collection methods. First add-on measuring devices will be used, next those measuring devices will shrink in size so they can be embedded in jewelry, and on the long run sensor technology will be such that advanced that a microchip can be planted in vivo at birth. Therefore applications will be fed by information from add-on or embedded sensors that are unobtrusive and uncompromised [Jean Gelissen (Philips), 2011]. Easy and fast insight in health status enabled by self-empowered health monitoring is valued high by patients since it contributes to their independency and freedom.

6.2 ROLES OF ACTORS BASED ON E-HEALTH INNOVATIONS AND THE CHANGING HEALTHCARE SYSTEM

Next we analyze what (groups of) actors are most suitable to realize the breakthroughs of Figure 30. Furthermore we compare how the roles of actors are expected to change compared to current situation, both due to the market dynamics in the Dutch healthcare sector and the breakthroughs defined in previous section. We start with the characteristics of the entrepreneur of CIM, so that we can take this into account in the actors’ roles suitable for realizing the breakthroughs. Furthermore we evaluate if TNO fulfills these criteria.

6.2.1 ACTOR ANALYSIS

We continue with an actor analysis by explaining the main groups of actors in the field of e-health and their interests and contributions, as well as how their roles are expected to change/have changed (Table 4). There is much mutual disagreement amongst groups in society about what the preferred model for healthcare is, to maintain a high level of quality under the influence of the current trends in the healthcare domain [Groll, 2006]. Disagreement exists on how in future the healthcare in the Netherlands can still be kept high quality, without the costs will get too high. We refer this as the “care system debate in the Netherlands.”

The positioning of the actors in the current e-health innovation domain of Figure 31 is equal to what we have explained in previous chapter. Due to the changing healthcare system and expected technology development in the healthcare, the position of the actors in CIM level 2 will change. The position of the health insurance companies is expected to change towards the future e-health domain, since they will be present in the middle and the social transitions node. Large companies will be positioned in the middle node as well in the new situation. Therefore each of the expert nodes has a representative party in the middle node, as explained in previous chapter to be desired for the success of an innovation system. By increased operation of testing fields, local governments’ presence is emphasized in the social transitions node of the future situation.
Figure 31: Roles different actors in the e-health innovation domain (Current left, future right).

Table 4: Changing roles of actors to enable future e-health innovations. Based upon [Asveld et al., 2009; Koopmanschap et al., 2010; IPTS, 2009; interview results part 1; ECP-EPN, 2010; Mengelers, 2011]

<table>
<thead>
<tr>
<th>Previous role</th>
<th>Future/upcoming role</th>
<th>Required changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>End-user as subject of care</strong></td>
<td><strong>End-user as care consumer</strong></td>
<td>Create awareness</td>
</tr>
<tr>
<td>• Passive attitude towards own health</td>
<td>• Patient towards the care professional; client towards the health insurance company; citizen towards the government.</td>
<td>• A norms and values debate on what is important to today’s society.</td>
</tr>
<tr>
<td>• Unawareness of what to do to become vital again</td>
<td>• Aware of consequences of own behaviour, aiming to improve unhealthy lifestyle</td>
<td>• Social adoption of ICT driven health innovations</td>
</tr>
<tr>
<td></td>
<td><strong>Advantages</strong>: Self empowered; independent; consumer tailored treatments</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Disadvantages</strong>: Pressure on freedom due to increased responsibility; lack of expertise to take medical decision on own health; Needs neglected when health insurers, industry and healthcare professionals determine healthcare supply.</td>
<td></td>
</tr>
<tr>
<td><strong>Health insurance company as care administration office</strong></td>
<td><strong>Health insurer as Commercial life style agent</strong></td>
<td>Create support</td>
</tr>
<tr>
<td>• Offering standard insurance packages</td>
<td>• Intermediary between care professionals and care consumers;</td>
<td>• A supportive attitude of health insurance companies towards care innovation</td>
</tr>
<tr>
<td>• Execute governmental policies, without considering patient’s needs</td>
<td>• Evidence-based treatments</td>
<td>• Learn how to deal with patients’ needs</td>
</tr>
<tr>
<td>• Not facilitate care innovation due to bothering Dutch law and regulation;</td>
<td><strong>Advantage</strong>: Target group tailored health insurance packages; improve their market position; product differentiation by means of high quality, low price</td>
<td></td>
</tr>
<tr>
<td>conflicting issues; too busy with reorganizations and mergers.</td>
<td><strong>Disadvantage</strong>: Squeezed between end-users needs and healthcare professionals</td>
<td>• Develop a vision on innovation in the field of care</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Medical expert as medical authority</td>
<td>- In charge of what treatments to use to cure their patients - Hospitals’ Business Models patient throughput based</td>
<td></td>
</tr>
<tr>
<td>Medical expert as information source and health coach</td>
<td>- High demand for preventive treatments results in a coaching role instead of a curing role for medical experts</td>
<td></td>
</tr>
<tr>
<td>Advantage:</td>
<td>Patient empowered; relation between patient and medical expert cooperative and coaching</td>
<td></td>
</tr>
<tr>
<td>Disadvantage:</td>
<td>Liability uncertain for the (selection of) treatment; loss of commitment to care developments; lose power</td>
<td></td>
</tr>
<tr>
<td>Government responsible for health insurance packages</td>
<td>- Guarantee affordable, accessible and qualitatively high care - Lack of technical knowledge to take right decisions looking after citizens’ interests</td>
<td></td>
</tr>
<tr>
<td>Government as venture capitalist for social projects</td>
<td>- Support e-health innovation developments as a funder and launching customer - Act for the good of their citizens by means of policy support programs (digital agendas) - Stimulate raising clusters of excellence in the top sectors defined; knowledge development aligned by industrial demand</td>
<td></td>
</tr>
<tr>
<td>Advantage:</td>
<td>Government can intervene market dynamics</td>
<td></td>
</tr>
<tr>
<td>Disadvantage:</td>
<td>No direct impact on affordable, accessible and qualitatively high care; loss of government power.</td>
<td></td>
</tr>
<tr>
<td>Industry Produces products satisfying end-users’ needs</td>
<td>- SMEs as the driver of growth and development of new products and underlying technologies - Large companies more waiting for evidence-based technologies before they get involved</td>
<td></td>
</tr>
<tr>
<td>Industry produces products satisfying end-users’ needs and form alliances to create niche markets</td>
<td>- Large companies have financial means - Convince medical professionals</td>
<td></td>
</tr>
<tr>
<td>Advantage:</td>
<td>Funding safeguarded; High chance of acceptance by health insurers</td>
<td></td>
</tr>
<tr>
<td>Disadvantage:</td>
<td>Less radical innovations; threat of large companies fully take over SMEs</td>
<td></td>
</tr>
<tr>
<td>Fundamental and applied researchers develop knowledge in accordance with own priorities</td>
<td>- RTOs support local and regional test and pilots more intensely; advise the (local) governments and industry what fields to</td>
<td></td>
</tr>
<tr>
<td>Researchers develop knowledge on areas underwritten by industry</td>
<td>Create acceptance</td>
<td></td>
</tr>
<tr>
<td>Advantage:</td>
<td>Knowledge institutions, universities and RTOs have to cooperate in clusters of excellence.</td>
<td></td>
</tr>
</tbody>
</table>

25 Medical expert and healthcare professional are used as synonyms.
When new fields of research are requested these are retrieved from applying e-health into practice

- Technological innovative ideas perceived too slow for the dynamic healthcare market

focus on

- Advantage: Innovate on a larger scale;
- Remove organisational barriers; Integrate programmes of applied and fundamental research.

Disadvantage: Research priorities for areas underwritten by industry; limited fundamental research without industrial incentives.

- RTOs have the technical knowledge to take right decisions for the good of citizens; recognize significant projects
- Universities Medical Centers can function as testing grounds

6.2.2 FUTURE SCENARIOS OF THE DUTCH HEALTHCARE SYSTEM

There is currently no single “best” practice in national healthcare systems. Healthcare systems of many developed countries outperform one another in several aspects, yet in the same time fall behind in other aspects [Groll, 2006]. This gives room for stakeholders to argue what the importance of such aspects is relative to each other, and consequently what type of healthcare system is preferred. Three scenarios for the healthcare system in the Netherlands by 2025 are given by [Idenburg and Van Schaik, 2010], meant to provide a better overview to the developments in healthcare:

1. **Qualitative high, but expensive care for a broad group of people**

   This scenario is mostly dictated by left wing politicians. It continues with the current healthcare system, without hard interventions to protect the current level of quality of healthcare. Changing the system will bring uncertainty on the quality of the care. This scenario hopes the technical and operational innovation to be fast enough to implement e-health devices and other innovations in a short term, on a large scale, to compensate for the rising costs and increasing demand within the current health care system. Because of the rising costs of healthcare in the Netherlands, this scenario relies on a resurgent economy to provide the needed funds and deprive politicians from pushing major healthcare reforms [Idenburg and Van Schaik, 2010]. By means of this scenario, the short term is considered. In the short term we expect an increased investment by the government to compensate for the rising costs.

2. **Scooping out of care, creating expensive, low quality care.**

   This scenario develops due to an ailing economy and political division, which prevents necessary restructuring. The lack of political direction will keep the healthcare system trapped in its current unsustainable form while insufficient fund are provided to keep the current level of quality [Idenburg and Van Schaik, 2010]. As explained before this unsustainable form is caused by the current trends of rising costs, rising demand, a decreasing responsible workforce, and so on.

3. **Leave care to the market which will result in dichotomy with excellent care for the rich and sober care for the poor.**

   This scenario addresses the wish of right wing politicians to continuing the privatization of the healthcare system. Such large scale changes will be more likely in a stagnating economy where reform is required, to tackle rising costs. As the industry outperforms the government in terms of technical and operational innovation, we expect the government to provide incentives and regulation frameworks to stimulate market dynamics, but still control quality. The healthcare system will in this case be able to sell excellent quality, yet at prices that might not be affordable to all citizens [Idenburg and Van Schaik, 2010].
From the above scenario’s it becomes clear that the second option falls behind in both quality and costs compared to the other two. The choice for the future healthcare system seems to be between the first and third option. This results in a discussion that basically addresses to option of implementing additional privatization into the healthcare system. Quality of care, financing of care and the performance of the healthcare system were taken into account. Some other features of influence on the care debate in the Netherlands, and in particular to develop and implement e-health innovations on a large scale, are shortly explained now.

### 6.2.3 SELF-EMPOWEMENT OF PATIENTS

The current discussion concerning self-management mainly focuses on the conditions in which self-management should become possible. Depending on the type of patient, self-management has a different content. For chronically ill, self-management would be focused on learning to live with limitations and self-application of disciplinary measures to prevent worsening of the illness or its consequences. For some mentally limited people, this form of self-management might prove too challenging, resulting in a different degree or selection of aspects to be included [De Jong and de Vos, 2009]. This needs to be considered when developing e-health tools, as not a single standardized product-service combination can be offered to different types of patients.

Large scale implementation of self-management for patients will have effect on the relationships between the different stakeholders in the healthcare domain. Patients will gain more control over their health situation, making them less dependent of health care providers and more influential on healthcare insurers according to some specialists [BMC Zorgdebat, 2006]. Healthcare insurers on the other hand might start forcing changes in lifestyle on its customers, like self-management practices, as rising costs of care or possible withdrawal of government funding puts pressure on the health insurers’ financial situations. [De Jong and de Vos, 2009].

One of the main ways in which citizens can currently exert influence on insurance companies is through the legalized practice of negotiating collective policies for a group of citizens. Through self-empowerment the patient will become less dependent on insurers to decide what care has his preference. As patients look more into individual health care preferences, low prices for standard health care insurance packages will lose part of their strength in attracting customers. Some believe this will result in a change of power from the healthcare insurers towards the patients [BMC Zorgdebat, 2006]. Self-empowerment of patients due to easy access to medical information has resulted in more proactive patients. In terms of the quantity of information acquisition by patients, medical experts have fallen to a second place as source being overtaken by internet (Table 4).

### 6.2.4 FINANCING OF CARE IN THE NETHERLANDS

Based on Figure 32 Gelevert et al. (2010) conclude that there is only limited relation between the money flows in the Dutch healthcare system, and the healthcare delivery process. This means that no mutual dependency exists between every two stakeholders, and results in no transparency on the gains of investments.
A feature of the Dutch healthcare system is that it is private from the point of the health insurer, as health insurers negotiate prices and contracts with health providers (hospitals, nursing homes etc). From the patient’s point of view the system is a combination of private and public health insurance. The public (basic) insurance, covers care that is either extremely expensive (unaffordable for uninsured) or that would otherwise be uninsurable for some (such as care for disabled) for which citizens pay a fixed fee [Groll, 2006]. Included in the basic package is a no-claim meant to withhold people from overusing care. Additional insurance packages can be added against additional costs, depending on the package and the health insurer issuing it.

Citizens pay for care due to two reasons [Gelevert et al., 2010]: (1). They are obliged by law to pay a tariff for the basic insurance package, and (2). The citizen wants to be assured of accessible and high quality care if it becomes needed. Most citizens want be kept informed of their condition and receive care that is suited to their specific needs. Costs are also a mayor issue for citizens, as health insurances take up a large portion of income as explained in the trends in chapter 5.

Health insures play a key role in the Dutch health care system, as they are partly funded by direct financing from the government concerning 50% of the costs of the basic health packages, and partly funded by premiums paid directly by the customers for their insurance. In return they arrange health care for their customers that are in need of it [Langejan, 2011]. This makes the health insurers the center peace between patient and healthcare provider, by managing the distribution of healthcare.

Through healthcare reforms the government in the Netherlands is stepping back from different positions and roles in the healthcare system, indicated in Figure 31 by a decreasing role in the social transitions node, and decreasing role in the middle node by not being the “responsible government anymore”. This has reduced the influence of the government on many fields within the healthcare system [Peters-Volleberg, 2006]. The prominent role in the system seems to be filled in by insurers as the government stepped back, though this balance of power does not seem fixed over time. The government still holds great influence on the quality of medical products through legislation and regulation, though their role in the organization of healthcare has been reduced. In terms of funding,
health care providers can no longer count on the government, but have to contract out there services to health care insurers. To survive in the new competitive market, hospitals have to provide a competitive combination of quality and volume of services to be produced and associated prices [Langejan, 2011].

6.2.5 TNO CHECKED AGAINST THE ENTREPRENEURIAL CHARACTERISTICS OF CIM

To determine the characteristics the entrepreneur should possess to suit the middle node of CIM level 1 and 2, we analyzed both literature and interview part 1 and part 2.

The table below represents the eight operational roles as defined by [Vilkinas and Cartan, 2001] and [interview part 1 and 2], checked against TNO’s capabilities (strong/medium/low) that followed from literature and interviews. The eight operational roles are given, and the last line of Table 5 shows the characteristics an actor should possess. We conclude TNO’s strengths lie with being a producer, coordinator and a mentor. Explanation is given next.

Table 5: Description of eight operational roles [Vilkinas and Cartan, 2001; interview part 1; interview part 2] (Strong ☑ Medium ☐ Low)

<table>
<thead>
<tr>
<th>Role</th>
<th>Characteristics from literature</th>
<th>Corresponding characteristics from interview part 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Innovator (CIM level 1)</td>
<td>Continually searches for innovation and improvements ☑ A Solves problems in a creative way ☑ B Envisions needed changes ☑ C</td>
<td>Business developer ☑ D Business developer ☑ D</td>
</tr>
<tr>
<td>2. Broker (CIM level 1)</td>
<td>Exerts upward influence ☑ F Acquires needed resources ☑ G External focus ☑ H</td>
<td>Business developer ☑ D Business developer ☑ D</td>
</tr>
<tr>
<td>3. Producer (CIM level 2)</td>
<td>Gets the work done ☑ L Customer focus ☑ M Achievement oriented ☑ N</td>
<td>Determined to reach consortium goal ☑ O</td>
</tr>
<tr>
<td>4. Director (CIM level 1)</td>
<td>Provides direction ☑ P Clarifies priorities ☑ Q Communicates unit’s goals ☑ R</td>
<td>Get others on the right track ☑ S</td>
</tr>
<tr>
<td>5. Coordinator (CIM level 2)</td>
<td>Coordinates activities ☑ U Schedules ☑ V Brings sense of order to workplace ☑ W</td>
<td>Monitor progress on reaching goals ☑ X</td>
</tr>
<tr>
<td>6. Monitor (CIM level 2)</td>
<td>Monitors progress ☑ Y Collects information ☑ Z Holds regular reviews ☑ AA</td>
<td>Monitor progress on reaching goals ☑ X</td>
</tr>
<tr>
<td>7. Facilitator (CIM level 2)</td>
<td>Builds teams ☑ BB Facilitates consensus ☑ CC Manages conflict ☑ DD</td>
<td>Monitor progress on reaching goals ☑ X</td>
</tr>
<tr>
<td>8. Mentor (CIM level 2)</td>
<td>Develops staff ☑ HH Listens emphatically ☑ II Treats each staff member in a caring way</td>
<td>Monitor progress on reaching goals ☑ X</td>
</tr>
<tr>
<td>Characteristics (CIM level 1 and 2)</td>
<td>Independent</td>
<td>Driven by both social and commercial stakes</td>
</tr>
<tr>
<td>----------------------------------</td>
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</tr>
</tbody>
</table>

To be an actor in the middle node of CIM level 1 role 1, 2, 4 are emphasized. To take the position as actor in the middle node of CIM level 2, role 3, 5, 6, 7, 8 are emphasized.

We have developed this table based upon what the majority of the interviewees perceived. Agreement was found on all characteristics, except the “independency” and “driven by a balance of social and commercial stakes” as interviewees from commercial companies disagree on this. Jean Gelissen (Philips) explains: “The middle node should be taken by a commercial party. In the end if you want to develop something sustainable, there is need for a party that understands it all, stays actively involved throughout the whole innovation process, and therefore should keep a stake in the end-product or service”. The remaining social actors will however not approve on a single commercial parties in the middle node. Therefore we conclude a group of actors with one party from each different expertise nodes involved with the consortium is desired to be positioned in the middle node. Dependent on the drive behind the innovations, a different party is dominant in the middle node. Initiation of system innovations can be knowledge-driven (science push), government driven (political awareness of need for demand pull) and market driven (market push), giving respectively a RTO/university, a government or a market player in the middle node [De Bruijn et al., 2004].

The market players for which we have found support in both literature and interview part 1, expected to play a major role in future, are the health insurance companies. As health insurers are involved in three out of four of the e-health service innovation processes, their pro-active role has already started. For the eHealthNu project, Menzis is even positioned in the middle node already. They seem suitable as entrepreneur CIM level 2 since they should aim to represent the social transitions of the care consumers (their customers), focus on availability of financial means, are in need for change to differentiate from each other, and have a large network in the care domain to establish consortia. So besides their role in the social transitions node, in future health insurers will take a dominant position in the middle node.

Next we evaluate the score of TNO on these operational roles. All interviewees, both inside TNO and external, confirm TNO can play a key role at CIM level 1, vision development, and carry this vision forward (innovator E and director T). “At RTOs like TNO and Novay people are thinking about failure of the innovation platform of care,” Patrick Strating (EIT ICT Labs) states. However, he states that RTOs are propagating a vision without telling a party what to do (director S, T). So the government is desired as well with the vision development, since it should assign tasks over the players in the care domain. All interviewees agree that TNO is highly qualified to communicate different partners’

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26 Achmea is one of the large health insurers in the Netherlands and therefore presented as example in Figure 30.
interests to each other and bundle them in a common vision (organization, LL). TNO can work together with municipalities and University Medical Centers on national level, and with the new Healthy aging initiative on European level. So TNO can form the bridge between the different levels of aggregation (facilitator, GG; broker, F).

Next we discuss TNO’s role at CIM level 2 that has followed from interview part 1. Jean Gelissen (Philips) sees TNO clearly as a knowledge organization, therefore not capable of being the business developer of CIM level 2. Only then sustainable innovations are developed. Patrick Strating (EIT ICT Labs) feels however that TNO does not have the size to create impact as technology developer, since there are many technology developers also internationally competing. RTOs cannot take part in the middle node of CIM level 2 according to Patrick Strating (EIT ICT Labs) since their developments are too slow (innovator, A, D).

TNO internal interviewees confirm that TNO perceives difficulties connecting activities of its own departments. However it can partner up with the coordinator of CIM level 2 and communicate the needs and interests to synthesize the CIM level 2 consortium group (facilitator, EE). Furthermore TNO is capable to perform capability checks at companies, to advice on what is best for them to focus on. This activity will be performed in the soft sciences cycle. Inside TNO interviewees see themselves a direction advisory as well, but they state not limit to advise to companies, but also advise the national government on which innovation fields to prioritize. TNO has contributed already to the development of the top sectors proposal of Life, Science and Health (innovator C, direction Q).

Furthermore inside TNO interviewees confirm that the main task for TNO is to assure the knowledge developed in the left side of CIM level 2 is actually applied to the market, to create impact. Therefore TNO’s main activities are in the integrated engineering cycle [Marc van Lieshout (TNO), 2011]. A more active role in the differentiated valorization cycle is desired by TNO, and this is feasible, since TNO has contacts with municipalities for in-field trials and co-design. However, by increasing its network in the care domain TNO will become even more suitable to be involved in the differentiated valorization cycle (organization PP, QQ).

As Monique van Blijswijk (TNO) has explained, TNO did not clearly present themselves in the care domain, since it did not included care innovation in their propositions, making it not (yet) part of the core activities of TNO. Lack of taking a clear desired position will negatively influence the trust of other care domain players in TNO, as TNO did not fully commit to care innovation yet (organization, PP). This can harm the opportunity of TNO to be the accelerator of the National Implementation Agenda e-Health (NIA), the follow-up initiative of the eHealthNu project, as well. The majority of TNO interviewees of interview part 1 also state that TNO should position themselves in the care field by clearly stating what is its role, and what is not.

So we conclude at CIM level 1 both internal and external interviewees of TNO, confirm TNO can play a key role with the vision development. At CIM level 2, internal TNO interviewees see a role as facilitator and mentor, which are more relation management skills, but less a coordinator’s role. External interviewees not see a role for TNO in the middle node of CIM level 2, however the focus of them was more in terms of innovativeness and business developers role, and we do not expect disagreement on TNO taking a facilitating role between the consortium members.
We clearly see that these characteristics and prescribed role are aligned with the prescribed future role of RTOs in Table 4.

### 6.3 PHASES IN DEVELOPING THE INNOVATION SYSTEMS OF THE FUTURE E-HEALTH DOMAIN

From interview part 1 no uniform perspective is derived on the development of future innovation systems to realize the breakthroughs innovations mentioned in previous section. Therefore we selected one that clearly dominates by gaining most support from interviewees as well as literature.

The majority of interviewees agree on the following e-health innovation system development steps. At the beginning a product-service innovator with a short time span of building and releasing new applications is desired. SMEs can easily adjust to changing demands. Patrick Strating (EIT ICT Labs) explains why SMEs are preferred at the beginning, over large product innovators: “SMEs are more suitable, as those large companies will first develop a roadmap of how the product and the process will look. This simply takes too long.” However, when we argue from a financial perspective, the financial means large companies have available for R&D exceeds that of SMEs. Therefore longer innovation trajectories, resulting in more radical innovations are realized with the help of large companies. Again this points out the need for collaboration.

Furthermore at the beginning housing corporations and health insurers should be present, so a market party that feels the need to incorporate technology in their services and can therefore be the potential launching customer. Moreover they have the financial means and with that the power to start a project. A RTO (TNO) can join later to act as intermediary as they can point out everyone’s individual interests and the contribution to a common goal [Erik Fledderus (TNO), 2011]. For example a RTO will protect the market from vendor-lock in, as no standard should be pushed by the product-service developer to create a monopoly. Furthermore the intermediary role is to stimulate trials to be hold by the housing corporation or health insurer to enhance end-user adoption before the actual implementation starts. A RTO can commit municipalities to act as launching area, since we have stated before the new role for RTOs is to provide prioritization of innovation fields for local governments. TNO can also offer their own internal organization as the launching area, to increase their contribution to the pilot phase. This is emphasized by several TNO interviewees.

There is later on also a role for alpha and gamma universities for determining new needs in the fields of sports, care and healthcare [Patrick Strating (EIT ICT Labs WEBSITE, 2011)]. The argument for not involving actors from the scientific and technology development side from the start is that their innovative ideas are too slow for the dynamic healthcare market. Therefore they cannot anticipate fast enough on changing demands. However technical universities are needed to realize technological breakthroughs which are too risky for industrial companies [Erik Fledderus (TNO), 2011]. If a technical breakthrough is too risky for companies to realize, we expect no feasible business model to exist for it yet, so this product is less likely to be introduced by a SME. Research divisions from large companies (e.g. Philips research) can still join. So we tempt to say that the more radical the innovation aimed for, 27 Syntens is an innovation institute aiming to trigger SMEs to innovate, by stimulating and guiding SMEs’ innovation projects [Syntens WEBSITE, 2011]. It is displayed in Figure 30 to represent the group of SMEs.

28 The Alliantie is one of the large housing corporations in the Netherlands and displayed in Figure 30 to represent this group.
the more emphasis the left part of CIM gets. Marc van Lieshout (TNO) also emphasizes the importance of the science and technology part of CIM at the beginning, though less extreme: “If more radical products will be developed like advanced medical devices and cancer treatment protocols, the left half of CIM level 2 is more important than the social side at the beginning of the innovation process. Societal needs are fulfilled anyways, as everybody wants to get better. When focusing on new healthcare concepts that do not demand advanced ICT technology but where ICT plays a significant role, you start at the right part of CIM and the left part is less emphasized”.

Remarkable is that the presence of the national government is only given at CIM level 1 by the interviewees. This as government can represent their inhabitants’ interests by means of a National Digital Agenda and similar initiatives. The partial privatization has diminished the government role substantially.

6.4 E-HEALTH FUTURE’S SYSTEM ERRORS IN TERMS OF CIM LEVEL 2

In terms of CIM level 2 a SE occurs when stating that radical innovations mainly demand the left side of CIM and incremental innovations demand the right side of CIM: a vertical communication barrier in which the left and right part of CIM operate independently, in Chapter 4 referred to as the vertical innovation paradox (Figure 30 SE1). So this innovation paradox will still be present in the future e-health domain. This same counts for the unaligned vision in terms of time between scientists and SMEs. We have emphasized in future universities will receive funding for application-oriented research instead of fundamental research as the focus of the CoEs is pre-determined. So it will still be hard to initiate PPPs, and attract public and private funding. In terms of public funding, initiatives for 2020 are there to simplify the law and regulation on healthcare and care, as well as for private funding purchases by health insurers are guaranteed if evidence-based treatments are offered. Investments of private companies will proceed with evidence-based treatments. Therefore the lack of private funding barrier can be removed in future as well.

The approach of starting with fundamental research and ending with applications emphasizes tech-push and therefore causes a horizontal communication barrier as end-users are only involved from the in-field trials on (Figure 30 SE2). Fortunate an alternative innovation system development is mentioned, most often referred to by interviewees so most likely to be executed. The horizontal communication barrier is worked upon by providing in-field pilots at in-between stages. Furthermore end-users are expected to be care-consumers in future, directly demanding the treatments from the health insurers. So patient-centred innovation is emphasized, but as stated not much is done with this in practise. The intra-nodal barrier in the social transition node will be removed as patients will be triggered to take responsibility of their own health.

Moreover each of the interviewees envisions a dominant role for their organization in the future e-health innovation system. This is again aligned with the obstacle of previous chapter, the uncertainty on who are the main players in the care domain, and certain individual initiatives do not contribute to an overall platform on which all systems are compatible indicating a lack of an overall leader (Figure 30 SE3).

Another possible explanation is that the interviewees only consider the benefits of initiating innovation systems and did not consider disadvantages, like the financial risk that needs to be taken.
For example the high responsibility it will bring to be in the middle node, and the expectations in terms of taking risks, bringing in funding, like with the pro-competitive service innovation processes. So in order to become a respected actor in the care field, some concessions need to be made.

The lack of an entrepreneur at CIM level 2 is worked upon, as the overall conclusion is the health insurance companies, SMEs, and RTOs can take a role. By involving a RTO the lack of unified vision in terms of CIM level 1 is worked upon as RTOs are capable of formulating visions.

6.4.1 FOCUS ON DEMOLISHING OBSTACLES PREVIOUS EDAS

We next analyze if the obstacles determined with the implementation of former EDAs, have a chance to be removed by activities focused on the desired breakthroughs in the e-health domain and the actors working on them. We conclude that the e-health innovation domain as described in this chapter can contribute at different aspects of the obstacles for implementation of former EDAs.

Table 6: Contribution of activities focused on e-health breakthroughs contributing to removing EDAs’ implementation obstacles

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Activities focused on the obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of evaluation during course of the action plan</td>
<td>The middle node is responsible for this. As the importance of the entrepreneurial node is acknowledged, developing process indicators and monitoring progress should be made his/her main activities.</td>
</tr>
<tr>
<td>2. Lack of societal adoption</td>
<td>Insight in society’s adoption patterns is investigated, just as increased health literacy and ways to remain therapy loyalty. By considering privacy from the beginning of the design phase privacy issues can be reduced (co-design).</td>
</tr>
<tr>
<td>3. Lack of overarching standards and a uniform regulation system</td>
<td>Law and regulation simplification in the health and well-being system, improved privacy security, an integral healthcare package and a single open platform on which different e-health systems are compatible.</td>
</tr>
<tr>
<td>4. Lack of strategic efforts to stimulate cooperation around common goals</td>
<td>The formulation of a common vision on e-health is included in the soft sciences. After formulating the common goals, entrepreneurs in the middle node should monitor that the innovation processes sticks to these common goals.</td>
</tr>
<tr>
<td>5. Lack of insight into added value of ICT to quality of life</td>
<td>Easy and fast insight in health status, accurate medicine transport, improved precision treatments, are all examples of ICT based innovations that will contribute to quality of life.</td>
</tr>
<tr>
<td>6. Lack of well-founded business cases</td>
<td>Feasible business plans will be developed, as there is awareness of the lack of private funding, due to high uncertainties.</td>
</tr>
<tr>
<td>7. Complexity of the EU financing structure</td>
<td>Law and regulation simplification in the Dutch health and well-being system should contribute to transparency on financial instruments, making it easier for organizations to acquire public funding.</td>
</tr>
</tbody>
</table>

Upcoming chapters continue with the case study performed on the e-health service innovation processes. We will compare if the actors envisioned at different phases when building up the innovation systems for the future e-health domain by 2020, are aligned with the partners joining at different phases in development of the innovation systems of the cases.
CHAPTER 7: THE ANALYSIS OF E-HEALTH SERVICE INNOVATION PROCESSES BY MEANS OF A CASE STUDY

ABSTRACT
Six development stages of an innovation process were defined and positioned in the cycles of change of CIM: the fundamental-, industrial-, experimental-, commercialization-, early scale-up and late scale-up stage. These positions were confirmed by means of the four e-health service innovation projects used with this case study, classified by these development stages. For illustration purposes the CIM has been applied to the cases to map the innovation systems. The analysis shows the steps in establishment of the innovation systems of the individual cases, giving similarities in the procedure. These are explained in the comparative case study of next chapter.

7.1 EXPECTED CLASSIFICATION OF THE CASES BY THE DEVELOPMENT STAGES OF THE INNOVATION PROCESS
The e-health service innovation processes we defined by engineering the transition path of Figure 29, are used for the case study. We classify them by the following development stages of an innovation process:

- Fundamental development stage: Scientific research
- Industrial development stage: Product development and proof of concept
- Experimental development stage: Prototyping and executing trials
- Commercialization stage: Turning knowledge into marketable products; product roll-out
- Scale-up stage: Large scale adoption

The first three development stages are defined in accordance to the EZ-CO instrument of the Ministry of EL&I [TNO, Feb 2011], and confirmed by the interviewees of interview part 2. The last two development stages are added later on based upon our analysis from interview part 1 and 2, and studying project documents. To give an impression of how we came up with these development stages, we give some citations used. Friso van der Meulen (TNO): “The next stage must show if the idea is commercially and technically feasible. In the prototype phase a business model exploration should take place, else you invest a lot of time and money in a dead end.” Monique van Blijswijk (TNO): “After the pre-competitive stages have finished, it is more about implementation.” Marc Steen (TNO): “The deliverables of the WeCare project are the services developed, a business model exploration and demonstrating functionality by means of trials. Next research into roll-out and scale-up will take place”.

We aimed to analyse at least one case per development stage listed above. However, no e-health service innovation project in which TNO plays an important role during the fundamental development stage has been selected. Main reason for this is the criteria of a large diversity of parties involved, which was not fulfilled for fundamental projects for which actors are often limited to the science and

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29 “Pilots are small scale versions of larger trials” [Cancer Research UK, 2012]. Therefore in this research we do not distinguish between referring to a pilot or to a trial. The interviewees of the experimental development stage use these terms interchangeably in the interviews as well.

30 “Rollout is the process of moving a product from the successful conclusion of the pilot test, to the point where it is fully operational in all desired locations” [Microsave, 2012].

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technology nodes (e.g. with CoE). No case has been selected from the commercialisation stage neither, as TNO is a “not for profit” organization, for which the main business does not lie within the commercialisation phase. TNO Companies commercializes e-health service innovations by means of its spin-offs, however the scope of our research is limited to TNO’s main organization. This results in four cases used for the analysis in this chapter, and for the comparative case study of next chapter. This is a feasible amount to work upon in the course of this research.

As according to the fourth generation innovation models theory an innovation process cannot be described as a chain, we classify the e-health service innovation projects by the development stage of the innovation process we expect them to be positioned in, as shown in Figure 33.

Figure 33: Overview of e-health service innovation projects

### 7.1 Case 1: Smart Coaching

To come up with radical new applications pre-competitive research offers great opportunities as it is focused on early development of new knowledge, not directly applicable to new products or services [TNO WEBSITE, 2011]. To support this kind of research the Ministry of EL&I has initiated the EZ-Co instrument for TNO in which the Ministry will partly fund research into new knowledge. Janine Swaak (Novay) explains this EZ-Co instrument simplified and honest as: “Knowledge development for TNO as they get the IP rights, by means of funding from co-funders who get free application rights for upfront determined application areas”. Therefore she states EZ-Co projects are hard to initiate for TNO, as potential investors have better alternatives. In Figure 33 the SC project is positioned in the industrial development stage in the integrated engineering cycle. It has just started.

#### 7.1.1 Smart Coaching – Background

The goal of the SC project is to find out how mobile technology can support the combination of self-management and inter-human coaching in the application domains Youth in Motion and Vital at Work [TNO, Feb 2011]. The 2020 expectations are a broader application area of this coaching service, and social adoption as well. In May 2010 the project development took off by Novay and TNO. In total the project’s time estimation is 2.5 years of which the industrial development stage will take 9 months.

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31 In this research we refer to co-funder, when indicating a consortium partner who is not operationally involved by means of formalized activities, but mainly investing financial means (shareholder).
[TNO, Feb 2011]. By March 2011 the project proposal was approved and in June 2011 the official kick-off took place. The actors involved are TNO, Novay, UVIT, Philips and Municipality Enschede.

Figure 34 shows the initial project organisation. The project group consists of 15 TNO members and 5 Novay members. The steering group consists of a corporate level representative from each co-funder, the booster from TNO, and the chairman from Novay. It aims to set direction for the SC project. The feedback group32 consists of an expert from each co-funder and can be consulted by the project group for expert opinions. The industrial development stage includes four work packages (WPs). WP0 - project management (PM), WP1 - conceptual model package, WP2 - concept development, WP3 – concept evaluation. TNO is responsible for WP0, WP1, WP3, and Novay for WP2.

Figure 34: Project organization of the Smart Coaching project [TNO, Feb 2011]

7.1.2 THE DEVELOPMENT OF THE SMART COACHING INNOVATION SYSTEM

After this brief introduction, we will analyse the innovation system development from perspective of the middle node. The different steps are explained, including factors considered during the development.

Step 1: Idea generation
TNO and Novay were the idea creators33, positioned in the middle node. Personal interests were important to come up with the idea, as their interests lie within the field of health and connecting human and technology [Ed Mos (TNO), 2011; Novay, 2011]. The joint initiative between Novay and TNO was due to a possible merger between them. Ed Mos (TNO) explains that by proving the added value of working together in larger projects, the merger is supported.

Step 2: Inventorise in-house knowledge
The middle node acted as knowledge manager. Janine Swaak (Novay) states the challenge of SC is to adjust people’s behaviour. Involved are social scientists, and a few technologists for demonstrator development. Novay is expert in relation management and working with steering groups. Janine Swaak (Novay) explains to commit co-funders the benefits like knowledge gaining should be emphasized instead of that EZ-Co projects only result in application rights. Friso van der Meulen (TNO) states that TNO excels in PM of multidisciplinary projects due to its varied in-house expertise.

32 Referring to a feedback group is interchangeable with referring to a control group.
33 In terms of the operational roles for the middle node, as stated in Table 5 this would be the innovator. However, as the innovator role covers more than being an idea creator, we preferred to be more precise.
Step 3: Involve a social co-funder representing public interest
The middle node acted as acquisition manager. The interest for the municipality Enschede is that the end-product effectively supports their healthy living policies [Friso van der Meulen (TNO), 2011; Municipality Enschede, 2011]. They are positioned in the social transition node. Furthermore they aim for an integral approach and strengthening cooperation with market parties. Municipality Enschede is a personal contact of Janine Swaak (Novay), and able to create potential markets. As they have access to pilot test groups (e.g. youth), value is added to the consortium.

Step 4: Involve a commercial co-funder with market knowledge
The middle node acted as acquisition manager. SC is a pre-competitive project while competitors already offer end-products. UVIT aims to deliver distinctive prevention and self-management services [UVIT, 2009; Friso van der Meulen (TNO), 2011]. Personal commitment of the corporate UVIT representative was decisive, plus UVIT had cooperated with Novay before. They joined under condition of being the only health insurer. Certainty of one health insurer joining (potential launching customer) added significantly to the consortium’s value, despite limiting the funding size. As UVIT is connecting the professionals with the end-users their position is in the social transition node.

Step 5: Involve a commercial co-funder with product knowledge
The middle node acted as acquisition manager. “It was hard to commit a big commercial company (product innovator) as their policy is to not invest in innovation they do not get the IP rights” [Janine Swaak (Novay), 2011]. Philips already had significant investments in the field of preventive care and aims for a standard product they can sell to varied target groups. The company is a relation of TNO and Novay. As co-funder, there are no obligations on operational contribution. Friso van der Meulen (TNO) states: “Philips has bought an admission ticket for the follow-up phase.” Philips is concerned about absence of reimbursement policies for preventive care, so commitment of the Ministry of EL&I interest them.

Step 6: Novay becomes sub-contractor
The steering group is facilitator for TNO and Novay, due to the declined merger. Janine Swaak (Novay) explains they still try to project a unified vision towards the co-funders. For future development of innovation systems this step has small relevance, so we leave out further analysis.

Step 7: Involve a sub-contractor with product knowledge
The middle node acts as a contractor. MobiHealth can produce the demonstrator against low costs, as they are experienced with building mobile applications [Mobihealth, 2011]. Mobihealth is subcontracted, and not co-funder, as for SMEs it is too risky to join a pre-competitive project in which they have to hand-over their main competitive advantage, their in-house knowledge.

Step 8: Network of activities industrial development stage
The middle node acts as PM. Janine Swaak (Novay) expects no new parties to join anymore, since the project has started. Acquired parties do not like a party entering late, to benefit from results up to now. This is an important consideration when establishing an innovation system.

34 In terms of the operational roles for the middle node, Table 4 this would be the broker. Again we preferred to be more precise.
**Figure 35:** Steps to establish the Smart Coaching innovation system
7.1.3 THE NETWORK OF ACTIVITIES

Figure 36 represents a zoomed in version of the network of activities. Activities of the SC project for the industrial development stage cover all cycles, rejecting the division as stated in Figure 33. As no radical new technologies are developed only few activities are present in the left top hard sciences cycle (7% of time spend) [van der Meulen, 2011]. The iterative approach includes a lot of in-between feedback resulting in a large portion of time (33%) spend on differentiated valorisation cycle. The interviewees agree the biggest challenge of the SC project will be to convince those risk-groups not willing to contribute automatically. Therefore the soft science cycle takes 20% of the time spend. Still the largest part of time (40%) will be spend on the differentiated engineering cycle, in which opportunities for new products are derived from technology. Iterations enabling continuous feedback flows of knowledge and information are desired for successful operations.

Next the activities of the middle node indicated with A, B, C, D in Figure 36 are explained. They focus on how the middle node can keep the innovation system running by supporting the expert nodes to interact to accomplish the targets. The activities contributing to TNO’s goals for the project are included.

35 For table format of the list of activities we refer to Appendix D.
From our case analysis we derive that to successfully enter the experimental development stage after the industrial development stage, the result of the industrial development stage should include a demonstrator (proof of concept), iteratively designed by co-design. The aims of TNO with the SC project are as Ed Mos (TNO) states: “To proof TNO’s ability to manage co-design and large multidisciplinary projects with many different interests involved, to show expertise in the field of community and coaching”. To support this we defined the following activities for the middle node. We only emphasize those of particular interest to this project. For the SC project a separate relation manager and project manager are involved.

### Project manager (TNO)\(^{36}\)
1. Organize regular meetings with the project group
2. Develop a list of activities and to whom these are assigned, to avoid ambiguity amongst Novay project participants on who to approach of the TNO project participants
3. Stimulate project group members TNO to visit co-funders
4. Inventorise in-house expertise
5. Communicate results of the quality manager to the project group. With that the project group members are triggered to deliver high quality work.
6. Develop project proposal for the follow up phase. A concrete plan will amplify commitment of co-funders, so should be developed at an early stage.
7. Ask concrete questions to passive co-funders during steering group meetings, and request from active co-funders to do the same, to assure a more equal knowledge sharing amongst all.

### Relation manager\(^ {37}\) (Novay)
Organize and chair regular meetings with the steering group, evaluate their satisfaction, align interests in terms of time and focus.
8. Emphasize advantages of collaborating in the SC project consortium to the co-funders. The EZ-Co project gives a special construction in terms of IP rights’ division. By emphasising other advantages (e.g. learning effects), this increases co-funders’ commitment.
9. Actively attend steering/control group representatives on meetings and reports, since the co-funders formally have not got assigned operational activities, their contribution is fully dependent on their own willingness.
10. Meet regularly with the PM and communicate steering group results
11. Ask concrete questions to passive co-funders during steering group meetings
12. Stimulate Municipality Enschede and UVIT to involve end-users from the beginning, to assure reaching the goal of co-design in an optimal way.

### 7.1.4 ACTIVITIES FOCUSED ON DEMOLISHING THE IMPLEMENTATION OBSTACLES PREVIOUS EDAS
From the list of obstacles detected with the implementation of former EDAs, we derived the following Table 7 to confirm if obstacles are considered. From this table we conclude the SC project does not include activities to work on obstacle 3 6 and 7.

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\(^{36}\) The project manager’s role covers multiple operational roles as defined by Table 5 (e.g. producer and coordinator). Therefore we use the general term project manager.

\(^{37}\) The relation manager’s role covers multiple operational roles as defined by Table 5 (e.g. facilitator and mentor). Therefore we use the general term relation manager.
Table 7: Focus of SC project on the obstacles from EDA’s implementation

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Activities focused on the obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of evaluation</td>
<td>A short-cyclic iterative approach is used with every outcome tested in-between.</td>
</tr>
<tr>
<td>2. Lack of societal adoption</td>
<td>A co-design approach is used by approaching testing grounds.</td>
</tr>
<tr>
<td>3. Lack of overarching standards and regulation</td>
<td>Awareness exists on the absence of reimbursement policies for preventive care, and the danger of persuasive technologies, but no concrete activities on it.</td>
</tr>
<tr>
<td>4. Lack of strategic efforts to stimulate cooperation</td>
<td>Steering group meetings, weekly project group meetings and monthly working sessions are scheduled on which co-funders are actively attended.</td>
</tr>
<tr>
<td>5. Lack of insight into added value of ICT to quality of life</td>
<td>Opportunities and threats of the SC applications will be evaluated as with co-design and pilots the target group’s experiences can be mapped.</td>
</tr>
<tr>
<td>6. Lack of well-founded business cases</td>
<td>The risk analysis emphasize the proof of concept should be significantly enough to ensure co-funders participate in next phase. But no concrete activities yet.</td>
</tr>
<tr>
<td>7. Complexity of the EU financing structure</td>
<td>As the SC project is supported by the EZ-CO of the Ministry of EL&amp;I, this project receives public funding. However no activities are performed that directly contribute to creating transparency of the complex financial structure.</td>
</tr>
</tbody>
</table>

Next section continues with the analysis for the second case, WeCare.

**7.2 CASE 2: WECARE**

This case is precompetitive again, and is still ongoing. WeCare is an EU-wide project but for the relevance to this research we focus on the Netherlands. It is positioned in the pilot phase in the differentiated valorization cycle as the WeCare pilot software is developed, and next tested, however the need for WeCare services already existed from a former project. The aim of WeCare is to encourage seniors to be active in their social networks so that when they become ill they can rely on this network [AAL WeCare Project Consortium, 2010]. If this project succeeds for this target group, it can be extended to the full disadvantaged people domain by 2020. Active participation in social networks prevents from social exclusion, one of the main problems seniors are currently facing.

**7.2.1 WE CARE – BACKGROUND**

The objectives of the WeCare are first to support seniors to be active in social networks by developing services, and secondly to encourage and empower them to help and offer help to others as well [AAL WeCare Project Consortium, 2010]. Moreover they aim to contribute to social sciences by analyzing if it is possible to improve quality of life by stimulating social inclusion of elderly, what services can support this, and what new business models are needed to develop this in Europe.

The partners that are cooperating in the WeCare project are from Spain, Ireland, Finland and the Netherlands. The project started February 11, 2011 and is expected to finish by August 2012. The initial project structure of WeCare is presented in Figure 37.

The Steering Committee works on process and progress and is responsible for the strategic direction. It consists of one representative from the consortium partners, and the PM.

The Coordination Group acts as subcommittee of the Steering group and is concerned with the technical issues, reviewing, quality of WPs and deliverables.

Next the WPs and their responsible leaders are provided. We emphasize only the pilot in the Netherlands, marked green. Several milestones are set [AAL WeCare Project, 2010]:

7.2.2 DEVELOPMENT OF THE WECARE INNOVATION SYSTEM

After this brief introduction to the WeCare project, we will continue with the development of the innovation system, again pointing out the roles of the middle node and relevant factors convincing partners to join. The steps of building up the innovation system of the WeCare project can be schematically displayed in a figure similar to Figure 35, shown in Appendix G. The acquisition of foreign partners from Finland, Spain and Ireland is not considered, as this research limits to innovation systems developed for the Dutch e-health domain.

Step 1: Idea generation
TNO acted as idea creator [Marc Steen (TNO), 2011]. The idea for WeCare was raised as a response to the foregoing project called Freeband User Experience (FRUX) (2004-2008) [Freeband, 2011], so suited the current activity portfolio of TNO. The idea creator found out about the Ambient Assisted Living Call for Proposal for raising big projects in this same field and decided to apply with WeCare. Personal commitment of the idea creator plays a role as well.

Step 2: Inventorise in-house knowledge
TNO acted as knowledge manager. The competencies of TNO that are useful to this project are [AAL WeCare Project Consortium, 2010]: To understand and map the needs and preferences of elderly people, user experience and usability engineering, user involvement methods, evaluations, field trials and business models. So TNO is involved with the social sciences, as well as with in-field pilot tests of the differentiated valorization cycle. Their position is in the scientific- and social node.

Step 3: Involve a large commercial partner with product and technology knowledge
TNO acted as acquisition manager. TNO approached the personal contact from Ericsson from the FRUX project. Ericsson was interested to continue as this project is a good way to make an entrance in the care domain, where they can wish to exploit their knowledge [Marc Steen (TNO), 2011]. A large commercial partner is beneficial in terms of funding and power of the consortium. They are the only party focusing on the mobile access to ICT applications for the Netherlands [AAL WeCare Project Consortium, 2010]. By delivering telecom equipment and working on the edge of technology and standardization, they are positioned in the technology- and product innovation nodes.

Step 4: Involve a SME with product knowledge
TNO acted as acquisition manager. ShareCare was approached, also a personal relation from the TNO
representative from the FRUX project. ShareCare’s existing product portfolio that could be reused during this project includes a Web Service, service offering, neighborhood- and care side application [AAL WeCare Project Consortium, 2010]. By delivering the product-service combinations they are positioned in the product innovation node. The pre-competitive WeCare project can benefit from a SME’s competitive advantage of being responsive to high dynamics. The consortium requirements from the AAL Call state that SMEs should clearly play a role. ShareCare was taken over by SIMAC but as this did not change the activities they perform during WeCare, we do not elaborate.

**Step 5: Involve a user organization with social knowledge**

TNO acted as acquisition manager. The consortium requirements from the AAL Call state a user organization has to be included. After WeCare was approved by Brussels, user organizations showed their willingness to join. Sharon Prins (TNO) explained ANBO was selected over care centers as they reach a broad field of seniors, and mainly those that are still in good health. This is aligned with WeCare’s project goals focusing on preventive steps to stimulate social embedding so that they can rely on this network if eventually necessary. So ANBO has a broad network useful for co-design and in-field pilots as well, positioning them in the social transition node.

**Step 6: Involve a SME with product knowledge capable to develop the overall platform**

In the last step of the development of the Dutch innovation system, we include the Irish company Skytek, as this company offered the overall platform on which the WeCare services in the Netherlands are running as well. Skytek also sees their participation in WeCare as the beginning of exploiting their products in the care field.

**Step 7: Network of activities**

In the last step the network of activities is given, on which we will zoom in for the specific case of the Netherlands in next section.

### 7.2.3 NETWORK OF ACTIVITIES

We continue with the network of activities of Figure 38\(^\text{38}\). Despite the fact that not all of the activities are performed in the differentiated valorization cycle, the largest part of time spend on activities is in this cycle of change. The division according to Figure 33 is not correct, but it was a sensible guess.

In the soft sciences cycle the user models and scenarios will be developed by means of co-design, and preparations for the pilot execution are taken. A group of seniors from The Hague Care Center for District and Living (Haagse Wijk en Woonzorg) was asked for the co-design process, to map their references on WeCare services. In the hard sciences cycle the definition and design of the WeCare architecture is made to show what is technical possible for the co-design. After the concept has been developed, in the integrated engineering cycle the integration of the different applications takes place so that a demonstrator/prototype for the trials is ready. In the differentiated valorization cycle the actual co-design takes place as well as the execution of the trials. Continuous feedback is desired to take place between the different nodes.

\(^{38}\) For table format of the list of activities we refer to Appendix D.
To successfully enter the commercialization stage after the experimental development stage, a prototype should be build, pilots should be held, and a feasible business model should be developed. The aims of TNO with this project are [Sharon Prins (TNO WEBSITE, 2011)]: “To increase their network in the care domain, to proof their capability with initiating large consortia and to proof their capability with co-design”. To support this (A, B, C, D of Figure 38) the following list of activities is defined for the middle node. We only emphasize those of particular interest to this project. The role of relation manager and project manager are represented by the same person for the WeCare project.

### Project management activities (TNO)

1. Support intensive face-to-face contact between WP1 manager and WP2 manager, since these WPs needed each other’s deliverables to proceed, but both were passively waiting. Since activity 6 takes place in the hard sciences cycle, and activity 3 in the differentiated valorization cycle, the absence of cyclic interaction is not surprising as they are not directly connected.
2. Critically review deliverables, to get approval of the AAL review group.
3. Organize and chair regular meetings with the steering and control group
4. Develop and monitor the contingency plan, since time management and an appropriate contingency plan are important to keep the trust of the client (AAL), that the PM is experienced and capable to coordinate the consortium.
5. Monitor progress on activities and involve other partners if expertise is lacking by one party to deliver sufficient quality.
6. Inventorise in-house knowledge upfront, before dividing the activities.
7. Facilitate between the parties on internal interest issues, and stipulate the fair use agreement signed by all. The WP2 manager should actively coordinate the equal inclusion of all partners’ components in the WeCare concept design.
8. Stimulate ANBO to inform and arrange the test groups for the in-field pilots of WP3, since the project emphasizes end-user involvement and co-design in its aims.
9. Regularly contact the partners’ representatives for updates on their organization’s progress. Ideally, there should be a “natural” two way information exchange between the PM and the partners, such that the PM does not have to ask for updates.

### 7.2.4 ACTIVITIES FOCUSED ON DEMOLISHING THE IMPLEMENTATION OBSTACLES PREVIOUS EDAS

From the list of obstacles detected with the implementation of former EDAs, the following Table 8 can be made to confirm if WeCare project has taken those into account. From this table we conclude the WeCare project has taken into account all but one obstacle: number 7 still requires attention.

**Table 8:** Focus of WeCare project on the obstacles from EDA’s implementation

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Activities focused on the obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of evaluation during the course of action plan</td>
<td>An iterative approach is used with continuous feedback, user involvement, co-design and market testing [AAL WeCare Project Consortium, 2010].</td>
</tr>
<tr>
<td>2. Lack of societal adoption</td>
<td>There is active user involvement and co-design, and pilots will be held, such that seniors, their close networks and carers can influence the design.</td>
</tr>
<tr>
<td>3. Lack of overarching standards and regulation</td>
<td>Privacy issues are considered in this project. Special protocols on personal settings are used. This enables the end-users’ feeling of being-in-control.</td>
</tr>
<tr>
<td>4. Lack of strategic efforts to stimulate cooperation</td>
<td>Within every WP a telephone call takes place every 2 weeks. Once a month the AAL coordination group meets. Every half a year the whole consortium meets.</td>
</tr>
<tr>
<td>5. Lack of insight into added value of ICT to quality of life</td>
<td>By performing a zero measurement before and a one measurement after the pilots the added value of the WeCare service can be analyzed.</td>
</tr>
<tr>
<td>6. Lack of well-founded business cases</td>
<td>WP4 focuses on developing business models for the WeCare pilot software. The claim is it is possible to organize WeCare services so they will spur economic activity.</td>
</tr>
<tr>
<td>7. Complexity of the EU financing structure</td>
<td>Public funding was retrieved from the AAL Call. Furthermore the PM is already aware of a follow up initiative for funding. However no activities are performed that directly contribute to creating transparency of the complex financial structure.</td>
</tr>
</tbody>
</table>

### 7.3 CASE 3: EHEALTHNU

The eHealthNu platform is focused on removing barriers bothering up scaling e-health applications [TNO, June 2009]. Due to lack of funding the project had a long incubation time before it rolled out [Monique van Blijswijk (TNO), 2011]. eHealthNu is positioned in the differentiated valorisation cycle as it focuses on detecting and removing barriers for scaling up, like interoperability and infrastructure barriers. This is also aligned with the future prediction of previous chapter, which states that a PHR can contribute to standardization and regulation issues.
7.3.1 EHEALTHNU - BACKGROUND

The aim of the eHealthNu is to bundle forces and boost e-Health implementation and acceptation in the Netherlands, so that by 2020 e-health services will be fully available [eHealthNu, 2011]. e-Health services for patients with diabetes mellitus and chronic heart failure are selected as the focus areas. It is an initiative of seven actors (Achmea, Menzis, TNO, Rabobank, the Ministry of VWS, Philips and KPN). The project started November 2009 and the initial idea was to continue for two years. The project organisation structure is [eHealthNu, 2011]:

1. Steering group: Involves a board member from each of the six initiators and VWS. The long term strategy and vision are determined.
2. Working group: This group consists of one representative from each steering group member. It is responsible for coordinating and developing e-health both at national- and at regional level.
3. Expertise groups: Each focus area has a participant group working on removing its barriers for e-health scale up. The top 3 scale up barriers equal to all chronic diseases is [eHealthNu et al., 2011]: Communication and culture, Interoperability and Purchase and funding.
4. Program desk: TNO is responsible. The program desk determines the eHealthNu strategy and vision together with the steering group and the chairman of the working group.

7.3.2 STEPS WITH ESTABLISHING THE EHEALTHNU INNOVATION SYSTEM

After this brief introduction to the eHealthNu project, we will analyze the innovation system development from perspective of the middle node. The different steps are explained, including factors influencing the development. Menzis initiated the eHealthNu platform together with some other market parties. The steps of building up the innovation system of the eHealthNu project can be schematically displayed in a figure similar to Figure 35, shown in Appendix G.

Step 1: Idea generation
Menzis acted as idea creator. The representative of Menzis is highly active due to personal commitment and has a large network throughout the whole care domain.

Step 2: Involve commercial partners with market/technical/product knowledge
Menzis acted as acquisition manager. Convincing the other partners was mainly by personal contacts. As the eHealthNu group consists of corporate level representatives, the power of the consortium is high.

The KPN representative has experience with raising new initiatives as the KPN Health is a relatively new KPN division. KPN has connections to lobby in The Hague to remove the barriers. Their motivation is to provide more fiber glass cables through the Netherlands, making them product innovator.

The Achmea representative was also committed to put effort in a broad-based approach. As Menzis, the Achmea representative has personal commitment and a network in the care domain. For health insurers the motivation to join is to reduce expenses of chronic disease treatment programs [TNO, June 2009]. As health insurers are connecting the professionals with the end-users their position is in the social transition node.

The Rabobank representative has a large affinity with applying new technologies in the banking world as well as with privacy issues that might occur [Monique van Blijswijk (TNO), 2011]. Rabobank is the least
obvious party to be involved with an e-health project. The interest of Rabobank to participate is that it has a large customer file in the care domain. As Rabobank wishes to monitor and increase the money flows between themselves and the care domain, eHealthNu platform can bring transparency to care institutions to apply for loans and investments. Rabobank is positioned in the technology development node, as they can use their expertise from online banking.

Philips has knowledge on products they develop in cooperation with other technology partners and has a wide lobby circuit in The Hague. It aims for large scale support of their e-health products, making them product innovator.

Besides these 7 partners there were no other parties investing in this pre-competitive research trajectory, but some participators contributed by means of their expertise.

**Step 3: Involve an independent contractor with scientific knowledge**

Upfront the e-HealthNu project was initiated, the partners had asked TNO to investigate barriers why e-health does not roll-out after the pilot phase [TNO, June 2009]. TNO has a great all-round overview of what research is performed in the field of care and is actively involved with pre-competitive processes creating social impact. Therefore TNO was asked as a full partner.

**Step 4: Involve a social partner representing the public interest**

The middle node acted as acquisition manager. The partners have a good relation with Ministry of VWS. As soon as partners assured private investment, the Ministry of VWS was convinced to actively participate and fund. They aim to keep tabs on what the outside world is thinking (social transition node) as they wish to reduce the costs of care, improve quality of care and accessibility.

**Step 5: Assign project management to an independent party**

The middle node acted as facilitator. The 7 partners were actively talking but did not proceed with action. Therefore a PM was needed with experience with big projects, stakeholders in a political context, and experience with projects where the results are defined during the project and not beforehand [Monique van Blijswijk (TNO), 2011]. TNO could provide certain qualified PM. TNO is carefully entering the field of e-health, without taking a clear positioning strategy. This can affect the trust in TNO as consortium manager.

**Step 6: Network of activities**

In the last step the middle node acts as project manager. In next section we zoom in on the activities.

### 7.3.3 Network of activities

We explain the network of activities of Figure 39. Less detail is provided as we did not have access to the list of activities of the eHealthNu project. The main part of the activities is performed in the soft sciences cycle, were barriers are determined and strategies to break them down, like care standards. Therefore the division of Figure 33 is not sounded, since activities are not solely performed in the differentiated valorisation cycle, however the emphasis for this scale up project lies there. In the hard science cycle partners worked on identifying the technological scale-up barriers. The integrated engineering cycle focuses on application possibilities of new technologies. The differentiated

---

39 No table format of the list of activities is given in Appendix D for the eHealthNu project, since a formal list of activities was out of our reach.
valorization cycle includes activities to implement the determined care standards and test the products. As eHealthNu is pre-competitive, the implementation of demolishing these barriers is not feasible to all care domains. Demolishing the interoperability barrier and communication and culture barrier is mainly performed by TNO and VWS, however no completion was reached during the time of the interview. In the meantime completion is reached for all three barriers. Demolishing the purchase and funding barrier was successfully accomplished during the eHealthNu spin-off project eCardioCare. From eHealthNu Achmea and Menzis were most actively involved with this.

Figure 39: Network of activities of the e-HealthNu project [Interview part 2; TNO, June 2009; eHealthNu, 2011]

<table>
<thead>
<tr>
<th>Hard Sciences Cycle</th>
<th>Soft Sciences Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Map functionalities of application areas</td>
<td>5. Research care purchase guide</td>
</tr>
<tr>
<td>2. Determine technical scale-up barriers</td>
<td>6. Determine social barriers</td>
</tr>
<tr>
<td>3. Research effective interoperability</td>
<td>7. Evaluate changing power balance</td>
</tr>
<tr>
<td>4. Develop technology standards</td>
<td>8. Identify solutions approach to overcome scale-up barriers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Integrated Engineering Cycle</th>
<th>Differentiated Valorization Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>22. Implement technology standards</td>
<td>24. Implement care standards</td>
</tr>
<tr>
<td>23. Develop online fora and community functionality</td>
<td>25. Pilots to test concepts</td>
</tr>
<tr>
<td>26. Develop diagnosis treatment combinations (DTC)</td>
<td>27. Target group tailored design</td>
</tr>
<tr>
<td>28. Stimulate insurers to purchase telemonitoring</td>
<td>29. Create know-how medical professionals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cross Cyclic Entrepreneurship</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>30. Business development</td>
<td></td>
</tr>
<tr>
<td>31. Acquisition Management</td>
<td></td>
</tr>
<tr>
<td>32. Knowledge Management</td>
<td></td>
</tr>
<tr>
<td>33. Project Management</td>
<td></td>
</tr>
<tr>
<td>34. Relation Management</td>
<td></td>
</tr>
<tr>
<td>35. Quality Management</td>
<td></td>
</tr>
<tr>
<td>36. Contract management</td>
<td></td>
</tr>
</tbody>
</table>

Next the activities of the middle node indicated with A, B, C, D in Figure 36 are explained. They focus on how the middle node can support the expert nodes to accomplish the targets to successfully enter the next phase. The activities contributing to TNO’s goals for the project are included. We conclude that
smoothly move from the commercialization to the scale up, the critical mass should be reached. Otherwise a scale up phase should be included in which the barriers are determined and how these barriers can be lifted. Monique van Blijswijk (TNO) states that TNO is still exploring the position they want to take in the e-health field, as they work on technological innovations in the care domain, but did not commit themselves yet to a proposition on care innovation.

The middle node’s activities below aimed to support the scale-up activities in this project. The eHealthNu project has a program manager, responsible for execution of the activities. So this is somehow the same as the PM. Furthermore the project organization is again with steering group and control group. Therefore a relation manager is responsible for maintaining relations. Menzis, TNO and the Ministry of VWS were the main accelerators for eHealthNu, performing these activities.

<table>
<thead>
<tr>
<th>Program manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Write the working plan, set the agreements with the seven partners. Determined project management is desirable when managing a strong group of partners. Monique van Blijswijk (TNO) states that if the program agency was not present, it would take a whole lot longer to actually start the activities.</td>
</tr>
<tr>
<td>2. Clearly divide the activities amongst all parties, to keep TNO project participants satisfied. Since TNO is expert in chronic heart diseases, it acted as main accelerator for the working group Chronic Heart Failure and sometimes approached activities somewhat individualistic. A danger of this is that other partners will leave all the work to TNO.</td>
</tr>
<tr>
<td>3. Stimulate the investigation of business cases to assure partners commit to proceed</td>
</tr>
<tr>
<td>4. Motivate partners to cooperate in their field of the care domain, to implement the eHealthNu results in their field of the care domain.</td>
</tr>
<tr>
<td>5. Develop a proposal for the follow up phase. All partners took this role, with Menzis and TNO in the lead.</td>
</tr>
<tr>
<td>6. Arrange steering group meetings, and align interest in the steering group in terms of time, quality, and results. The corporate level representatives in the steering group have a strong personality, high expertise, big networks and they are capable to deploy financial means. The disadvantage is however that they are quite tenacious, less flexible to go off the track they wish to follow [Monique van Blijswijk, (TNO)].</td>
</tr>
<tr>
<td>7. Indicate possibilities on lobbying in The Hague, to commit the partners to continue with demolishing the barriers in e-health implementation after this project has finished.</td>
</tr>
</tbody>
</table>

#### 7.3.4 ACTIVITIES FOCUSED ON DEMOLISHING THE IMPLEMENTATION OBSTACLES PREVIOUS EDAS

From the list of obstacles detected with the implementation of former EDAs 2, we derived the following Table 9 to confirm if obstacles are considered. From this table we conclude the eHealthNu has taken into account almost all of these obstacles, except of number 6.

| Table 9: Focus of eHealthNu project on the obstacles from EDA’s implementation |
|-------------------------------|----------------------------------------------------------------|
| Obstacle                      | Activities focused on the obstacles                         |
| 1. Lack of evaluation during the course of the action plan | The participant groups gained information, developed a concept and tested the concept. The results were presented to the working group for feedback. |
| 2. Lack of societal adoption  | Culture, communication and a large social base is one barrier determined and |
As a next step we continue with the last case, eCardioCare.

### 7.4 CASE 4: ECARDIOCARE

The idea for eCardioCare was triggered by the “Call for scaling up” from the Ministry of EL&I [Van der Hoeven, 2009]. The request of this Call was to come up with proposals to open up the market for products and services that have proven their technical functionality, but that are still insufficiently applied to support disadvantaged people. It is a spin-off project of the precompetitive eHealthNu platform, as with this project the commercial parties can practically implement eHealthNu’s results on barriers identification. The commercial parties can implement their business models in the care domain. Therefore eCardioCare is positioned in the differentiated valorization cycle.

#### 7.4.1 ECARDIOCARE – BACKGROUND

The aims of eCardioCare are to scale up the application of a selected telecare solution, such that when the project finishes the amount of hospitals using it will be twice the amount from now, as well as 10 times as many patients using it, and 4 times as much healthcare insurance companies purchasing it [TNO, 2009]. Main barriers are a high complexity with the lack of an overarching leader, lack of familiarity with the e-health solutions, lack of standards, and lack of a diagnosis treatment combination (DTC). The telecare solution that is selected is the Motiva of Philips, an interactive care platform to connect patients with a chronic disease to their care professionals [Philips, 2011]. By means of realizing structural funding as a DTC is initiated, scale up to whole of the Netherlands is enabled [Van der Hoeven, 2009]. The project started March 2010 and is expected to finish March 2012.

The partners involved are Philips, TNO and Achmea. Fluent is sub-contractor. 5 WPs can be distinguished [TNO, 2009]: WP1: Value web, WP2: Preparations and Scale up, WP3: Scale up, WP4: Knowledge Retention and Transmission, WP5: Project Management.

The project organization is as follows [TNO, 2009]:

1. **Steering group**: One senior representative of each partner to decide upon the track of the project.
2. **Overall TNO PM**: The project manager from TNO is responsible for the execution of the project and reports the progress to the Ministry of VWS. To make the project manageable, each WP is triggered by a sub-project manager. Steering group meetings are organized by the PM.
3. **Project group**: Consists of project members. For each of the WPs a PM from TNO is responsible.
4. **Board of Advisors**: This advisory board of cardiologists has knowledge on what will work in the field of care. Moreover joined ownership of the scale up targets is created, by involving them.
7.4.2 STEPS WITH ESTABLISHING THE ECARDIOCARE INNOVATION SYSTEM

After this brief introduction to the eCardioCare project, we will analyze the innovation system development from perspective of the middle node. The different steps are explained, including factors influencing the development. The steps of building up the innovation system of the eCardioCare project can be schematically displayed in a figure similar to Figure 35, shown in Appendix G.

Step 1: Idea generation
Two business developers from TNO responded to the Call for Scaling up of the Ministry EL&I. They acted as idea creators with personal commitment to the problems in the healthcare domain. An earlier attempt to scale up a chronic device for heart failure failed due to technology-push [Anita Lieverdink (TNO), 2011].

Step 2: Inventorise in-house knowledge
TNO acted as knowledge manager. TNO’s fields of expertise relevant to this project are related to technical sciences, like the technical implementation processes, but also social sciences like business development, and expertise in chronic diseases and standardization. As an independent party TNO is highly capable of objectively managing a scale up project that failed before due to conflict of interest.

Step 3: Involve a product supplier
TNO acted as acquisition manager. With the focus on a telecare solution for chronic heart failure, the product Motiva from the product innovator Philips was selected. As scale up of this product is not successful, Philips is willing to put effort. The eCardioCare project adds to Philips’ current activities portfolio, as the Philips representative also takes part in the eHealthNu platform. Therefore TNO and Philips have a trustful relation. The Philips representative has a large lobby network in the Hague.

Step 4: Involve a commercial partner with market knowledge
TNO acted as acquisition manager. As the previous initiative to scale up the chronic heart failure device failed due to incredibility amongst health insurers and professionals, a party from the health insurers’ own domain will enhance credibility [Anita Lieverdink (TNO), 2011]. As Achmea is connecting the professionals with the end-users their position is in the social transition node. The Achmea representative also took part in the eHealthNu platform. Therefore a trustful personal relation between the Philips representative and the Achmea representative, and trustful relation between TNO and Achmea convinced Achmea to get involved in this project. For Achmea the eCardioCare project was very interesting, to gain from applying the results gained from eHealthNu.

Step 5: Involve a sub-contractor with market knowledge
TNO outsourced the development of a price calculation model for the DTC funding case. Fluent is an expert in DTC funding cases both from perspective of healthcare professionals and insurers [Fluent, 2011]. Therefore their position is in the social transition node, also dealing with market transitions. Despite Fluent is a sub-contractor, they joined the steering group meetings as funding the purchase is a crucial part of this project, also follows from the risk analysis [TNO, 2009]. Fluent has a big network in the care field, and the representative has an important personal network as well.

Step 6: Network of activities
In the last step TNO acts as project manager.
7.4.3 NETWORK OF ACTIVITIES

Figure 40 shows a zoomed in version of the network of activities of eCardioCare. The first two WPs are focused on the preparations for scale up, therefore their activities are mainly found in the soft sciences cycle (37% of the time scheduled). The actual scale up took place in the differentiated valorization cycle, taking 43% of the time scheduled. Due to the complexity and time that passed before the milestones were reached, we assume WP3 took most effort. The project team managed to get the healthcare purchase guide published by ZN, this is one of the most valuable results of this project according to the client [Anita Lieverdink (TNO), 2011]. With this realization of this healthcare purchase guide, most effort was put by Achmea. So the division according to Figure 33 is not sounded as also activities in the soft sciences are performed, however the majority of time was spend on the differentiated valorization cycle.

Figure 40: Network of activities of the e-CardioCare project [TNO, 2009; Interview part 2]

<table>
<thead>
<tr>
<th>Hard Sciences Cycle (2%)</th>
<th>Differentiated Valorization Cycle (43%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Propose an ICT development path to connect Motiva and software used by cardiologist, based upon current standardization protocols</td>
<td>1. Interviews with actors from the care chain to understand the care delivery process (roles/financial structure)</td>
</tr>
<tr>
<td>Soft Sciences Cycle (37%)</td>
<td>13. Support the DTC negotiations for which preparation in WP1 and WP2 are taken</td>
</tr>
<tr>
<td>2. Information gathering current use of eCardioCare</td>
<td>14. Scale up of eCardioCare in the nine hospitals in which Motiva is already implemented</td>
</tr>
<tr>
<td>3. Standardization status and analysis of the impact on the value chain</td>
<td>15. Implement eCardioCare in new hospitals and support first connections of patients throughout this project</td>
</tr>
<tr>
<td>4. Analysis of the impact of current DTC on offering eCardioCare in the compulsory insurance package</td>
<td>16. Stimulate a standard DTC for eCardioCare</td>
</tr>
<tr>
<td>5. Create the value web</td>
<td>Cross Cyclic Entrepreneurship (18%)</td>
</tr>
<tr>
<td>6. Testimonials given by medical professionals and patients of the use of Motiva in practice</td>
<td>18. Knowledge management</td>
</tr>
<tr>
<td>8. Collect care protocols from the hospitals that use Motiva, develop a widely applicable concept care protocol</td>
<td>19. Project management</td>
</tr>
<tr>
<td>9. Involve eHealthNu and other triggering platforms</td>
<td>20. Relation management</td>
</tr>
<tr>
<td>10. Develop a Motiva management game to illustrate the advantages</td>
<td>21. Quality Management</td>
</tr>
<tr>
<td>11. Presentation slides to communicate results</td>
<td>22. Contract Management</td>
</tr>
<tr>
<td>12. Create a broad basis by organizing meetings with umbrella organizations</td>
<td>23. Business development</td>
</tr>
<tr>
<td>17. Document the project results and methodology used,</td>
<td>24. Acquisition Management</td>
</tr>
</tbody>
</table>

---

For table format of the list of activities we refer to Appendix D.
Next we continue with the activities in the middle node, taking 18% of the time for the eCardioCare project. To successfully go from the commercialization to the scale up phase, the critical mass should be reached. If this is the case, scale up will proceed without much effort. Otherwise the barriers should be determined and how these barriers can be lifted. TNO aims with the eCardioCare project to show their independency and with that their capability to manage a large group of parties, their quality to bring together those parties, and broaden their network in the care field [Anita Lieverdink (TNO), 2011]. We continue with the activities of TNO to successfully support the activities in the cycles of change, indicated by A, B, C, D of Figure 40.

Project manager (TNO)

1. Stimulate Philips and Achmea to contact their network in the care domain to develop an integral value web.
2. Operational knowledge management by working on knowledge retention and diffusion.
3. Balance the push from TNO for a more general applicable concept, and the pull from Philips create a market for Motiva. The aim of eCardioCare was broader than to scale up one e-health service, as the barriers that are described and removed are applicable to the majority of e-health applications [TNO, 2009].
4. Stimulate Fluent to approach health insurers and professionals with the calculation tool on price negotiations.
5. Stimulate partners to join forces to stick to tight time schedules. As time management is particularly important for a scale-up project, Fluent and Achmea joined forces to speed up the development process of the calculation tools on price negotiations.
6. Stimulate Achmea to raise a lobby for a purchase guide telemonitoring by chronic heart failure
7. Balance the push for a general applicable concept (TNO) and the pull of Philips Motiva solution
8. Keep individual conversations with each of the partners at in-between stages, since earlier inconvenience of partners was that TNO approached the value web analysis sometimes somewhat individualistic.
9. Stimulate TNO to contact other partners to avoid an individualistic working approach.
10. Organize meetings between TNO and other partners.
11. Trigger partners to use their network in care domain. The PM stimulated Achmea to raise a lobby with ZN on promoting eCardioCare services by means of a purchase guide in which it is included. Furthermore the PM triggered other partners to use their networks to implement the results of eHealthNu in their part of the care domain.

7.4.4 ACTIVITIES FOCUSED ON DEMOLISHING THE IMPLEMENTATION OBSTACLES OF PREVIOUS EDAS

From the list of obstacles detected with the implementation of former EDAs, the following Table 10 can be made. The current approaches to overcome the obstacles are given, as well as warnings on what should be emphasized more. We conclude the eCardiocare project has taken into account all obstacles.
Table 10: Focus of eCardioCare project on the obstacles from EDA’s implementation

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Activities focused on the obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of evaluation during course of the action plan</td>
<td>An integral, stage-gate approach for scaling up is applied. Several milestones are set, and funding will be paid out after a milestone is completed.</td>
</tr>
<tr>
<td>2. Lack of societal adoption</td>
<td>In September 2011 a study has started on inclusion and exclusion criteria of a patient profile that will accept and adopt the eCardioCare in their daily life.</td>
</tr>
<tr>
<td>3. Lack of overarching standards and regulation</td>
<td>eHealthNu was involved to gain from the results. Policy frameworks by the ministry of VWS were adjusted during the timeframe of the project.</td>
</tr>
<tr>
<td>4. Lack of strategic efforts to stimulate cooperation</td>
<td>The strategy and vision are determined by the steering group which meets regularly and communicated to the project level by the overall PM.</td>
</tr>
<tr>
<td>5. Lack of insight into added value of ICT to quality of life</td>
<td>Telemonitoring enables preventive treatments resulting in shorter and less hospital stays. The lean cardio-phase is screening care processes by evaluating improvement of the work processes before and after Motiva’s implementation.</td>
</tr>
<tr>
<td>6. Lack of well-founded business cases</td>
<td>Milestones concerning the amount of hospitals and patients that should be connected to Motiva are set. The scale-up method can be used by others.</td>
</tr>
<tr>
<td>7. Complexity of the EU financing structure</td>
<td>Public funding was retrieved from the Call for scale up. The project aimed to get DTCs for eCardioCare, Demolishing the funding barrier for telemonitoring.</td>
</tr>
</tbody>
</table>

7.5 CLASSIFICATION OF THE CASES BY THE DEVELOPMENT STAGES OF THE INNOVATION PROCESS

We conclude that the expected classification as shown in Figure 33 is not complete, as the scale-up stage has to be divided into an early- and late-scale up stage. The activities prescribed by the e-health service innovation process of the eHealthNu project, are mainly taking place in the soft sciences cycle, since this project focuses on detecting e-health scale-up barriers and an approach to demolish them. This falls under pre-competitive cooperation, which is very unique for a consortium with mutual competition among consortium partners. The majority of the activities of the cases has been performed in the cycles of change corresponding to Figure 41.

![Figure 41: Adjusted division of the cases over the cycles of change](image-url)

In next chapter we perform a comparative case study, using the results of this chapter.
CHAPTER 8: SIMILARITIES AND DIFFERENCES BETWEEN E-HEALTH SERVICE INNOVATION PROCESSES

ABSTRACT
Based on the comparative case study, several factors proved to influence the e-health innovation system development steps. For pre-competitive projects the power of the consortium and trustful personal relations dominated the acquisition of partners, for competitive projects the expertise and activity portfolio. CIM proved its capabilities to define establishment steps of e-health innovation systems, aligned with chapter 6: (1) Vision, (2) The process, (3) Transition paths, covering both CIM level 1 and CIM level 2. The capabilities of CIM to detect system errors in my cases were proven, like a lacking vision development and vertical communication barrier. The analysis shows that TNO can work on all but the system error - capabilities. Limited evidence-based best practices were found to define the activities of the middle node of CIM, like carrying forward an unambiguous vision and develop a follow-up project plan, and define and formalize the project organization’s structure.

8.1 CHARACTERISTICS OF E-HEALTH SERVICE INNOVATION PROCESSES
In this section the characteristics of e-health service innovation processes are explained. We distinguish between the development phases of innovation systems for e-health, and the development stages of the innovation process of the e-health service innovations.

8.1.1 FACTORS OF INFLUENCE ON THE E-HEALTH INNOVATION SYSTEM ESTABLISHMENT STEPS
We use a comparative case study to derive the similarities and differences in factors taken into consideration with the establishment steps of innovation systems. Based on the interview part 1 and product documentation a list with factors has been developed (Appendix H: Table with relevant factors per case). To do so we listed the different factors mentioned and evaluated the amount of references to them during the different steps with developing innovation systems defined in previous chapter. To give an impression of how we came up with these factors, we give some citations used in the explanation.

As explained in Appendix H no weights were given to the factors. We consider the perspectives of the middle node, as well as the other consortium partners that were asked to join. Although we have aimed to perform this case study on cases with which many partners were involved, we still conclude some of the actors referred to in chapter 6 as important for the success of innovation systems, were not part of the consortia of the cases of our case study. Important examples are the care consumers, and universities.

1. PROJECT ORGANISATION
A steering/control group- versus a stakeholder group organisation can be used. Janine Swaak (Novay) states: “With the steering group organisation co-funders can exert more influence, while not being obliged to contribute with operational activities”. The steering group organisation gives better insight in the satisfaction of co-funders and creates more commitment amongst them, compared to working with stakeholder groups that solely provide funding. When a party performs operational activities influence can be directly exerted, so to compensate for this lack of direct influence by stakeholders, the steering group is the solution. By half of the cases the importance of the project organization is emphasized, but
with all of the cases the project organisation uses a steering group in their project organization. However the control group consisting of experts that can be consulted was not adopted by all. This is aligned with the SE of chapter 4, stating that as a result of the lack of transparency on who are the main players in field of care, expertise is not fully used.

2. PARTY’S EXPERTISE AND ACTIVITY PORTFOLIO
The current project portfolio plays a role to parties, just as expanding their portfolio by exploiting their expertise. Marc Steen (TNO) states: “Ericsson sees the WeCare project as an interesting opportunity to enter the care domain”. A wide variety of expertise fields ranging from technical expertises to project management contribute to more advanced results and avoids reinventing the wheel. Party’s expertise was emphasized in multiple steps of all innovation system development processes, particularly for sub-contractors work. For half of the cases SMEs were hired as sub-contractors, as they can build cheap demonstrators/prototypes.

3. PARTNER’S CORPORATE POLICY
All service innovation processes analysed with this case study emphasize the importance of the individual parties’ interests. Janine Swaak (Novay) states that the corporate policies of commercial parties like IBM and Philips state they will not participate in projects they do not obtain IP rights. The policy of a ministry is to not financially support local governments participating in co-funded service innovation projects.

4. DEVELOPMENT STAGE OF THE INNOVATION PROCESS
For the majority of the cases the importance is emphasized of the current development stage of the service innovation process. As explained in previous chapter, the different development stages we distinguish in this research are based upon the different development stages of co-funding of the government, and the remaining development stages are determined by interview part 2. Janine Swaak (Novay) states: “The learning aspects of cooperating with so many expert parties in a pre-competitive project should be emphasized to convince private funders, since short term revenues are often not visible”. So it is hard to attract private funders for pre-competitive projects. Therefore the Dutch government funds the largest part of the money needed for pre-competitive research. For service innovation processes in the late scale-up stage, private funding is easier to obtain as a feasible business case is directly visible.

5. TRUSTFUL RELATION BETWEEN PARTIES
Important is a trustful relation between party developing the innovation system, and the potential party to join, and a trustful relation between the potential party and the other parties already acquired. A party with a large network of relations increases its impact in the field and contributes to the project getting wide support. New parties can be introduced by already acquired ones. The factor trust plays a significant role in each of the cases. Literature supports this as Kogut (1989) found that when companies are involved in more than one alliance with the same partner, the stability of all those alliances will be raised significantly.

6. PERSONAL RELATIONS
Each of the cases emphasize the use of using trustful relations to acquire partners. So a large personal network is beneficial, particularly when knowing board members that are authorized to take action. The
representatives of an acquired party can introduce new potential parties, or have an important lobby network in The Hague. Monique van Blijswijk (TNO) explains that the representative of Menzis has a large network in the care domain, contributing to acquiring partners for this unique pre-competitive project. From the case study it follows that the trustful personal relations are more important to convincing potential partners to join than trustful relations between parties in general.

7. PERSONAL COMMITMENT
For each of the processes the personal commitment of the idea creator was highly emphasized to come up with the care innovation processes. Secondly a corporate level representative with personal commitment feels motivated to be actively involved with the project. We particularly see this for pre-competitive stages of the innovation processes like Smart Coaching and eHealthNu, as Monique van Blijswijk (TNO) explains Menzis has a large personal commitment to the problems in the care domain, which is important for competitive partners to cooperate in pre-competitive innovation activities.

8. CONSORTIUM INNOVATION
The power of the consortium played an important role to convince potential parties. From the case study we conclude that mentioning ongoing negotiations with other large/influential players can convince them, even if those did not commit yet. So they get convinced by knowing others will join, making them all join. Duysters et al. (1999) explain that in high-tech industries partner selection at individual player level is not appropriate to benefit from the strategic value of cooperative strategies. However “innovation in a consortium demands concessions like in terms of time, speed, focus, IP rights” [Janine Swaak (Novay), 2011]. For the pre-competitive stages of the innovation process more large parties are involved in the consortium, as they can take more risks. SMEs on average do not have money to invest in long precompetitive development processes. Therefore they go for a strategy with quick time-to-markets, launching new products adjusted to dynamic customer demands. Furthermore for SMEs it is riskier to be involved in precompetitive innovation process in which open innovation is highlighted, since their pool of resources is specifically focused on their core business, which they do not wish to give away.

It is important to take into account when establishing an innovation system, that after the innovation process has started no new commercial parties are expected to join anymore, as the commercial parties that have already joined will not easily accept another party to arrive late in the innovation process and still share the benefits of the efforts put in it by the consortium members so far [Janine Swaak (Novay), 2011]. Therefore the kick-off of the project should only take place after feasible financial sources have been obtained.

In Appendix H: Table with relevant factors per case, we listed the relevant factors per case. For the SC project the power of the consortium was the main factor influencing the innovation system development. We explain this as a pre-competitive trajectory involves a lot of uncertainty and therefore high risks. The support of other large/influential players being in this together can help. As WeCare is a follow up project, trustful personal relations dominated the innovation system development as the majority of the partners were acquired by personal contacts. The power of the consortium is less emphasized by the partners, as the AAL Call already required a multidisciplinary group. For eHealthNu and eCardioCare the parties’ expertise and activity portfolio are most often emphasized. For the scale-up development stages partners will reason most from perspective of their current activity portfolio. From the table in Appendix H: Table with relevant factors per case, we furthermore observe the
following. The factor having the highest influence per e-health service innovation project in terms of influence is also having the highest impact in the end, when considering the amount of references to a certain factor as well. This makes the outcome more plausible.

8.1.2 THE PHASES IN THE ESTABLISHMENT PROCESS OF INNOVATION SYSTEMS IN THE E-HEALTH DOMAIN

We have developed the following chronology of steps for developing innovation systems that can be used to carry out e-health service innovation processes. The innovation system establishment procedure is illustrated in Table 11. Since we consider the order as defined at the beginning of chapter 6, a vision is developed, secondly the process model and finally the transition path after which iterations will take place. The role of the middle node is mentioned, first the most important task, and next the corresponding role(s) of Table 5.

PHASE 1 – VISION DEVELOPMENT

The business developer will start with developing an image of the future of e-health. This future image is based upon the internal interests of the organization of the business developer, so the fields in which it wants to excel, as well as the external trends of e-health, so the fields in which there is urgency for change in healthcare or beneficial breakthroughs are expected. Furthermore the scope of the idea is determined, in terms of what expertise do we need, based upon the vision. If one of these requirements is not fulfilled, the idea creators should go back and adjust the idea, else the idea can enter the second phase.

PHASE 2 – PROCESS MODEL ESTABLISHMENT

As a second step the in-house knowledge is inventorised. Consequently, ‘a party’s expertise and activity portfolio’, was the most important factor during this phase. In-house knowledge can be used to convince potential partners to join as this will benefit the quality of the end-products and bring learning effects, what cooperating in a consortium with a large in-house knowledge base can give. From the case study personal relations turned out to be more valuable to the innovation system development than factors like in-house knowledge. Therefore inventorising existing relations is positioned before developing an overview of who might be interested to join. For all cases the first partner that was acquired used its strong relations with the others to build the innovation system further, so a large personal network turned out to be highly important for acquiring the next partners. Consortium innovation is an often returning factor as well, since parties acknowledge the importance of an influential innovation system to realize successful care innovations. After this the potential partners are approached, and this repeats until a sufficient knowledge and funding base is retrieved. At the end of phase 2 the middle node acts as knowledge manager and evaluates if the in-house knowledge is sufficient to start engineering transition paths. This results in Go/No Go 2, in which is decided to either acquire more partners and return to step 3, or proceed with the next phase.

PHASE 3 – TRANSITION PATH ENGINEERING

Phase 3 covers the engineering of the transition path. At step 8 the goals are set for in-between stages of the transition path, resulting in the vision developed at stage 1 (indicated with arrow 1 in Table 11). At step 9 new ideas for e-health service innovation processes are given. Next in step 10 the processes are selected and confirmed with the goals set at step 8 as well as confirmed with the initial vision generated in step 1. From this, knowledge is gained on what should be outsourced and therefore on which sub-contractors are needed during the project. This results in Go/No Go 3, in which the gate
keeper either decides more knowledge and other resources are needed, so a No Go is given and the process starts at step 3 again, or a Go is given and the project kick-off can take place.

To acquire sub-contractors, step 3-7 are repeated, in which step 3 and 4 are performed interchangeably (indicated with arrow 1 in Table 11). For outsourcing the (sub) contractors are not committed to the project by means of investments, and relations between them and the consortium members are more distant. Therefore the potential (sub) contractors’ interest in accepting this contracting work is based upon financial considerations. So the interest of the (sub) contractors to accept this contracting work is more important to convince them, than existing relations from previous cooperation. Next the (sub) contractors will be approached and contracts will be concluded. After this the in-house knowledge is inventoried again, clearly mapping the capabilities of each of the partners, since we have noticed in the majority of the cases difficulties occurred with executing the tasks assigned.

Table 11: Establishment steps of e-health innovation systems

<table>
<thead>
<tr>
<th>Stages</th>
<th>Steps</th>
<th>Activities of the middle node</th>
<th>Roles of the middle node</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>Step 1</td>
<td>Idea generation (vision) and scope</td>
<td>Idea creator (innovator, director)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Go/ No Go 1</td>
<td>Gate keeper (monitor)</td>
</tr>
<tr>
<td>Phase 2</td>
<td>Step 2</td>
<td>Inventorise in-house project knowledge</td>
<td>Knowledge manager (facilitator)</td>
</tr>
<tr>
<td></td>
<td>Step 3</td>
<td>Inventorise parties fitting the scope</td>
<td>Acquisition manager (broker)</td>
</tr>
<tr>
<td></td>
<td>Step 4</td>
<td>Overview of parties with which relations exist</td>
<td>Acquisition manager (broker)</td>
</tr>
<tr>
<td></td>
<td>Step 5</td>
<td>Inventorise parties that might be interested</td>
<td>Acquisition manager (broker)</td>
</tr>
<tr>
<td></td>
<td>Step 6</td>
<td>Approach parties</td>
<td>Acquisition manager (broker)</td>
</tr>
<tr>
<td></td>
<td>Step 7</td>
<td>Inventorise in-house project knowledge</td>
<td>Knowledge manager (facilitator)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Go/ No Go 2</td>
<td>Gate keeper (monitor)</td>
</tr>
<tr>
<td>Phase 3</td>
<td>Step 8</td>
<td>Develop the goals at in-between stages of the transition path to the vision</td>
<td>Transition path engineer (director)</td>
</tr>
<tr>
<td></td>
<td>Step 9</td>
<td>Develop new e-health service innovation projects</td>
<td>Transition path engineer (director)</td>
</tr>
<tr>
<td></td>
<td>Step 10</td>
<td>Select the e-health service innovation projects suitable for the transition path</td>
<td>Transition path engineer (director)</td>
</tr>
<tr>
<td></td>
<td>Step 11</td>
<td>Confirm alignment with initial idea generation (vision)</td>
<td>Overall program manager (producer, director)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Go/No Go 3</td>
<td>Gate keeper (monitor)</td>
</tr>
<tr>
<td>Phase 4</td>
<td></td>
<td>Project kick-off</td>
<td>Project manager (coordinator, mentor)</td>
</tr>
</tbody>
</table>

**PHASE 4 – KICK-OFF**

After the project kick-off, no large number of commercial parties is expected to join anymore, as we have explained before the commercial consortium members that have been present from the
beginning do not wish that parties that join late, can benefit from the results obtained so far. This will be particularly the case when the project is positioned more towards the competitive stages of the innovation process. Internal ambitions then start to dominate since all commercial parties wish to exploit the results obtained in the pre-competitive innovation process stages. (Sub) contractors are however likely to join at any moment required. Since they do not commit to the project by means of funding, phase 3 of acquiring contractors can proceed fast.

8.1.3 CHARACTERISTICS PER DEVELOPMENT STAGE OF THE INNOVATION PROCESS

Although the factors of Appendix H: Table with relevant factors per case, were derived from the interview question(s) based upon the steps of establishing innovation systems, we also verify the applicability of these factors to the different development stages of the innovation processes of the cases. No common list of factors is found valid for all cases in different development stages of the innovation process, in which parties from the different expert nodes will join to establish an innovation system at this development stage. However we have found some motivations for decisions to acquire a party as the first for establishing an innovation system during a particular development stage of the innovation process, to increase the power of the consortium such that others will be convinced as well. Furthermore similarities and differences between the different e-health service innovation processes of the different development stages are summarized in Table 12 and explained below.

INDUSTRIAL DEVELOPMENT STAGE

When establishing an innovation system of an e-health service innovation project starting in the industrial development stage, it is important to start with activities in the social sciences cycle. The aim is to first analyze how an individual’s life looks, and next how this can be supported. Therefore the innovation processes are vision driven, starting from detecting needs. We conclude that the SC project is knowledge-driven in terms of the types of system innovations defined by [De Bruijn et al., 2004], therefore it is not surprisingly two RTOs (TNO and Novay) were the idea creators. A social partner that can fully represent the public interest should be involved at an early stage, to make sure that social adoption would not become an issue at a later development stage. So the power of the consortium increases by acquiring a social player first, in order to convince other potential players.

As for the SC project, Novay could acquire Municipality Enschede based on two factors: First argument is policy based, since as a social party the municipality feels the need to do something with ICT, secondly personal relations with the Novay business developer. These factors are confirmed with the other cases to be main arguments for social parties to join an e-health service innovation project. Municipality of Enschede is expected to deliver the launching area, so the product starts in one region and is scaled up from there.

Interoperability and other roll-out barriers that have been detected as main barriers for bothering implementation of the innovation, and a start with demolishing them can be made in this stage as well. Therefore partners with a lobby network in The Hague are highly appreciated, clarifying the interest for involving Philips and UVIT with the SC project.

EXPERIMENTAL DEVELOPMENT STAGE

For an innovation in the experimental development stage, acquiring the social partner should be performed first, since customization of the final e-health product is still needed. However for the WeCare project TNO acquired the technology developers first. Reason for this is that WeCare is a
follow-up project so the personal relation with technology partners that joined was sufficiently close hence no long acquisition process was needed for them to give approval. The activity and expertise portfolio of the technology partners moreover played a role to convince them. The WeCare project is government driven in terms of the types of system innovations defined by [De Bruijn et al., 2004], since it is based upon a Call for Proposal initiated by the AAL. Acquired technology partners like Ericsson, have access to financial means and a powerful network, therefore they add significantly to the power of consortium to convince other potential partners. It is a business case driven project as the e-health product is developed and insight on feasible business cases is already there for the partners. It expands from one region as pilots are held in certain regions per country, aiming to result in a launching area for the e-health product from which it can be adopted on a broad scale.

WeCare aims to comply with current barriers for scale up, like privacy. By personal settings, people can manage their privacy and organize profiles and authorization [AAL WeCare project consortium, 2010]. User-generated content, tackles social adoption barriers upfront.

**SCALE UP STAGE**

A scale up stage is not always needed, only if after the roll-out in the commercialization stage the e-health service innovation does not reach a broad basis.

The eHealthNu project is market driven in terms of the types of system innovations defined by [De Bruijn et al., 2004]. Since the market players are frustrated by the difficulty with up scaling their product, the idea came from a market player (Menzis). Despite the vision-driven character, commercial partners were acquired first with eHealthNu, since they are most experienced with what goes wrong when launching their products. At the beginning a health insurer is important since it has a large network in the care domain, and driven to scale up e-health service innovations, since it wishes to offer improved health insurance packages (corporate policy). This significantly adds to the power of the consortium. As the top 3 barriers for scaling up are equal to all chronic diseases [eHealthNu et al., 2011], the market is opened up for scaling up to other specialism as well.

For the eCardioCare project the e-health innovation still needed to be adopted in an individual’s daily living pattern. The eCardioCare project was government driven in terms of the types of system innovations defined by [De Bruijn et al., 2004], since it was developed based upon a governmental Call for up scaling. This was important for its success, since when it would have been market driven the focus would have been less on a broad solution of Demolishing barriers for all eCardioCare tools. For the eCardioCare project the product supplier Philips has been acquired first, since the e-health service innovation to be scaled up is a Philips product. Therefore besides this scale up project showing short term revenue prospects, its current activity portfolio committed them to this project. The medical professionals need to be convinced first, who can convince the patients on their turn. It is therefore recommended to involve the society from a later stage in the scale up process, since first the scale up barriers need to be identified and lifted before the product gets the support of medical experts, bringing over their expert knowledge to the end-users.
Table 12: Characteristics of the cases per development stage of the innovation process

<table>
<thead>
<tr>
<th>Stage of innovation process</th>
<th>e-health service innovation project</th>
<th>Types of system innovations</th>
<th>Party that adds most value to the consortium</th>
<th>Factors determining partners to join</th>
<th>Vision versus business driven</th>
<th>Barriers removed upfront versus afterwards</th>
<th>Scaled up from region versus specialism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial stage</td>
<td>Smart Coaching</td>
<td>Knowledge driven</td>
<td>Social party</td>
<td>Party’s corporate policy; personal relations</td>
<td>Vision driven innovation</td>
<td>Barriers removed upfront</td>
<td>Expand from one region</td>
</tr>
<tr>
<td>Experimental stage</td>
<td>WeCare</td>
<td>Government driven</td>
<td>Technology party</td>
<td>Expertise and activity portfolio; personal relations</td>
<td>Business-driven innovation</td>
<td>Barriers removed upfront</td>
<td>Expand from one region</td>
</tr>
<tr>
<td>Early scale-up stage</td>
<td>eHealthNu</td>
<td>Market driven</td>
<td>Commercial market player</td>
<td>Large network (trustful relations); party’s corporate policy</td>
<td>Vision-driven innovation</td>
<td>Barriers removed afterwards</td>
<td>Expand from one specialism</td>
</tr>
<tr>
<td>Late scale-up stage</td>
<td>eCardio-Care</td>
<td>Government driven</td>
<td>Product supplier</td>
<td>stage of the innovation process; expertise and activity portfolio</td>
<td>Business-driven innovation</td>
<td>Barriers removed afterwards</td>
<td>Expand from one specialism</td>
</tr>
</tbody>
</table>

As we can conclude from the analysis above, the following factors show a party adds significantly to the consortium power, therefore acquired as one of the first: Possessing financial resources available to implement, a powerful network, and insight/expertise into the care domain.

Although we cannot generalize the results (external validity) since we base our analysis on only one case per phase, we believe the in-depth interviews accurately represent the interviewees’ knowledge and ideas (high internal validity). Therefore we recommend further investigation on whether the characteristics above will result in innovation systems highly suitable to develop and implement e-health service innovations in the particular development stages. We shortly describe how this table should be interpreted for the first phase.

When a party wishes to establish an innovation system in the industrial development stage, the party should first acquire a social partner. Implementation barriers should be removed from an early stage, and not postpone this, since scaling up can be seriously bothered by this. Since the e-health service innovation is vision driven, the focus should not be too much on revenues models, as this might negatively impact the radical level of the innovation. As trust plays an important role with developing the innovation systems in the industrial development stage, expansion from a region is advised as in general personal relations are stronger in the same geographical area. Furthermore for pre-competitive stages of innovation processes it is important to already inventorise at an early stage who can be the launching customer and what the launching area (test group) can be.

8.2 DETERMINING SYSTEM ERRORS BY MEANS OF A COMPARATIVE CASE STUDY

We start with the SEs in terms of CIM level 1 and CIM level 2. Instead of mentioning all of them per case in the previous chapter, we decided to focus on those that occur multiple times in different e-health service innovation processes, or those that seem to be likely to occur again. The added value of
mentioning only this group is therefore higher for setting up new innovation systems or keeping existing ones running. Although our expectations in the methodology part were that the unfinished cases can anticipate on avoiding the SEs that have occurred with the finished cases, we conclude sometimes the finished cases can learn from the approach of the unfinished ones. Therefore we have stated both, as we assume e-health service innovation processes similar to the finished cases might occur in future.

8.2.1 SYSTEM ERRORS DERIVED FROM THE COMPARATIVE CASE STUDY (CIM LEVEL 1)

We continue with the SEs CIM level 1 that occurred with at least one of the cases (left part Figure 42). We aim to clarify why these SEs occurred by means of the characteristics of influence on the establishment steps of the e-health service innovation systems per innovation process development stage. We also point out the differences with the e-health service innovation processes in which no problems have occurred, to determine how the SEs can be solved. Finally we point out if the SE are aligned with the SE we determined in Chapter 5 and 6, to confirm if vision level and project level are aligned.

Figure 42: System Errors derived from the comparative case study (CIM level 1 and 2)

As an upfront remark, we state that the visions we derived from the project documentation and interview part 2, are aligned with both the external trends as defined in Chapter 5 and the image of the future of Chapter 6. For the WeCare and the eCardioCare service innovation processes the alignment with the external trends follows as a logical consequence of their initiation based upon a Call for proposal of the government, obviously taking into account main Dutch trends in the field of healthcare.

SE1 – VISION DEVELOPMENT ERROR

In terms of CIM level 1 we determine a vision development error for each of the cases. The project participants of the cases had a clear bias towards the e-health service innovation projects they were currently operational in. Instead of coming up with a vision directly, a concrete image of the future was only derived based upon the current goals of the e-health service innovation processes. As explained at the beginning of Chapter 6, the order in which we desire activities to be performed at CIM level 1 is starting with the vision development, next building the consortium, and finally determining what transition path can guide the partners to this vision.
We give two possible explanations for SE1. First of all if a project level representative is asked for their vision, they expectedly refer to a project level instead of vision level, while a senior manager of interview part 1 is capable to overview the full situation and give a vision level description. Secondly, the project participants do as told without considering a broader perspective.

Another explanation is that since we have approached the project participants for an interview about the e-health service innovation processes they are involved with, despite we have asked for their general vision on e-health, the interviewees based their answers on the innovation processes. A last explanation is ambiguity of the question that was asked. To verify these lines of reasoning, we have asked the SC project steering group representatives of Philips and Municipality Enschede to give their vision as well. Both gave a broad vision including EHRs, patient care at home, e-health applications enabled by internet and smart phones for the use of healthy living coaching programs. Therefore our assumption of the difference in sense of reasoning between a project participant and a senior manager is confirmed.

Since the same question was asked, and the same goals of the interviews described, the ambiguity of the question and the context in which the questions were asked, cannot have influenced the outcome. The assumption that project participants do not think from a broader perspective is confirmed, since half of the PM of the cases state they not have a vision on the future of e-health. A last interesting observation is the SC steering group members’ vision is aligned with the high-level vision of the e-health domain of interview part 1, as presented in Figure 28. Therefore there is no gap between vision level and implementation level with the SC project. The vision development error was also found in the current e-health innovation system of chapter 5, and the future e-health innovation system of chapter 6, although for a different reasoning.

SE2 - INTERNAL AMBITIONS ERROR

The internal ambitions error was strongly present for all cases. A distinction can be made between internal ambition errors for the pre-competitive and competitive innovation processes.

For the pre-competitive innovation processes the user rights and conflicting business models are causing internal ambitions errors. We give as example the eHealthNu. As Monique van Blijswijk (TNO) explains less cooperation and discussion took place towards the end of the vision driven eHealthNu project, since parties searched for how to incorporate the eHealthNu project’s results in their own field (business driven), and see how the e-health industry starts working with the results. Menzis and Achmea had become more careful with the knowledge they shared, since they are direct competitors. However the partners still strongly have the intentions to continue to collaborate in the e-health field after this project has finished [Monique van Blijswijk (TNO), 2011]. With a level playing field the health insurers can draw their own plan within the rules set. This will not contribute to implementing the results of the eHealthNu project as a uniform plan on purchase and funding of all health insurers should be proposed to ZN in order to get their support. In a pre-competitive vision based project, one WP fully dedicated to business model development can avoid certain tensions towards the end. The WeCare project included this strategy, and added to this who will do what according to a fair use agreement.

For the competitive eCardioCare the internal ambitions error expressed itself as an unaligned idea on money spending. As Anita Lieverdink (TNO) explained, a gentlemen’s agreement was made up front in which every partner approved to put maximum effort and resources to successfully accomplish the eCardioCare project. All parties exceeded the costs that were budgeted upfront. Therefore we conclude
that a RTO like TNO as well as a SME like Fluent are troubled by exceeding budgets. Reason for this is that SMEs do not have sufficient financial means, and RTOs need to justify their spending since they work with cost-based projects. What we have seen in the WeCare and the eCardioCare projects is that the funding will only be paid out after completion of the milestones. We recommend this approach to the other projects as well as this commits them to be actively involved and less focus on internal ambitions.

**SE3 – CIM LEVEL 1 TO LOWER LEVEL CIM LEVEL 2 ERROR**

The gap between CIM level 1 and the CIM level 2 was present with the majority of the cases. For the SC project the error is clarified by the non-formalized cooperation with co-funders. The expert members of the co-funders are still searching for their role in the project. TNO and Novay have worked on defining the control group, in which the experts are positioned. Janine Swaak (Novay) explains the initial idea for the control group was to let co-funders meet around preset activities. This idea has been rejected and the experts are only actively attended on meetings and reports. Therefore we assume their knowledge is not exploited maximally.

The middle node must weigh up a more pure way of involving co-funders, not damaging the reputation of TNO, against actively involving experts in the WPs by making them responsible for tasks (although they cannot formally held responsible), but with that assure exploitation of co-funders’ knowledge since co-funders have insight on at which points their contribution is demanded [Janine Swaak (Novay), 2011]. The SE we determine is the translation of CIM level 1, in which a project organization with a formalized steering group and control group turns out to excel the project organization with a stakeholders group defined, and CIM level 2, the actual execution of this project organization in practice.

For both eCardioCare and WeCare the feedback group is a formalized review group. This concept might work as well. However for the eCardioCare project Anita Lieverdink (TNO) states it is still a challenge to not only commit health insurance companies’ board members (steering group level), but let them integrate the purchase of e-health in their primary care purchase processes (implementation level) as well. So when we consider CIM as a firm level model, we distinguish the same SE: Difficulty with implementing CIM level 1 decisions to the lower level (CIM level 2).

Finally a vision level error with unaligned ideas in terms of speed of carrying out the innovation process, will translate further to CIM level 2, in a SE related to time-to-market and time-to-production. This is the case with the SC project, since UVIT feels the innovation process takes too long, and competitors have many products launched to the market already. This is an example of how the SE CIM level 1 can translate further into SE CIM level 2.

**SE4 – OVERALL PROGRAM MANAGEMENT ERROR**

For the WeCare project we detect a SE in the overall program management. Sharon Prins (TNO) states the PM could have been stricter on the quality of the deliverables. The external review committee of the AAL judges the quality of the project after this judgment of the PM, therefore the PM will not appear in good daylight if she reviewed not strictly enough. Moreover the project management with WeCare project is performed on non-hierarchical, informal base [Marc Steen (TNO), 2011]. This is required since the individual organization’s corporate policy should be followed by the organization’s representatives participating in the project. So the PM has no formal power to judge the others, which could be a weakness when aiming to guide the project by carrying forward a shared vision.
For the eCardioCare project Anita Lieverdink (TNO) states that the complexity of the care domain is influenced by different factors like funding, law, care processes, care provision. In each of these sub-domains different actors are performing activities. There is no overall party coordinating this all, which we have concluded before as a SE of the current e-health innovation domain in Chapter 4, and as a possible explanation of a lack of a vision for the care domain. Anita Lieverdink (TNO) states: “There is need for a party that determines, oversees and pays”.

As with the SC project, health insurers did not recon why this project stands out from the rest and other parties offer solutions already, while these are the pre-competitive stages. This is the overall program manager error which was not able to “sell” the idea convincingly to attract co-funders. This is particularly for pre-competitive innovation stages as these are vision driven and do not directly give prospect for ROI. So the idea could have been sold more convincingly.

SE5 – CAPABILITIES ERROR
All of the e-health service innovation processes are/were facing a capabilities error. For the eCardioCare project Anita Lieverdink (TNO) states that looking back to the eCardioCare project TNO could have been more actively involved with developing the calculation tool on price negotiations between health insurers and healthcare professionals. Since upfront was not considered that TNO was capable of this, TNO was not approached for this.

Unforeseen was ANBO’s limited experience on questionnaire development for testing well-being during WP3, for which TNO provided support. The PM can anticipate soon on this if they closely monitor the progress on the activities, keeping project participants of other WPs up-to-date. This also enhances close cooperation between the WPs. ANBO’s limited expertise was only found out when it was needed, so we again emphasize the lack of insight into own capabilities. ANBO either underestimated the task, or has limited insight on its in-house capabilities.

For all of the capabilities errors we conclude upfront no clear inventory has been made of partners their capabilities. Therefore the recommendation is to better inventorise capabilities and start dividing accordingly. This is aligned with step 2, 7 and 12 of the innovation system development procedure of Table 11.

SE6 – STRATEGY ERROR
The strategy error was present for all of the cases except for the SC project. The strategy chosen for the WeCare project is the iterative approach SCRUM [Sharon Prins (TNO), 2011]. This approach turned out to be less suitable to the target group of seniors, as seniors are less acceptable to computer changes after they have just get accustomed to how it works in its current state. The iterative approach chosen by WeCare allows for co-design and feedback during the pilot phase. Therefore adjustments can still be made during the pilot phase. This is very interesting as we have implied so far with CIM that the cyclic approach adopted is ideal to any case. This is important to take into account with the SC project for which SCRUM is used as well.

The second example we give is from the eCardioCare project. Anita Lieverdink (TNO) explains that despite the fact Fluent is only contractor and not part of the consortium, they can participate in the steering group. The advantage is their expertise and connections in the care domain. The disadvantage is yet another party judging on the direction of the project, adding on to the complexity. So there is chosen for a strategy to exploit Fluent’s knowledge and expertise.
8.2.2 SYSTEM ERRORS DERIVED FROM THE COMPARATIVE CASE STUDY (CIM LEVEL 2)

We continue with the SEs CIM level 2 that occurred with multiple of the cases. Remarkable is that this amount is only small compared to the amount of CIM level 1 errors. The project organization is more thoroughly thought of and has a standardized, explicit procedure to approach it, while for coming up with a vision and aligning interest there is less awareness and structure of the approach.

**SE7 – VERTICAL COMMUNICATION BARRIER**

The vertical communication barrier is detected for all service innovation processes, up to a certain extent. For the WeCare project there is an agreement stating to as much reuse existing components as possible [AAL WeCare Project Consortium, 2011]. As each of the product builders is requesting an equal share of their components included in the WeCare service, this has lead problems with the technical interoperability [Sharon Prins (TNO), 2011]. We have seen this SE in chapter 5 as well, stating a lack of an overall platform on which all products are compatible. Therefore this points out the vertical communication barrier since the common platform needs to be developed in the hard sciences cycle (left side of CIM level 2), and the product builders are designing individual solutions to include in the WeCare service, which takes place in the right side of CIM level 2.

For the SC project it became clear that the vertical communication barrier is caused by the pre-competitive character of SC. As a result the co-founders have different priorities as their primary processes. This results in a low commitment to the SC project, particularly noticeable for the product innovator’s node. Janine Swaak (Novay) explains commercial parties are not willing to invest many man-hours, as they entered the pre-competitive EZ-Co project with the consideration of creating a lot of innovation with only a small financial contribution. Friso van der Meulen (TNO) expects a more active participation of the Philips representative after the demonstrator is build and the proof of concept has been realized. The Philips SC steering group representative states that knowledge exchange occurs somewhat at a distance, and Philips would prefer more intense communication and interaction with other parties. Therefore the vertical communication barrier is causing a vertical barrier on exchange of knowledge and information, not desired by all.

**SE8 – HORIZONTAL COMMUNICATION BARRIER**

A horizontal communication barrier was found in the majority of the e-health service innovation processes. For the WeCare project it followed that cooperation and communication between technical and user WPs could be difficult [Sharon Prins (TNO), 2011]. This indeed turned out to be a problem. The technical partners and the user centric designers were waiting for each other’s inputs. The PM took the lead in overcoming this horizontal communication barrier by stimulating meetings between the WPs. Still the translation of the end-user requirements into technical specifications took more effort than initially was planned for. However Ireland, Finland and Spain perceive the WeCare services enabled by the pilot software promising, continuing with the development of a real product-service combination [Sharon Prins (TNO), 2011].

The horizontal barrier also follows from the SC project. According to UVIT the innovation process takes longer than expected. UVIT compares its involvement in the SC project with the results it would have gained from applying trial and error approaches, for which products would have been launched at a regular base. So there is a misalignment in terms of time-to-market of the smart coach product. This misalignment is explained by the difference in focus between commercial partners and non-commercial
partners. As Municipality Enschede did not decide on its role with the SC project, it is less attached and not sure yet how to contribute in terms of activities. Actively attending them on meetings, and pointing out what is expected from them, will contribute to reduce the chance of a tech-push solution pushed by the technology development node.

**SE9 – INTERCYCLIC ENTREPRENEURSHIP ERROR**

The coordination of the CIM level 2 is difficult for every project. For the eCardioCare project the overall PM, as well as the WP managers are from TNO. At the WeCare project different partners are dedicated to the WPs. The advantage of the latter is a shared responsibility and not the full responsibility lies at one party. On the other hand, a disadvantage is the communication goes smoother when all project management activities are performed by a single party. Anita Lieverdink (TNO) states that with separate WP managers from TNO, she sometimes felt like work was double done between the WP manager and the PM. So both approaches have pros and cons.

For the SC project Municipality Enschede is still looking for the role they prefer to take in the consortium. The middle node should stimulate them with this, and actively attend them on brainstorm sessions, as to take a role they should clearly communicate their interests with the SC project. We clarify this lack of a clear position of Municipality Enschede in the SC project as the Novay representative acquired Municipality Enschede by her close personal relation. Therefore the corporate strategy in this project was not determined upfront. Furthermore both Municipality Enschede and Philips steering group representatives explain they have not attended any meetings on aligning activities between the project group, feedback group and steering group. The system bias between parties at CIM level 2 is that communication between them only takes place through TNO and Novay’s middle node representatives. This dominant middle node also makes the co-funders sit back until something is asked from them, as they do not have to put effort themselves.

**SE10 – NODE THAT DOMINATES**

The majority of the interviewees of interview part 2 emphasized the added value of a well-balanced consortium. This is aligned with CIM level 2, stating that successful innovation requires actors in each node equally contributing. Despite this, still dominant nodes are identified within the innovation systems of most e-health service innovations.

The way TNO performed the value web analysis with the eCardioCare project was sometimes somewhat individualistic [Anita Lieverdink (TNO), 2011]. As soon as the PM noticed the inconvenience on this, individual conversations were held to get everybody’s opinion and get things straight.

For SC project, UVIT has indicated from the beginning that they would like to take an active role. Friso van der Meulen (TNO) explains that for the working sessions UVIT was therefore invited and other co-funders were not. We conclude that by doing this, no equal chances are offered to each of the co-funders. For the SC project dominant nodes can be clarified by the pre-competitiveness, as committing commercial actors by means of a feasible business case is not yet possible. So personal commitment is likely to commit commercial parties, like with the UVIT representative. Since the SC project has just started by the time of conducting our interviews, we expect the network power of the consortium to positively influence the contribution of all co-funders, and with that the dynamics of the innovation system.
8.3 ACTIVITIES OF THE MIDDLE NODE

In this chapter we have so far determined the similarities and differences between the cases. We continue now with the activities of the middle node that will contribute to the e-health service innovation for which SEs are determined.

8.3.1 COMPARATIVE CASE STUDY ON DEMOLISHING THE IMPLEMENTATION OBSTACLES

We start with the similarities and differences between the e-health service innovation processes on demolishing the obstacles of previous EDAs. We refer to a case that has worked on the obstacle, and derive what with the other cases should be done.

For Smart Coaching and WeCare the Complexity of the EU financing structure is indicated as to which no significant activities are performed upon. However activities that focus on creating transparency in the complex financial structure should not be seen as part of a project, but a project on itself, as with eHealthNu and eCardioCare.

Furthermore for the Smart Coaching and eHealthNu according to our opinion improvement is possible in terms of well-founded business cases. For the pre-competitive Smart Coaching project we argue that it is relatively early to already develop business models, however high prospects should be emphasized already from the beginning to keep the co-funders committed. Friso van der Meulen (TNO) states that from the pilot phase on a feasible business model should be developed. Since the eHealthNu project is a scale up project, in theory the business model development for e-health services was expected to have taken place already. However, this is not the case since else the scale up would have proceeded directly after the commercialization stage, without intervention of the eHealthNu platform. We clarify this lack of feasible business models by the high complexity in the care domain. More guidance is needed on developing business models since the eHealthNu project’s results do not easily roll-out into the care domain. It is important to dedicate one WP to developing feasible business models, as was done with the WeCare project. In parallel the activities can be performed. This is advisable to any project, but particularly relevant to pre-competitive service innovation processes, to commit partners since the revenues (short/long term) will become visible. Monique van Blijswijk (TNO) partly disagrees on that the eHealthNu partners lack the business model development, since they are currently working on a follow up initiative already together with umbrella organizations NCPF, KNMG, ZN. Therefore the business case is under development. However, we argue it is not desirable to delay the implementation of the eHealthNu project results while the business model development would have taken place in parallel, smooth implementation was enabled.

With the SC project no activities are performed on the lack of overarching standards and regulation. As explained before in Table 12 upfront demolishing the standardization and regulation barriers is desirable for a project in the industrial development stage. As soon as it is known where the problems might occur, the partners should actively work on implementing current regulation (as with the privacy law for the WeCare project), or lobby for new policies and get commitment of the Ministry of VWS to adjust policy frameworks during the time span of the project. It is interesting to observe that for each of the cases different obstacles are not fulfilled. The lack of overarching standards and regulation, and the lack of well-founded business cases, are corresponding to the SEs and can be worked upon with the e-health service innovation processes.
For the eCardioCare and the WeCare project activities were performed on each of the implementation obstacles of EDAs stated. Therefore these two service innovation processes are examples to the rest, in terms of the seven obstacles defined in chapter 3. For each of the service innovation processes we recognize the same components to which was often referred to as indispensable for a project’s successful completion. These components are: (1) Sufficient funding committed to the e-health service innovation project, as a combination of public and private funding is needed to commit parties. We have seen public-private funding as a factor in chapter 5. Furthermore gradually pay out the public fund after reaching millstones to assure commitment of private organizations to the end. (2) The organizational structure in terms of organizing a steering group, a feedback group and a project group, in order to align ideas at a higher level and exploit the expertise of partners. (3) End-user involvement, co-design and in-field pilots, to develop services that will be easily adopted by the society.

8.3.2 SIMILARITIES AND DIFFERENCES WITH GUIDING THE NETWORK OF ACTIVITIES

We continue with the similarities and differences in the activities of the middle node, to guide the network of activities. In previous chapter, we have given this analysis per case. We conclude that only a scarce amount of evidence-based best practices is found by comparing results of the different cases.

1. Regular meetings between the PM and relation manager. If two different parties are taking the middle node’s roles of PM and relation manager, communication between them is crucial to carry forward an unambiguous vision towards the partners.

2. Early development of a project proposal for the follow up phase. A clear project proposal for the follow up phase is important for a project in the precompetitive development stages, to commit partners to proceed and commit funding.

3. Facilitating between parties with conflicting interests, set agreements with the commercial partners in terms of IP rights. To avoid conflict of interests caused by internal ambitions, the PM should make rights clear upfront. Ways to do this that followed from the cases, are by coming to a fair use agreement with the partners, or agree upfront for which application areas the partners get a license of the IP rights, or assure that components of different partners are equally used in the final design of the product, to give all partners equal chances on roll out. IP right discussions are characteristic for projects in the pre-competitive phase.

4. Organize regular meetings with the steering and control group. This ensures satisfied partners and adds to building up trustful future relations for future collaborations. The disadvantage of corporate level representatives in the steering group is that they are quite tenacious, not so flexible to go off track they are aiming for. Satisfaction of the partners can be monitored by means of individual conversations at in-between stages as well. To exploit the knowledge of the partners, the PM should formalize the tasks of the partners’ representatives in the control group, or if there are objections to formalizing this, partners should be actively attended on the upcoming meetings and reports.

5. Manage a short incubation time of the project. A long incubation time can cause inconvenience amongst partners. When a project is based upon a “Call for Proposal” by the EC, this Call will have a clear deadline, causing no trouble in terms of a long incubation time.
6. Trigger the partners to exploit their network. This is emphasized with all cases. Possibilities to do so are, by lobbying in the Hague, or contacting testing fields to execute pilots or by means of codesign.

7. Develop a risk analysis, update it regularly, and monitor and list developments. By doing this appropriately, the faith of the client in the PM will increase.

8. Organize regular meetings with the project group participants to align activities and enable knowledge and information exchange flows required to perform all the tasks of the WPs.

9. Perform a final quality check of the deliverables. This is required to get approval of review groups like the control groups, and commit partners to continue.

10. Stimulate TNO to contact other partners, and organize meetings between TNO and other partners to integrate TNO’s activities and avoid individualistic behavior.

11. Inventorise in-house project capabilities per party involved. There are two reasons for this. First partners know who to approach from each other, for help in which expertise fields. Secondly, a well-supported division of activities can be made, such that a party is capable of executing the tasks it got assigned. When partners are not capable of executing the activities assigned to them, other partners can easily provide support to avoid undesired delay.

8.3.3 CHARACTERISTICS OF THE MIDDLE NODE DERIVED FROM THE E-HEALTH SERVICE INNOVATION PROCESSES

Finally we conclude on the characteristics of the actors taking a role in the middle node of the cases. We aim to confirm or add to the characteristics mentioned in Table 5 of Chapter 6.

It is emphasized with the majority of the e-health service innovation processes that the middle node should be an independent party, not having commercial stakes with the end-product of the project. For the eHealthNu project this was not the case, since Menzis was idea creator. This turned out well since Menzis could commit another health insurer to the eHealthNu platform. We guess that since Menzis has the same commercial stakes as Achmea, this gives more trust in Menzis to take decisions in favor for health insurance companies. However towards the end of the eHealthNu project all partners started to into implementing the eHealthNu results in their own part of the care domain. This reduced the involvement of the commercial partners towards the end, although still committed to proceed with an eHealthNu follow up initiative.

So a (group of) commercial actor(s) in the middle node, without any social or independent actors, might influence the stability of the innovation system, when moving towards the end of the pre-competitive development stages. Therefore we confirm again a diverse group of actors should be positioned in the middle node.

Furthermore we conclude from the case study analysis, that the group of actors in the middle node should not be too big, since the different ideas make it “unmanageable”. To give an example, with the eHealthNu project a participant group is defined next to the steering group and project group, since not all partners willing to participate with knowledge, but not with financial means, should be allowed to
have a stake in the overall direction. By limiting the amount of parties in the middle node, it is easier to carry forward a common vision. The strategy of the eCardioCare project is an exception; by letting Fluent which is a subcontractor, decide with the other board members of the partners in the steering group. However the board members of the partners believe in the added value of the Fluent representative, since the Fluent representative has specific knowledge and a large network in the car domain.

With the majority of the cases it is emphasized the PM should have a determined personality. A determined PM will write the project proposal in a short time, and set an agreement with the partners. Particularly for the pre-competitive stages of the e-health service innovation processes a determined PM can be useful since it can be difficult to set agreements with the potential partners. By having a determined PM chairing the steering group meetings, it can be assured results will be obtained.

None of the PMs of the e-health service innovation projects (except for eHealthNu, for which this was still the case with the program desk manager) had a background in the field of care. This clarifies why the formulation of a vision on the e-health domain was perceived as difficult by PMs from the cases. So upfront care field expertise is not a precondition for the success of managing the innovation processes and their execution, as long as the project management skills are sufficient. We argue that close involvement will (incautiously) bias the independency of the PM.

8.4 TNO’S ROLE WITH DEMOLISHING THE SYSTEM ERRORS OF THE CASES IN TERMS OF CIM

We next verify if TNO is capable to work on overcoming the SEs mentioned in this chapter. This brings them great added value since innovation processes will be more efficient and effective if no SEs of the innovation system occur. Furthermore capabilities to demolish the SEs, will contribute to TNO’s credibility in the field of developing innovation system for the e-health domain.

8.4.1 TNO’S ABILITY TO LIFT THE SYSTEM ERRORS AT CIM LEVEL 1

SYSTEM ERROR 1 - VISION DEVELOPMENT ERROR

To overcome the vision development error, starting with the formulation of the service innovation processes instead of the vision, a party should trigger the others to think beyond the project goals. They should moreover clearly guide the steering group to develop a common vision and communicate this to all project members. TNO is capable of doing this, as they have proven their coordinating skills and helicopter view.

“RTOs like TNO and Novay are capable to view the care system from a broader perspective, considering the failure of the complete care system, and therefore they have a vision in which direction to go” [Patrick Strating (EIT ICT Labs), 2011]. All of the interviewees agree that TNO can be the organization to develop an agenda with a common vision for the Dutch care domain. If TNO can show the added value of following this agenda in terms of economic and social benefits, TNO can suggest tasks to companies to work on implementation, and monitor the execution of the agenda. TNO has a high commitment to 2015.eu’s agenda. As explained before in Chapter 3 the Netherlands has both top-down and bottom up initiatives to realize implementation of 2015.eu’s agenda. We have also stated before TNO should work on bridging the gap, so again an intermediary role for TNO.
SYSTEM ERROR 2 - INTERNAL AMBITIONS ERROR
From the pre-competitive stages of the service innovation processes the user rights and lack of business model were causing an internal ambitions error. The middle node should clearly point out what has been agreed upon before, like is done with the WeCare project [Sharon Prins (TNO), 2011]. With the eHealthNu project the partners are triggered to continue with implementing the eHealthNu in their own care domain after the project finishes, but as this rolls out not so easily (only for the healthcare insurers) more guidance is needed here to create synergy in the consortium towards the end.

At the beginning the middle node should dedicate one WP on business model development. TNO is fully capable of doing this, as they have expertise on business model development, and they can overview the partners’ knowledge exchange such that open innovation is enhanced. For the competitive project the major problem was the exceeding amount of budgeted cost. The middle node should monitor satisfaction in terms of time, speed, focus, costs, IP at a regular base. Moreover we advise the middle node to use the approach in which payout of public funding is only performed after completion of the milestones, to keep commitment till the end. This payment method has shown its strength with the WeCare project. As TNO has no commercial stakes involved, they can also take initiative themselves and transfer the money for the competitive project after completion of the milestones.

SYSTEM ERROR 3 – TRANSLATION FROM CIM LEVEL 1 TO CIM LEVEL 2
The middle node should actively work on formalizing the roles and cooperation between the co-funders, if this has not been agreed upon already. To exploit the knowledge of the passive co-funders, tasks should be assigned to them. For example, by putting those in the WPs. TNO can coordinate this process. However to keep their unbiased position and not destroy their reputation, TNO should not make co-funders formally responsible for the activities of the WPs. However we still think TNO can list the desired contribution of both the steering group and control group members upfront.

TNO is experienced with top-down and bottom-up approaches. To successfully translate the CIM level 1 to CIM level 2, it is important to practically show the results obtained so far during steering group meetings. It is important to commit partners their corporate level representatives in the steering group, which decide over the financial means. Furthermore the control group members should be committed, since these have highest impact on the practical implementation of what has been agreed upon in their organizations. The control group representatives provide both feedback in terms of expertise to the project group, and their expert opinion on the project’s contents and progress to the steering group representatives and therefore influence both the top-down and bottom-up approaches.

SYSTEM ERROR 4 – OVERALL PROGRAM MANAGEMENT
It is important that one party in the CIM level 1 middle node has the formal power to hold the other partners responsible for their acts. As this overarching party is lacking, no coordination of the care sub-domain initiatives is there, and no common agenda on the e-health vision is developed. Therefore an independent party should take this role. We think TNO capable of taking this role, only its willingness can be doubted. As long as TNO does not commit itself on corporate level to care innovation propositions, we see few opportunities.

TNO can however still contribute by inventorising which party is most suitable to be overarching. Another problem perceived at the overall program management level is to sell an idea for a project convincingly to commit other partners. Particularly we concluded this to be difficult for pre-competitive stages of the service innovation processes. TNO is not the ultimate party to sell the idea, as it wishes to
be seen as independent [Anita Lieverdink (TNO), 2011]. With the SC project TNO however we expect that TNO has learned a lot from Novay in terms of relation management. A last issue the program manager should work on is to stimulate direct contact between co-funders so that they do not only communicate via the middle node. They can also convince each other, or motivate each other to be more active with the consortium.

**SYSTEM ERROR 5 - CAPABILITIES ERROR**
During the e-health service innovation processes several times the capabilities of the different partners are not properly inventorised. For example it has happened that a party got assigned a WP they were not capable to perform all the activities of, and others needed to assist. Therefore we recommend upfront inventorising parties’ capabilities is crucial, after which the WPs can be assigned accordingly. This is explained in the steps of Table 11, the innovation system development procedure. TNO is suitable to take this role, but should start with inventorising and mapping the expertise for its own organization to facilitate cross-disciplinary research in its departments.

**SYSTEM ERROR 6 - STRATEGY ERROR**
The iterative approach of CIM was not ideal to a project like WeCare in which seniors are involved. Therefore a waterfall or other approach is advised to be used when seniors are involved. TNO can evaluate what approach to be used, since this is part of the business development process. Another strategy error is the involvement of a subcontractor in a steering group. Explanation for this is that if too many parties are to judge on the direction, this will cause problems with aligning interests. Therefore the middle node should clearly state upfront who are included, and who not. A suitable selection criterion is to include partners that contribute with funding. This will trigger TNO as well to contribute, since TNO does not want to be abandoned from the strategy development process: “TNO does not bring in own funding to e-health service innovation processes. VWS and the consortium members are. This is strange as TNO could argue we would like to contribute as an employer, but again we notice the eat your own dogfood problem” [Erik Fledderus (TNO), 2011]. So to make TNO capable of working on the strategy system error, TNO should improve its own contribution to enhance its reliability with coordinating the innovation system unbiased and independently.

**8.4.2 TNO’S ABILITY TO LIFT THE SYSTEM ERRORS CIM LEVEL 2**
We continue with the CIM level 2 errors.

**SYSTEM ERROR 7 AND 8 – COMMUNICATION BARRIERS**
To overcome the horizontal and vertical communication barrier the middle node should bridge between market-pull and tech-push. Commercial partners should be convinced of the relevance of cooperating in this consortium. Janine Swaak (Novay) explains this is done by emphasizing the advantages of working in a consortium with so many expertise fields involved (learning effects). Due to the open innovation concept every co-funder knows how far developments are of the others. To overcome both the horizontal and vertical communication barriers synergy should be created between partners of the different nodes. More emphasis should be given on the added value of consortium innovation. This can be realized by providing enough financial incentives. Anita Lieverdink (TNO) emphasizes a larger amount of private investment, will commit the partners more to a project. This is aligned with literature by Koopmanschap et al., (2010). TNO is capable of taking this role as a project manager. As soon as internal ambitions are involved, TNO will focus too much on generic solutions which are not desired by product suppliers. For the partners for which the communication barriers are caused by the fact that the project
is not part of their primary processes, the middle node should point out the great advantage of cooperating. Clear closed questions should be asked to still exploit the knowledge of these partners. TNO is capable of doing this, however it is preferred to let the other partners also asked these critical questions during steering group meetings (Friso van der Meulen (TNO), 2011).

**SYSTEM ERROR 9 - INTER-CYCLIC ENTREPRENEUR ERROR**
The middle node should align the activities between the different nodes. If TNO is involved at the middle node as well as at the different expertise nodes, TNO should equally divide the activities over all expert parties to avoid internal inconvenience inside TNO. Furthermore we determined an error in terms of timing the e-health service innovation processes, as partners perceived the time-to-market and time-to-production differently. The middle node should monitor the different interests by aligning expectations at steering group meetings.

Furthermore with some cases the overall PM as well as the WP managers were picked from the same organization (TNO), others divide the WP managers over the partners involved. Advantage of all managers being from one organization is the smooth communication. The advantage of having PMs divided over different organizations is that no double work is performed, as this was sometimes perceived with the eCardioCare project [Anita Lieverdink (TNO), 2011].

A last issue in terms of inter-cyclic entrepreneurship is that TNO’s ultimate independency can be questioned. Anita Lieverdink (TNO) explains that it will be hard to not favor implementation of e-health as this is aligned with the overall project goal of the eCardioCare project.

**SYSTEM ERROR 10 – NODE THAT DOMINATES**
Despite the fact that one of the partners in an e-health service innovation project might prefer to be active and another to be passive, the entrepreneur should still strive for equal opportunities to provide input. By doing so, it also becomes clear who is more actively and less actively involved. As TNO is independent and has a reputation of being driven in the tasks they perform, they are a suitable party to monitor this.

So we conclude that TNO is capable to lift the SEs defined in Chapter 8 except for SE5, the capabilities error. In next chapter we will provide an overview of TNO’s desired position in general, in the e-health domain, and what we recommend TNO to focus on at the different development stages of innovation processes, as well as TNO’s envisioned role with the implementation of 2015.eu’s agenda.
CHAPTER 9: TNO’S POSITIONING

ABSTRACT
TNO’s roles during the different development stages of the cases are given, based upon TNO’s internal ambitions and a SWOT analysis, such as to become more demand driven and practice what you preach. The analysis shows TNO is suitable as entrepreneur at CIM level 1, to prioritize focus fields. Next an analysis of TNO’s roles at different development stages showed for all but the commercialization stage, TNO can be the entrepreneur as well as take an expert node position. For the commercialization stage, TNO only takes an expert node. The analysis gives several recommendations for improvement of TNO’s capabilities, like selling business concepts and choosing a clear position in the care domain, which fulfillment results in TNO being capable to perform every aspect of the middle node including acquisition management.

9.1 VISION DEVELOPMENT
The development of a vision on TNO’s role in the e-health innovation domain is done based upon the internal ambitions (section 9.1.1.) and the external trends (section 9.1.2.).

9.1.1 TNO’S INTERNAL AMBITIONS
The reorganization from January 2011 has changed the activities of TNO. By changing the matrix some expertise are mixed now. The idea behind this reorganization is that by meeting new people new opportunities will be detected to work together, or provide additional knowledge to each other’s work. Oscar Rietkerk (TNO) explains “An innovative, creative organization like TNO should expose their employees to a dynamic environment, to avoid them getting stuck in routine”. Therefore based upon the reorganization, TNO will aim for a new strategy to position them in the e-health domain.

As explained before in the introduction TNO strives to fulfill the five policy recommendations below. Therefore these can be seen as indicating their desired position. TNO was advised to only focus upon points in which perceive they can have certain competitive advantage [Gijsbers et al., 2005]:

1: “Become more demand-driven in its funding and operations”.
2: “Establish direct linkages with key actors in the innovation system, especially the private sector”.
3: “Play its intermediary role in dynamic networks of knowledge organizations”.
4: “Increase its impact in society”.
5: “Increase its support to Small and Medium Enterprises”.

We add to this small list the goals of TNO we retrieved from the four e-health service innovation processes of the case study [TNO, Feb 2011; AAL WeCare Project Consortium, 2010; eHealthNu, 2011; TNO, 2009]. An interesting observation is that the first six goals mentioned are equal to all innovation. Sharon Prins (TNO) confirms this by stating: “In my view, it could have been a different project in which TNO proves its ability with co-design and a special target group, to present ourselves towards the EU as well as at national level. So the fact that the project takes place in the healthy living field is not the decisive factor, the domain could be different”.

6. Prove TNO’s capabilities with managing large projects
7. Prove TNO’s capabilities with managing multidisciplinary projects
8. Prove TNO is leading in certain fields
9. Prove TNO’s independency
10. Prove TNO’s capability with bringing together parties, and building a consortium
11. Increase TNO’s network in the care domain
12. Gain new knowledge on co-design
13. Prove TNO’s capabilities with managing co-design with a special target group
14. Prove TNO’s capabilities with involving end-users
15. Prove TNO’s expertise in the field of community and coaching
16. Contribute to the track-care-record for the seven habits for well-being defined by TNO
17. Lead by example in the care domain
18. Gain new knowledge on the effects of implementing e-health
19. Develop best practices widely applicable to a scale-up project

From the policy recommendations 1 to 5, we confirm which ones TNO has focused upon with the e-health service innovation processes of our case study: Point 1, 2, 4 and 5. This indicates that TNO has indeed incorporated the policy recommendations into its strategy (CIM level 1), which has been translated further into implementation level (CIM level 2). Point 3 cannot be confirmed by means of the e-health service innovation processes, which were selected based upon involvement of a wide variety of actors (not solely knowledge organizations). RTOs prominent role in CoE, as explained in Chapter 6, indicate point 3 is fulfilled as well.

From point 6 to 19 we conclude with the service innovation processes TNO does not aim to improve or show its technical expertise, but positioning themselves as an independent party, able to develop consortia, proving their capabilities and experienced with co-design (organizational oriented). Nowadays testing fields are stimulated by the government, and we have seen before that a more active role for RTOs with guiding in-field tests and trials is expected. From the case study analysis TNO’s fulfillment of all but the following points was confirmed: 7, 10, 11, 18. However TNO can still improve on those points with the existing innovation processes.

In next section we determine the SWOT analysis, focusing on the external trends.

### 9.1.2 SWOT ANALYSIS

We continue with the SWOT analysis, from which we can conclude how TNO is currently performing. We directly relate the SWOT to events in the care domain and the e-health service innovation processes, as well as to the SEs and activities performed on overcoming the obstacles of previous EDAs. For opportunities and threats we did not limit to an external evaluation, since internal ambitions in terms of a new strategy bring new opportunities as well. Table 13 provides the overview of the SWOT.

Table 13: SWOT analysis on TNO

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multidisciplinary projects

- W8 - Lack of knowledge management skills
- W9 - Lack of synthesizing in-house knowledge

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**STRENGTHS**

**S1 – COMMITTING PUBLIC FUNDING**
The e-health service innovation processes of the case study initiated by TNO, are all partly supported by governmental funding. TNO contributed by responding on Call for Proposals and by means of the EZ-Co. The danger with raising certain vision driven innovations is that as soon as the funding stops, there is not enough private funding available as financial commitment of commercial partners is not high enough. This is particularly the case when no direct revenues can be envisioned. We again emphasize the importance of raising PPPs, and developing business model for the follow up phase to commit partners. With a business-driven innovation the industry funds from the beginning, and is driven by Return on Investments (ROI). Therefore they take the largest part of the funding, bringing lowest risks to the project.

**S2 – MULTIDISCIPLINARY DEPARTMENTS**
From both the interview part 1 and interview part 2 it follows that since TNO has many different fields of expertise in-house, ranging from social sciences, to technical sciences, environmental sciences. Therefore it is capable of offering highly specialized domain specific solution approaches.

**S3 – INDEPENDENCY STATUS**
The majority of interviewees part 1, perceive TNO as an independent party. However, Erik Fledderus (TNO) states that it is important to continue with emphasizing this is our role, and this is not, since some parties will perceive TNO as a technology player. Independency is given as one of TNO’s goals, as well as one of the requirements a party should fulfill that is willing to position itself in the middle node of CIM level 1 or 2. Anita Lieverdink (TNO) does not fully believe in the independent role of TNO. Promoting e-health, although not biased by stating who should provide the services, is still not unbiased from perspective of parties not favoring e-health.

**S4 – LOBBY NETWORK IN THE HAGUE**
Despite that TNO is still working on increasing its network in the care domain, TNO already has a strong lobby network in The Hague. As we have seen in the future roles’ prediction, TNO is expected to advise the government what fields of innovation to focus on, and stimulate the government to develop policy frameworks that intervene with the market dynamics. By means of the lobby network in The Hague, TNO can also raise a lobby for institutions on standardization and privacy, to remove barriers with the e-health service innovation processes.
S5 – TNO IS A LARGE RTO
Advantages of TNO being a large RTO is that many experts of different expertise are involved, particularly domain-specific knowledge like in the care domain. Another advantage for TNO is that it is the preferred knowledge organization of the Ministry of EL&I, making them the only RTO able to create knowledge for the Dutch industry under funding of the Ministry EL&I’s EZ-CO instrument [Janine Swaak (Novay), 2011].

S6 – INNOVATOR
TNO has a reputation of being an innovator. TNO business developers have the specific task to come up with new innovation aligned with the external trends and internal capabilities.

S7 – PROJECT MANAGEMENT OF LARGE PROJECTS
TNO is experienced with managing multi-disciplinary projects. TNO is good at project management activities in terms of developing contingency plans, sticking to time schedules and coordinating activities.

WEAKNESSES

W1 – TENDS TO USE AN INDIVIDUALISTIC APPROACH
The criticism other partners had on TNO’s approach during the eCardioCare project, was that TNO operated sometimes somewhat individualistic. The PM solved this issue by individually talking to each of the partners to sound out their opinions and search for a solution. Avoiding is of course better than solving, therefore TNO should focus on integrating their activities more with those of others. Erik Fledderus (TNO) states: “TNO consists of many fields of expertise, comparable with a university. TNO is smart, but individualistic”. As we have seen in chapter 5 when analyzing TNO’s current activities in the e-health innovation field, these current activities were difficult to map. Monique van Blijswijk (TNO) mentions that TNO is currently working on an “up to one TNO” initiative, aiming to connect the different disciplines. Therefore when multiple departments of TNO are involved it is very important to explicitly defining the goals, to assure a shared perception of what should be done, and make sure the developments at different departments can be offered to the client or commissioner as a whole.

W2 – INNOVATION IN STATIC ENVIRONMENTS
Technical progress goes too fast even for RTOs like TNO, making their innovations lag behind what is most up to date and demanded. Therefore TNO is more comparable to universities rather than to SMEs, which can easily operate in highly dynamic environments and move fast enough [Patrick Strating (EIT ICT Labs), 2011]. This brings TNO a disadvantage in terms of a role as business developer.

W3 – TNO IS A LARGE RTO
The downsides of being a large RTO is that there are internal processes that take long, and TNO is less manoeuvrable than a smaller RTO like Novay [Janine Swaak (Novay), 2011]. When you are big you should act more formally and more purely to avoid chaos and remain to be seen as independent. TNO does more research for companies as a contractor of companies and Novay does more research together with companies, as seen policy recommendation 2 the linkages of TNO with the private sector is focused upon, as well as more links with the private sectors in terms of policy recommendation 5. Janine Swaak (Novay) states it is no guarantee if you assign co-funders to the WPs, their contribution
will be better. But their experience so far is good with this approach. So we advise TNO to learn from Novay’s relation management approach, up to the extent they can still justify their behaviour.

**W4 – LIMITED NETWORK IN THE CARE DOMAIN**
A weakness of TNO acknowledged by the majority of the e-health innovation processes, is that TNO has a limited network in the field of care. As TNO is not perceived as a direct competitor by health insurers and product suppliers, we do not perceive difficulties with exploiting other parties’ networks in the care domain. In order to establish new innovation systems in the field of healthcare it is crucial for TNO to expand this network, as they do not wish to rely on others. Currently we see for TNO the role as project manager rather than as acquisition or relation manager.

**W5 – LACK OF SALES POWER**
Anita Lieverdink (TNO) states that TNO can still improve on its sales power, as the promotion of e-health could have been better. Therefore the acquisition management skills of TNO have been not so significant for the cases. The threat TNO faces is that by promoting e-health (particularly with a competitive project), it risks taking over the marketing department of a commercial party. Perhaps it is therefore not so bad that TNO has no sales power, to contribute to its independency. TNO highly values its independency, making them able to objectively facilitate between partners in an innovation system. Nevertheless, from the cases it follows that bringing together multiple disciplines is not TNO’s main competence.

**W6 – LACK OF POSITIONING IN THE CARE DOMAIN**
TNO did not take a clear position in the care domain. From the eHealthNu project it followed that TNO has not included care innovation in their propositions, making it not (yet) part of the core activities of TNO. Monique van Blijswijk (TNO) explains that the ministry of VWS approached the Board of TNO to explain their appreciation of TNO proceeding with developments in the field of care innovation. Lack of clear positioning will negatively influence the trust of other care field partners in TNO, as TNO did not fully commit to care innovation yet. This can harm the opportunity of TNO to be the trigger of the national Implementation Agenda e-Health (NIA), the follow-up initiative of the eHealthNu. This is also confirmed by the majority of TNO interviewees of the interviews part 1. They state that TNO should choose a position and clearly state what their role is and what is not. When we see TNO in terms CIM, the lack of a vision on care innovation (CIM level 1), will result in lack of developing the consortium on care innovation, and lack of formulating innovation processes on care innovation. So TNO has a SE on translating to a lower level CIM internally as well.

**W7 – PROJECT BASED COST APPROACH**
Financial means can be an obstacle for TNO’s participation in an innovation system. As explained before, with the eCardioCare project all parties exceeded the costs budgeted upfront, which troubled TNO as RTO using a project-based cost approach. Certain situations can have an influence on the trustful relationship between parties, particularly if those consortium members are not aware upfront of the fact that financial means might form an issue to TNO. TNO should be carefully going along with certain upfront proposals they should return to at a later stage. From interview part 1 we concluded that TNO is able to contribute by own financial means, however they should put priorities differently than they are currently doing. So it is still possible for TNO to invest own means. Erik Fledderus (TNO) states that e-health service innovation processes resulting in social impact, should be translated into steps that all fit in a viable earnings model.
W8 – LACK OF KNOWLEDGE MANAGEMENT SKILLS
TNO does not excel in knowledge management skills. Therefore inventorising the in-house project knowledge before assigning activities to different partners, has not always been performed optimally. This can also be due to wrong information given to them by the partners.

W9 – LACK OF SYNTHESIZING IN-HOUSE KNOWLEDGE
The management of the internal multidisciplinary organization has become particularly relevant since the reorganization of January 2011, since intra-disciplinary cooperation has improved a lot, but not the cross-disciplinary cooperation [Sharon Prins (TNO), 2011]. Therefore we conclude that TNO lacks the synthesizer’s role.

OPPORTUNITIES

O1 – GENERIC SOLUTIONS WIDELY APPLICABLE
Patrick Strating (EIT ICT Labs) explains TNO was more sector-oriented when it was founded. It initially focused on sectors, certification and standardization. TNO is more focused on domain-specific solutions. However we see opportunities as well in terms of generic solutions, as these are implementable on a broader scale. With the eCardioCare project part of the aim was to develop the best practices that benefitted scaling up the eCardioCare service, which can also be used for other scale up applications.

O2 – PRACTICE WHAT YOU PREACH
At both interview part 1 and part 2 is referred to the opportunity for TNO to deploy their own staff. For example to offer their employees as the pilot test group. With the Treaty of Maastricht project three parties joined forces to develop health programs for their own staff, which is explained as: “To practice what you preach” [TU Delft, 2011]. Erik Fledderus (TNO) reasons why TNO should join as well: “It is important to profile yourself as an employer with such a leading project. TNO is often taking a neutral distant position. TNO lacks to take the eat their own dog food role\(^{41}\), so they do not see the added value of connecting to processes other than starting up innovative projects and executing them”.

O3 – LEADER IN RESEARCHING EFFECTS OF IMPLEMENTING E-HEALTH
Monique van Blijswijk (TNO) states that worldwide not so much research is performed into the effects of implementing e-health. Therefore we recommend it as an opportunity for TNO to focus upon. The Netherlands can be leading in this, and this can spur economic activity to support other countries.

O4 – DEMAND DRIVEN INNOVATIONS
Since seniors do not feel their needs are addressed sufficiently by current e-heath solutions, there is need for investigating social needs. For the majority of the cases gaining knowledge on co-design was emphasized. So TNO aims to excel in this, such that for future project they can emphasize demand driven innovation. By improving their demand-driven innovation, TNO works on diminishing the weakness of not being dynamic healthcare market proof.

O5 – VISIONARY
TNO has got the uniform support from interviewees’ part 1 and 2, to develop the agenda on e-health. TNO seems suitable to align several partners their interests. This supports as well why TNO is the

\(^{41}\) Dogfooding is defined by [Harrison, 2006] as the idea that an organization uses the product they are making themselves. Reasons to do so is to provide confidence towards customers that the organization believes in its own product, and secondly to uncover unfound bugs.
ultimate party to advise the government and municipalities, as well as the industrial parties what fields of innovation in healthcare to focus on (prioritizing).

**O6 - MASTER OF INNOVATION SYSTEM DEVELOPMENT**

To become an expert on procedures for developing innovation systems, seems like an interesting business opportunity for TNO. Despite that TNO is comparable to a university in terms of money making possibilities (spin-offs and consultancy), TNO has the expertise to detect on what innovation fields to focus. From the interviews with TNO interviewees and informal chats at TNO, we also noticed TNO is ahead in terms of awareness of the existence of innovation systems and the advantages that mapping innovation systems can bring to a successful innovation process execution. First of all it brings them a competitive advantage compared to universities that start to create money in the same ways as TNO. Furthermore it easily suits TNO’s strategy of innovation with social impact. Next it will bring an increased understanding of successful coalitions from which TNO itself can benefit with its operations. The innovation system development procedure of Table 11 can be used.

**THREATS**

**T1 – OVERLOAD WITH WORK**

From interview part 1 it follows that TNO should not take all roles and perform all activities by themselves. If this is the case, the other partners will lay back [Erik Fledderus (TNO), 2011]. This is supported by Man (2009) who explains that no risk for the other partners, results in no commitment. For the eHealthNu project we have already explained that the attitude of some of the partners was that as TNO is such an expert in that field, they can do all the work. Despite that TNO feels honoured by this and temps to work somewhat individualistic (as followed from eCardioCare), they should resist on doing all the work, as part of innovating is operating in an innovative environment, in which cooperation is highly emphasized.

**T2 - LESS CROSS DISCIPLINARY RESEARCH**

As a consequence of the reorganization of January 2012 there is a division in departments. TNO employees perceive less cooperation takes place between departments from the technical sciences and from the behavioral and societal sciences. As an example, Sharon Prins (TNO) explains that the power of TNO is to have all the expertise in-house. Up to four years ago the departments of TNO were divided according to the markets they operate in. This was a very dynamic environment as technical and non-technical experts were part of one department. The matrix organization since 2011 works very well for cooperation with other TNO employees from different locations, however still within the same expertise field. So intra-disciplinary cooperation has improved a lot, but not the cross-disciplinary cooperation. This is concerning since TNO should not lose one of its main competences, the multidisciplinary research.

**T3 – UNIVERSITIES WILL START SPIN-OFF COMPANIES**

Universities are valorizing their knowledge by university spin-off companies. This forms a threat to the spin-offs of TNO Companies, both focusing on innovations with social impact.

**T4 – UNIVERSITIES PERFORMING CONSULTANCY JOBS**

An upcoming threat is that universities are performing consultancy jobs as well. Reason for this is that they need to raise money themselves, since they get less money for research from the government.
The different roles TNO should play during different development stages of the innovation process will be evaluated now based upon previous section.

### 9.2 TNO’S ROLE AT DIFFERENT DEVELOPMENT STAGES OF THE SERVICE INNOVATION PROCESSES

From the SWOT analysis we conclude that TNO is expert in the fields of obtaining public funding, developing domain specific solutions, it can benefit from its large lobby network in The Hague and from the advantages of being a large organization by itself. Finally TNO is perceived as independent. We combine these competencies and derive the roles we recommend to TNO within the different development stages of the e-health service innovation processes of our case study, shown in Figure 43.

Furthermore we verify 2015.eu agenda’s contribution during each of these development stages.

#### FUNDAMENTAL DEVELOPMENT STAGE - CARE TECHNOLOGY RESEARCH

Although no fundamental case has been analyzed in this research, we still aim to prescribe a role for TNO, based on documentation and interview part 1. Since CoEs are defined, the innovation strategy needs to be demand driven and have a clear industrial focus. TNO is capable to set priorities of interesting research fields for society, and next link them to the industry. Therefore TNO acts as innovator in terms of Table 5. A weakness of TNO’s SWOT is innovation in static environments. This makes TNO as business developer (part of innovator), too slow for realizing radical innovations, according to commercial actors. However, with a fundamental development project this is of less concern. Therefore in Figure 43 TNO is positioned in the technology development, middle node, and social transitions node, to integrate science and business, TNO’s core competency which it should surely maintain. The main part of its activities it will perform in the integrated engineering cycle.

To give an example of a CoE in the field of medical technology, we refer to the Center for Care Technology Research (CCTR). The roles of the partners in CCTR are explained by Nico van Meeteren (TNO): “University Maastricht and Maastricht University Medical Center will provide the healthcare innovation and the test field, University of Twente will provide the technology, and TNO has the persistence to operate on national level by integrating the knowledge into the daily life”. The close cooperation between university scientist and TNO researchers is enabled by the fact that many TNO employees are part-time working at universities as well. This makes them as RTO a valuable intermediary of connecting the disciplinary science field, the technology science field, but also connecting this to the product innovators field [Gijsbers et al., 2005]. This pleats for a position for them as entrepreneur. TNO should not perform social or technical disciplinary sciences in a project in the fundamental phase, competing directly with universities.

Since 2015.eu’s agenda has as main goals to spur innovation and exploit the advantages that ICTs bring to public interests, not much is focused on the fundamental research phase. However, the Research and Innovation action areas work on ensuring sufficient financial support to join ICT research infrastructures and innovation clusters, establish an EU strategy on cloud computing for government and science, and increase the public spending on ICT research and development [COM (2010) 245, 2010]. These might contribute to fundamental research as well. This confirms policy recommendation 3.
Figure 43: TNO’s role at different development stages of the e-health service innovation process
**INDUSTRIAL DEVELOPMENT STAGE – SMART COACHING PROJECT**

With the Smart Coaching project in the industrial development stage, TNO has taken the largest role in terms of expertise. Therefore TNO’s researchers from social and technical disciplines are present. Social sciences issues are to actively contribute to investigating what kind of e-coaching tools will effectively coach end-users (policy recommendation 4), as well as being technical expert and supporting the in-field trials (policy recommendation 1). TNO’s role in the integrated engineering cycle is significant with SC project, since TNO aims to integrate the knowledge obtained in the left part of CIM into product-service innovations that benefit the whole society. So a broad range of expertise nodes of CIM level 2 are covered by TNO (Figure 43): science-, technology- and social transitions node. The disciplinary sciences are filled by TNO since no need to involve universities was perceived for SC project since enough in-house knowledge of TNO and Novay was involved [Ed Mos (TNO), 2011]. Finally TNO also fulfills a coordinating role with the SC project, since TNO is the PM. TNO is not leading in terms of radically new innovations anymore, therefore it is less desired to take a role as business developer. However, since SC project concerns a pre-competitive project TNO is capable of business development as the innovation process will take long anyways. TNO’s main problems are/were to convince the co-funders of the value of a precompetitive research and cooperating in an EZ-Co initiative. Therefore TNO should improve its relation management skills, which it does during the SC project by learning from Novay. From the SWOT analysis we stated TNO’s in-house knowledge management skills require improvement, which has been worked upon during the SC project. By improving these two, the acquisition management skills will improve as well. So policy recommendation 2 is considered, as well as goal 6, 7, 8, 11, 12, 13, 15, 17.

Since in the industrial development stage standardization and regulation are important to focus upon from an early stage, 2015.eu’s action areas focused on interoperability and standards, and trust and security will influence this. In terms of the action area research and innovation, we expect 2015.eu’s agenda to contribute the same to the fundamental as to the industrial development stage.

**EXPERIMENTAL DEVELOPMENT STAGE – WE CARE PROJECT**

With the WeCare project in the experimental development stage, TNO has taken the role of an analyst and researcher, verifying the WeCare product with in-field trials, but also exploring business opportunities, demolishing barriers on privacy and other law and regulation fields (alpha sciences) and co-design (social sciences). Mainly important to this stage is to involve many cheap SMEs to build the prototypes (policy recommendation 5). This requires acquisition management skills, which we have just seen are not fully developed at TNO. Acquisition management did not cause trouble with the WeCare project, since potential commercial partners were willing to join this EU funded project, very close to the market. Furthermore TNO could represent the interests of both social and business partners. The preferred role of TNO during an experimental development stage is to be the entrepreneur that coordinates the project, and be actively involved with the execution of the pilots by means of the co-design lessons learnt (policy recommendation 4). Furthermore it is stated by Oscar Rietkerk (TNO) that TNO can be the launching area by applying the smart coaching tool to its employees. Therefore the eating your own dogfood opportunity is emphasized again, as well as TNO’s ambition to lead by example.

At the end of this phase, when the commercial incentives start to take over the innovation process, TNO should hand over the innovation system management to a commercial party. This is confirmed by all interviewees of interview part 1 and 2. Therefore, a commercial party suitable for taking over the entrepreneurship should be kept in mind at the beginning when acquiring the partners for the
consortium. Besides the policy recommendation mentioned, the goals that we have found back in the experimental development stage were: 6, 7, 11, 13, 14 and 16.

2015.eu’s agenda contributes to the experimental development stage since some action points advise engagement in large scale pilots to test and develop innovative and interoperable solutions in areas of public interests [COM (2010) 245, 2010].

COMMERCIALIZATION STAGE – TNO SPIN-OFF

As explained before, when the previous development stages have been properly executed, no difficulties are expected with commercialization and roll out, since the obstacles detected in the pre-competitive phase have been overcome already. So only if the e-health innovation is not naturally taken up by market dynamics, or complexities in the domain are big (non-trivial money flows [Marc Steen (TNO), 2011]), TNO takes part in the commercialization and scale up phase, taken into account that the service innovation should create impact on society. After the pilot phase of e-health services often problems occur in terms of availability of money for commercialization. We have referred to this before as the opposite valley of death. This can be caused by the lack of a clear business case, or not enough commitment of the private companies since their investments have been low during the pre-competitive development stages.

Expectedly TNO has given away its entrepreneurial role to one of the commercial partners involved from the beginning, as soon as the commercialization starts. TNO should start a spin-off company itself for those products with high social impact that the market dynamics do not naturally take up [Oscar Rietkerk (TNO), 2011]. TNO’s spin-off position in CIM level 2 will be in the product-service innovator’s node and the entrepreneurship node. An example of an e-health related TNO spin-off is the Quality for Medical Information and Communication, mentioned before in chapter 5. When a commercial partner takes over the entrepreneurial role, but the complexities in the care domain are high, TNO can act as advisor on selecting the most feasible business model to implement, and how to realize it [Marc Steen (TNO), 2011]. Again we warn TNO should not aim take over the sales department of a commercial partner it cooperates with, as was stated before by [Anita Lieverdink (TNO), 2011]. Therefore TNO’s position will be in the technical sciences node, and the social transitions node, as the business model implementation will be covered in the social sciences cycle. Both scenarios of TNO Companies as entrepreneur, as well as another commercial entrepreneur taking over and TNO advising on the business model implementation, are displayed in Figure 43.

2015.eu’s action points in research and innovation are focused on light and fast access to EU research funds in ICT, making it more attractive to young research. This is suitable for TNO spin-offs. Policy recommendation 5 can be noticed.

EARLY SCALE UP STAGE - EHEALTHNU PROJECT

If TNO expects barriers for scale-up in advance, since it knows the complex healthcare market in which the e-health implementation barriers have not been removed during the industrial- and experimental stages, it can work as process activator to pre-competitively determine the barriers bothering scale up of e-health products and demolish them. This makes them innovator (business developer) as well as project manager. So TNO can work on bringing transparency in difficult markets like the healthcare. If TNO would have also taken the role of acquisition manager, its limited network in the care domain
would start playing a role, so it is recommendable to first participate in e-health service innovation projects to build up its own network (relation management).

Since eHealthNu project is in the early scale up stage, the detection of the barriers (social sciences cycle) dominates implementing solutions to lift them (differentiated valorisation cycle). Therefore TNO’s experts are mainly active in the social sciences cycle. Technical barriers are possible as well, although in the field of e-health this is often not the case. Since the early-scale up is still a pre-competitive phase, TNO as entrepreneur is feasible. TNO Companies, or the commercial organization to which TNO has handed over the entrepreneurship role after the experimental stage, can also initiate this pre-competitive scale up project. In that case, TNO can still be the project manager, coordinating the activities.

**LATE SCALE UP STAGE - ECARDIOCARE PROJECT**

The eCardioCare the project is in the late scale up stage, in which demolishing the barriers is emphasized (last image Figure 43). Therefore the differentiated valorisation cycle dominates. Since it is a competitive project applying what is found in the eHealthNu project to Philip’s Motiva product, the commercial partners prefer a commercial party as entrepreneur. Involving a research organisation might limit the speed of the product roll-out. However, eCardioCare is partially publicly funded, expectedly this Call for Scale-up would have been less easily accepted when a commercial party had applied for it [Anita Lieverdink (TNO), 2011]]. One of the deliverables of the eCardioCare project is a scale-up protocol, needed to be developed with guidelines for other e-health products, perceiving difficulties with scaling up. TNO can perform well, since it has no conflicting interests. Furthermore relation management is well performed, by organising the steering and soundboard group meetings, but also by holding individual conversations with project members, to verify the satisfaction level.

Scientific researchers had proven to be important for realizing social acceptation of the eCardioCare service, including adoption pattern investigation. Since mainly TNO had emphasized this, positive gains were reached by TNO taking the lead.

Furthermore TNO can contribute to the identification of more application areas for expansion of the e-health services development in accordance with social needs. This positions them in an advisory role in the social transition node as well. The policy recommendations recognizable in the scale up development stages are: 1, 2, 4, 6, 7, 8, 9, 10, 12, 17, 18, 19.

Since 2015.eu’s agenda also focuses on the obstacles detected as scale up barriers by the eHealthNu project (e.g. standardization and interoperability), EDAs support e-health innovation in the scale up phase as well. Furthermore 2015.eu’s agenda focuses on leveraging more private investment through the strategic use of pre-commercial procurement and PPPs.

So we see a role for TNO as the entrepreneur with all but one stage (the commercialization stage) of the e-health service innovation processes.

As we have seen in chapter 6, commercial organizations often disagree with the fact that TNO can be the entrepreneur of the innovation system by itself. Therefore we recommend to involve a market player (e.g. health insurance company, housing corporation) and/or the government from the beginning.
9.3 TNO’s Ideas on Implementing 2015.EU’s Agenda in the E-Health Innovation Domain

We provide insight in TNO’s role with implementing 2015.eu’s agenda in the e-health innovation domain. All of the interviewees of interview part 1 agree that a role to translate 2015.eu’s agenda into more practical actions, suits TNO.

1. Jean Gelissen (Philips) states that a party like TNO is suitable to work on this as it is an independent party. TNO can develop and execute an integrated approach with a common vision and an agenda. Patrick Strating (EIT ICT Labs) explains that RTOs are the only parties involved in the Netherlands with the translation of 2015.eu’s agenda. Therefore they should clearly and forcefully articulate this vision.

2. Erik Fledderus (TNO) explains that TNO tempts to commit to EDA as TNO’s sphere heads are socially oriented. In the introduction we have already explained Digital Agenda.nl developed by Ministry of EL&I has a clear focus towards business [Ministry of EL&I, 2011], and less towards social aspects. Therefore TNO decided to get involved as the independent party emphasizing both social and economic aspects. “The Dutch Council will take over 2015.eu’s ambitions, but does not consider them as a final aim” [Ministry of EL&I, 2011]. The government perceives it as most important that by 2020 the Dutch infrastructure is adjusted to the demands of users and service providers in the Netherlands. TNO should stay synchronized with the Dutch government since TNO is partially funded by government money.

3. TNO already performs projects in each of the seven action areas of 2015.eu’s agenda. It can translate its current activities and show its impact.

4. TNO has the right expertise to take meaningful decisions. The expertise TNO uses to advice the European Parliament on 2015.eu’s agenda is a combination of both policy analysis and in-depth ICT knowledge. TNO has provided advice already on net neutrality, next generation networks, internet and privacy and the ideas for a future European Network and Information Security Agency [TNO WEBSITE, 2011]. If TNO is narrowly involved with this from the beginning this will make TNO expert, obtaining a strategic position. Erik Fledderus (TNO) states: By linking its current activities to 2015.eu agenda’s interests, TNO can get the attention of the EC and not only get more attention from the EU, but also access to EU financial means to increase its possibilities to create impact”. This is not only aligned with TNO aiming to increase its European focus, but also contributes to TNO’s aim to lead by example. TNO can for example on the long run support implementation of other EU MSs as well.

9.3.1 TNO’s Role with Translating and Implementing 2015.EU’s Agenda in the Dutch E-Health Domain

TNO’s vision is that for the successful implementation of EDAs bottom-up approaches might work better than solely top-down implementation [TNO WEBSITE, 2011]. Together with Province of Friesland TNO has taken the lead with developing and executing the LDAs, in order to become expert on new regional design [Province of Friesland, 2011]. TNO can prioritize the problem fields for the Netherlands, to which 2015.eu agenda’s objectives should be tailored. Again we emphasize that TNO should not have the intentions to take over the governmental decision making, but solely provide advice on priorities of research fields. Marc van Lieshout (TNO) states: “TNO has to verify if the research agenda of the EC is aligned with what we are good at in the Netherlands”. TNO has already started with this [IPN, 2011]. It developed in cooperation with ICT Office an “Innovation Accelerator”, which gives each of the top sectors defined by Ministry of
EL&I insight into the ICT ambitions and needs of this particular sector, including the steps that should be taken to reach these goals, and the opportunities and threats most applicable to the sector. With these results, ICT companies can develop business cases and RTOs/knowledge institutes can derive research goals from it.

TNO can stipulate to the social players what the dominant points in their region are and where they should focus on. Erik Fledderus (TNO) confirms this thought: “TNO can show how particularly the societal players can deal with those innovation systems where EDA lies underneath as a blueprint.” TNO can act as the role model for other social players how they should deal with 2015.eu’s agenda. An important consideration with this is stated by Erik Fledderus: “TNO wishes to invest in projects which have the prospect on a feasible business model. One can question if the challenges defined by 2015.eu’s agenda should be covered fully by TNO, or only those parts economically feasible”. Since we have explained before the focus of 2015.eu’s agenda is already mainly economically, we expect the high creativity of TNO employees can contribute significantly to showing the economic feasibility of all of the social issues that can benefit from the implemented 2015.eu’s agenda.

Expectedly, municipalities are the first to discover the target groups that deal with health problems [Oscar Rietkerk (TNO), 2011]. As we have explained before, the national government is requested to point out the future fields of e-health innovation. TNO can support them with this, by translating the social needs detected at local level into fields of innovation (vision development step of CIM level 1). It identifies in which fields a particular Municipality is lagging behind, and should alert it on this. By doing so, TNO can take into account the infrastructure expected to be realized by 2020, enabled by 2015.eu’s implementation. The other way around, from the local level social needs TNO has detected it can identify required innovation fields. After this TNO should approach the main players in the care domain to form a consortium. With this consortium the e-health service innovation processes are defined guiding the process of reaching the vision. By defining these e-health service innovation processes a feedback is required towards the consortium development to inventorise what additional in-house knowledge is needed to execute these e-health service innovation processes. Therefore iterations are performed.

When we integrate TNO’s role with the innovation system development process in e-health and implement 2015.eu’s agenda, TNO’s role will be intermediary between different levels of aggregation. TNO has knowledge on both sides: A player in the innovation system by local initiatives, as well as taking an overarching role by involvement in 2015.eu’s top-down implementation. This makes TNO qualified to work on connecting local initiatives and 2015.eu’s agenda and closing the gaps. When focusing on implementation of 2015.eu’s agenda in e-health domain, the eHealthNu platform is mentioned by the majority of the interviewees of both interview part 1 and 2. We can consider this initiative therefore as an important link between EDAs and the e-health domain for the Netherlands. As TNO currently has an active role in the eHealthNu platform, this can provide them handles to translate 2015.eu’s agenda to the e-health domain.

eHealthNu project members should take note of 2015.eu agenda’s contents and adjust their vision and track to this. “The eHealthNu platform partly follows the same track as 2015.eu’s agenda as it is formulated and developed in cooperation with many partners, including those of the eHealthNu platform” [Nico van Meeteren (TNO), 2011]. So the vision and track should be advised to eHealthNu,
since this platform can contribute to defining new technology development fields as well as to social cultural innovation.

### 9.3.2 TNO’S ROLE WITH DEMOLISHING THE IMPLEMENTATION OBSTACLES OF PREVIOUS EDAS

In previous chapter we have seen that for the cases there were a few obstacles which were not taken into account with the network of activities of the cases: the complexity of the EU financing structure, lack of well-founded business cases and lack of overarching rules and standards. Table 14 below describes how TNO can contribute to any of the obstacles defined, therefore also including those three with which issues occur for the e-health service innovation processes.

**Table 14: TNO’s activities focused on lifting the implementation obstacles of EDAs**

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Activities focused on the obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lack of evaluation during the course of the action plan</td>
<td>Since TNO was PM for all projects, monitoring progress on activities is their task. Since TNO aims to get more closely involved with in-field pilot test, it will contribute to in-between reviews by end-users.</td>
</tr>
<tr>
<td>2. Lack of social adoption</td>
<td>TNO performs research into social adoption, determining social needs and behavior (soft sciences cycle). Furthermore it aims to increase its influence in the differentiated valorization cycle. It is focused on end-user involvement and co-design, and aims to take a more pro-active role with in-field pilots.</td>
</tr>
<tr>
<td>3. Lack of overarching standards and regulation</td>
<td>In terms of lack of overarching standards and regulation TNO can lobby in the Hague, as they have many contacts there. Furthermore TNO is experienced with implementing policies so they can help the government with this.</td>
</tr>
<tr>
<td>4. Lack of strategic efforts to stimulate cooperation</td>
<td>Since TNO favors a consortium organization including a steering group and a control group, TNO can evaluate if interests are still aligned, and will create synergy to avoid passive partners.</td>
</tr>
<tr>
<td>5. Lack of insight into added value of ICT to quality of life</td>
<td>In terms of lack of insight into the added value of ICT to quality of life, we have seen with the WeCare project that TNO is highly qualified with developing questionnaires. Furthermore TNO has invented the seven habits for well-being, where WeCare project adds to the track-care-record. This indicates TNO’s expertise in this field.</td>
</tr>
<tr>
<td>6. Lack of well-founded business cases</td>
<td>TNO should emphasize the high prospects of pre-competitive stages of e-health service innovation processes. When establishing innovation systems it should already be assured that enough stakeholders with financial potential are involved. TNO can contribute to this by promoting the business cases to attract investors. Moreover they can provide guidance with the business model development. Due to their comprehensive understanding of technologies TNO can advise technology partners which business models they should focus on.</td>
</tr>
<tr>
<td>7. Complexity of the EU financing structure</td>
<td>In terms of the Complexity of the EU financing structure, mainly a lack of insight on financial instruments available, TNO already works on simplifying the complex financial structure of the Dutch care sector. Their</td>
</tr>
</tbody>
</table>
knowledge on EU funding instruments and national instruments should be up to date in order to exploit governmental support.

So to conclude, we foresee TNO can perform meaningful activities to overcome all of the obstacles (if it did not do so already).

Furthermore TNO should develop a list of indicators to monitor the progress on implementation of 2015.eu’s agenda in the Netherlands. For the implementation obstacles of previous EDAs, indicators have been developed as shown in chapter 3. This list of indicators can be added with indicators measuring the successful implementation of e-health in the Netherlands. The indicators should be verified at several in-between stages during execution of the innovation process.

9.4 RECOMMENDATIONS FOR IMPROVING TNO’S CAPABILITIES

If TNO wishes to: (1) be qualified and accepted as the entrepreneur, (2) capable to lift the SEs that have occurred with the cases, and (3) capable to lift the obstacles occurring with implementing previous EDAs, TNO should update its capabilities and reputation in the following fields:

1. Become more demand driven in its funding and operations
2. Improve its knowledge management skills
3. In-house knowledge management
4. Improve its skills to sell the business idea and acquire partners
5. Improve its skills to acquire co-funders for an EZ-Co project
6. Improve its relation management skills
7. Increase its knowledge on public funding instruments
8. Increase its network in the healthcare domain
9. Improve its credibility in the care domain by creating transparency on its position
10. To gain independency by clearly stating what is and what is not part of its activities
11. Eat its own dogfood to increase credibility
12. Get others on the right track by developing and carrying forward the e-health vision with a common agenda
13. Develop a clear approach on organizing the responsibilities of the steering group and the control group.
14. Deal with the complexities of being large.

Furthermore we advise TNO as the independent entrepreneur to develop a list of indicators to measure the progress on the innovation processes managed by the innovation systems established by TNO. TNO seems qualified for this role due to its position as entrepreneur, and its experience with developing evaluation protocols.

The main fields of innovation for which realization and implementation of e-health can be bothered we have noticed during this thesis are: Social and behavioral innovations, Institutional innovations, organizational innovations and technical innovations. We have already given some examples of indicators to measure the progress on the implementation obstacles of EDA in chapter 3. For example, the amount of in-between reviews, the amount of business cases developed for the innovation, the amount of public funding committed, the amount of private funding committed, amount of new laws accepted, the amount of in-field trials and also important the amount of meetings, formal or informal. Based upon the cases we give some examples of indicators that should be added: The amount of
updates for the risk analysis, monitoring the progress on the risk analysis, an overview of partners committed by means of personal relations, the in-house capabilities of a company, and the in-house capabilities of the project. The latter one will contribute to the commitment of the partners, since we have noticed if a partner is involved for a greater amount of money a strong personal relation can contribute. Besides these indicators, more indicators should be developed after the kick-off and progress should be closely monitored. Possible indicators we base upon relevant aspects of this thesis, are: (1) steering group representatives satisfaction, (2) interests of the individual partners and (3) progress in the different cycles of change.

Next chapter finalizes this research by means of the conclusions and recommendations made.
CHAPTER 10 – CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND FUTURE RESEARCH

The objective of the research stated in chapter 1 is as follows: To contribute to structuring the implementation process of 2015.eu agenda, by prescribing a systematic approach for establishing innovation systems in the Dutch e-health domain, such that those innovation systems can develop service innovations for the future e-health domain, to which 2015.eu agenda’s objectives can add.

In the previous chapters answers have been given to the research questions posed in chapter 1. These answers are first summarized, resulting in the conclusions of this research. After that practical and scientific implications are given, and finally the limitations and recommendations of this research.

10.1 ANSWERS TO RESEARCH QUESTIONS

The research questions are chronologically answered.

RQ1. What are the main obstacles and indicators derived of previous implementations of EDAs?

In section 3.3 the following obstacles and indicators were derived.

<table>
<thead>
<tr>
<th>Obstacle</th>
<th>Indicators</th>
</tr>
</thead>
</table>
| 1. Lack of evaluation during the course of the action plan of the implementation process | • Amount of in-between reviews  
• Variety of information sources used for evaluations/timely data collection |
| 2. Lack of social adoption of ICT services by society                    | • Amount of reviews by end-users during different stages of the service life cycle |
| 3. Lack of overarching EU wide policy frameworks                         | • Amount of EU-wide laws accepted  
• Amount of EU-wide policy frameworks adjusted                             |
| 4. Lack of strategic efforts to stimulate cooperation between stakeholders around common goals | • Amount of collaborations between different level stakeholders  
• Amount of collaborations between stakeholders from different specialization |
| 5. Lack of insight into the added value of ICT to improving quality of life | Qualitative indicators:  
• Amount of in-field trials (questionnaires sent)  
• Variety of test groups  
• Variety of data collection methods  
Quantitative indicators:  
• Percentage of income spend on ICT based healthcare/well-being tools  
• Number of face-to-face visits by carers an independent living person has had in past three months |
| 6. Lack of well-founded business cases for private sector                 | • Amount of business cases developed  
• Amount of PPPs initiated                                                   |
| 7. Complexity of the EU financing structure                              | • Amount of EU level instruments available  
• Percentage of EU financial instruments known                              |
**RQ2. Which innovation model is most suitable for this research?**

In Chapter 4 we have concluded that 4th generation innovation systems are most suitable to this research. Balancing scientific push and market pull is considered, feedback loops included, and a broad range of innovations is covered, including market and organizational innovations. Particularly the last one is relevant to this research. As the 4th generation innovation systems stand for open innovation, they exploit them rather than only creating them. 4th generation innovation systems aim to visualize the complexity of an innovation system and offer a grip for establishing such an innovation system, or how to participate in it to keep it running. As 4th generation models can deal with a complex environment with many external relations and interdependencies, they are most suitable for analyzing the radical e-health innovation domain.

Within the 4th generation innovation models the Cyclic Innovation Model of Berkhout (2000) has been selected by assessing seven innovation system theories, selected from a larger set that seemed not feasible from the start. The CIM model consists of two levels of abstraction: 1. the business development framework, which can be referred to as the vision level CIM level 1, and the 2. Cyclic Innovation Model, which is the process execution level CIM level 2. A complex area with boundary crossing innovation processes can be described. Seven selection criteria were used, of which the ones most relevant to convince suitability of this innovation model is that CIM is an actor-oriented model, and our research aims to map the different actors and prescribe a role for TNO in order to show how innovation systems should be established and kept running. Furthermore the multiple levels of abstraction is important to align the image of the future vision of e-health innovation domain, based upon 2015.eu’s agenda and also e-health service innovation processes, requiring a lower level of detail to describe how the service innovation processes should be executed. Thirdly specifying the entrepreneurial activities is highlighted by the presence of the middle node in both CIM level 1 and CIM level 2. For the establishment of innovation systems, an entrepreneur is needed. Furthermore aligning different perspectives in an actor-oriented model, as well as align the different level of abstraction, requires entrepreneurial activities.

**RQ3. What are the main trends on e-health in the Netherlands and what activities does TNO perform?**

We will divide this RQ into two sub-RQs.

**RQ3.1a. What are the main trends on e-health in the Netherlands?**

A (Political, Economic, Social, Technological) analysis has been performed, to assure all domains have been considered with the trend analysis.

1. The factors explaining urgency for change in the e-health domain and with that increase the demand for e-health services, urged upon: 1. Aging population (S), 2. Decreasing active population (E), 3. Living unhealthy lifestyles (S), 4. Increasing percentage of a household’s income spend on care (E).

2. The factors influencing the speed of implementation of e-health in the Netherlands: 1. Lacking law and regulations on standardization, data security, uniformity (P), 2. Public and private funding issues (P), (3) Increased market dynamics (E), (4) Privacy and security concerns (S), and (5) Increased knowhow and ICT developments (T).
RQ3b.: What activities does TNO perform in the current e-health innovation domain?

TNO performs a wide range of activities focused on developing, sharing, applying and valorizing knowledge in different domains. Therefore it is a multidisciplinary company with a lot of in-depth expertise fields, as well in healthcare. TNO has formally not included care innovation as one of its propositions, and lacks the skills to synthesize its in-house knowledge. This clarifies the ambiguity on TNO’s activities in the e-health domain.

Therefore we have mapped TNO’s Centers of Expertise and these in Information Society and Healthy living. As TNO is positioned in every node we conclude they are capable to perform activities in every cycle of change. In the soft sciences cycle their main activities are business model development, e-health vision formulation and policy development. In the hard sciences cycle departments perform applied scientific research into new sensor technologies, technical interoperability by means of vital ICT infrastructures and network technologies, all enabling to e-health. In the differentiated valorization cycle TNO’s social and behavioral departments go in-field to co-design, contribute to implementation and valorization, evaluate end-users’ satisfaction and analyze how to overcome scale up barriers. In the integrated engineering cycle the technology assessment takes place, as well as the demonstrator development. Actual product development is left to the commercial parties, currently mainly SMEs. In the middle node the main activities TNO performs are project management, quality management and business development.

RQ4. How does an image of the desired future of the Dutch e-health innovation domain and its service innovations look by 2020, based upon TNO’s perspective of 2015.eu?

The absence of an entrepreneur at the vision development level (CIM level 1) of the Dutch e-health innovation domain, results in lack of a common agenda. Therefore the image of the future of the Dutch e-health domain by 2020 is described with high level statements like: An improved quality of life of Dutch citizens can be expected. On the lowest levels we find first steps towards implementing these visions: Healthcare professionals, patients and policy makers are expected to pay increased attention to new e-health developments, and will have by 2020 an increased understanding of the priorities in the care domain. We can conclude no uniform vision for e-health can be based on 2015.eu, without translating and prioritizing 2015.eu’s agenda first. 2015.eu’s agenda does not develop solutions itself, but it establishes the mechanisms to develop solutions. The two fields in which breakthroughs are envisioned, referred to most often were the e-prevention field and the e-support field.

From interview part 1 it follows how the innovation system should look to realize the 2020 future interviewees envisioned. At the beginning a product-service innovator is needed, in particular a SME which can launch new products with a short time-to-market. But also large companies are needed with a bigger R&D budget, able to execute longer innovation trajectories resulting in more radical innovations. Market players should also be present from the start, like health insurers and housing corporations that feel the need to do something with ICT in their service provision. An important reason for health insurers is to differentiate from each other. At a later stage a RTO like TNO can join to act as intermediary, point out the contribution of individual interests to the common goal. Furthermore they can stimulate municipalities to get involved as launching areas. For alpha and gamma universities furthermore a role is envisioned to determine new application domains. We conclude by stating there is a role for technical universities (and RTOs) in terms of technical knowledge development, when the innovations are perceived as too risky by industry. Research divisions from
large companies (e.g. Philips research) can still participate with this more fundamental research. At the entrepreneurial node a market player (health insurance company) is envisioned, balancing both social and commercial stakes, focus on availability of financial means, are in need for change to differentiate from each other and have a large network in the care domain.

The e-prevention service innovations focus on preventing care consumers from situations negatively influencing quality of life. This can be prevention of unhealthy lifestyles by means of enabling coaching services, or prevention of social exclusion and insufficient healthcare provision by increasing the role of the community in this. The Smart Coaching project is a first step in the transition to realize e-coaching services, and the WeCare project is a first step in the transition to an increased role and value of the community, both indicating at a future for prevention breakthroughs. Characterizing for the SC project positioned in the industrial development stage, is to start with analyzing how an individual’s life looks, and next how it can be supported. This makes the SC project vision driven, suiting for a pre-competitive project. Expertise is next applied to work on a solution making SC project knowledge driven. A social party that can fully represent the public interest should be involved at the beginning to avoid adoption problems later on. Commercialization barriers are removed upfront. So the social transition node and the social scientists are dominating.

Expectedly for the WeCare project positioned in the experimental development stage, is to involve a social party at the beginning, to customize the final product. However with the WeCare project technology partners were acquired first since existing relations existed. It is business case driven project, as the e-health product is already developed, and insights on business cases for the private partners feasible. Commercialization barriers are removed upfront. So the emphasis is in the soft sciences cycle and differentiated valorization cycle, making social scientists, social partners, and product-service innovators most relevant.

The e-support service innovations focus on the desired future in which an e-health enabling infrastructure is realized, such that e-health support solutions like a PHR can be implemented. eHealthNu project and eCardioCare project, both positioned in the scale up phase, are focused on detecting and demolishing the implementation barriers of e-health in the Netherlands, so by 2020 large scale adoption is enabled.

eHealthNu project is a pre-competitive project positioned in the early scale-up stage. Commercialization barriers were not successfully removed upfront. Therefore the aim is to identify the scale up barriers, and make a start with demolishing them. Market partners were acquired first to determine what can go wrong when launching their products (market driven), since they have a large network in the care domain. The social scientist and market players are dominant for this project, performing most activities in the soft sciences cycle and differentiated valorization cycle.

eCardioCare is a competitive project positioned in the late scale-up stage. The e-health innovation still needed to be adopted in the individual’s daily living pattern, so commercialization barriers were not successfully removed upfront. The society should be involved at a later stage, as soon as medical experts are convinced of the e-health service, they can on their turn convince patients. The product-service innovator Philips was acquired first, making this project clearly business-driven, despite it was governmental initiated by means of a Call for proposal for scale up.
RQ5. What transition path can guide the change from current situation service innovations towards the envisioned state in 2020?

We conclude from chapter 6 that the largest problem perceived currently is the process how to get from the current actions, to the e-health 2020 futures.

The transition path defines what e-health service innovation processes in the e-health are needed to reach the future e-health image by 2020. It should be seen as a means to reach the future and not as goal on itself. The transition path is iterative and interactive, so that continuous feedback can take place between the e-health futures (e-prevention and e-support) and the present actions, to make sure that by executing the e-health service innovation processes the e-health futures will be reached.

To reach the e-prevention future image by 2020, one transition path should focus on realizing e-prevention breakthroughs, as is the case with WeCare and Smart Coaching. The transition path reaching the e-support future focuses on removing barriers such that the possibilities the ICT infrastructure brings can be exploited by 2020. eCardiocare and the eHealthNu project focus on detecting and demolishing barriers for scale up.

RQ6. Which roles can or should TNO take in different innovation systems in the e-health domain?

We distinguish between different roles that TNO should play: 1. TNO’s role at CIM level 1 in the e-health innovation domain, 2. TNO’s role at CIM level 2 in different service innovation processes of the e-health innovation domain, 3. TNO’s role as expert in innovation system development.

In this research we have seen that the implementation of 2015.eu’s agenda in the e-health innovation domain can be supported by the innovation systems that already exist there. At CIM level 1, an independent party like TNO can translate the main concepts of 2015.eu’s agenda and prioritize them according to what the Netherlands will benefit from most in terms of economic growth and quality of life. Secondly, the independent party (TNO) will develop an agenda with concepts enabling a common understanding of the direction to go in the e-health innovation domain (National Implementation Agenda on e-health), in which 2015.eu’s priorities for the Netherlands are incorporated. This will provide direction to the main parties in the e-health domain to do something with 2015.eu’s agenda, in the execution of the eHealthNu platform (CIM level 2). A last step, certainly not to forget, is to monitor progress on 2015.eu’s implementation by means of monitoring the indicators aligned with former EDAs’ implementation obstacles.

By getting involved from the beginning in the implementation process of 2015.eu’s agenda, TNO obtains a strategic position, giving possibilities to exert more influence and act as an expert by advising other countries how to implement it. By means of a strategic position in 2015.eu’s agenda’s implementation TNO can contribute to demolishing the implementation obstacles of former EDAs, and monitor if those will not occur again for 2015.eu.

Next we give the roles of TNO in the different stages of development of the e-health service innovation processes of the case study. These roles are limited to the process model, CIM level 2.

Fundamental development stage – TNO’s role will be the entrepreneur of fundamental projects, since TNO is contributing to set priorities for the research areas of the CoE interesting to society, as well as connecting disciplinary sciences, technology sciences, and industry.
Industrial development stage – TNO’s role in the integrated engineering cycle is significant with SC project, since TNO aims to integrate the knowledge obtained in the left part of CIM into product-service innovations that benefit the whole society. TNO can take the role of entrepreneur or researcher during the industrial development stage since it has proven its capability to be project manager and coordinator of large pre-competitive multidisciplinary projects. As explained before main challenges on e-health innovation lie within the soft sciences cycle, giving TNO a dominant position there as well. By means of SC project TNO is still working on improving its acquisition management skills and relation management skills.

Experimental development stage – The WeCare project is a pre-competitive project as well. Therefore TNO can play a role as entrepreneur, both as business developer and project manager. TNO is a suitable party to respond to a Call for Proposal, since they can represent interest of both the social and market side. A government driven project prefers to have an independent party like TNO involved. TNO acts as analyst, contributing to the development and execution of pilots. Furthermore developing business models is important, to avoid problems in next phase. TNO has specialists in this field. TNO can improve its contribution as an expert by practicing what it preaches, so using its employees as launching area. The aim is to hand over the management of the innovation system to a commercial player at the end of this phase, as entering the commercialization stage as independent organization will harm its reputation and is against its principles.

Commercialization stage – TNO has given away its entrepreneurial role to a commercial player that it has already cooperated with during the experimental development stage of the e-health service innovation project, or to a TNO spin-off if there is no interest shown by commercial partners. After the pilot phase lack of private funding is an often occurring problem. This is caused by the lack of a clear business case and not enough commitment of the private companies. By contributing more in terms of knowledge / financial means, commitment will increase.

Scale-up stage – By being entrepreneur in a scale up project, TNO has taken a process-activating role. A distinction can be made between early scale up and late scale up stage. eHealthNu project is in the early scale up stage, which is pre-competitive. Therefore TNO could have been the business developer but Menzis established the consortium. TNO became project manager. Detecting e-health scale up barriers was the main activity (soft sciences cycle).

For the eCardioCare project in the late scale up stage, demolishing the scale up barriers is emphasized. TNO has initiated this competitive project and is again process-activating, since the application field is broader than the scale up of one single e-health product. TNO’s contribution resulted in increased attention to the scientific side which benefited the project. Expectedly, the Call for Scale up funding was less easy received by a commercial party again. Furthermore TNO contributes to new application opportunities in fields with complex innovation processes like healthcare. Its activities will therefore mainly take place in the differentiated valorization cycle.

Remarkable is that in the answer to RQ4 we explained RTOs are envisioned to not take part as business developer, since their technology development is too slow to fulfill the changing demands in the dynamic environment. Still, TNO has initiated three out of four of the e-health service innovation processes. We can however argue that since Smart Coaching, WeCare and eCardioCare are all partially funded by government instruments, this changes the situation. Particularly as TNO is the only
organization in the Netherlands able to get the EZ-Co funding, and when pure commercial oriented companies go for the Call for proposals, they have more difficulties to get their proposal accepted as well.

Finally we state that TNO can exploit a new business opportunity by becoming expert in innovation system development. During this research we have emphasized the significance of innovation systems to the successful execution of innovation processes, like in terms of transparency in responsibilities. TNO is ahead in terms of the awareness of the existence of innovation systems and the advantage that mapping innovation systems can bring to successful project execution. By means of this TNO can differentiate its business from universities, and improve its own coalitions.

By combining the answers to the RQs above the central research question can be answered:

**How to develop innovation systems for the Dutch e-health domain based upon Europe’s Digital Agenda 2010-2015?**

In order to develop innovation systems for the Dutch e-health domain to the accompaniment of Berkhout’s Cyclic Innovation Model, the following counterclockwise order of stages in the development process at CIM level 1 should be followed: (1) Vision development – (2) Cyclic process model development – (3) Transition path development. The stages of the innovation system development procedure of section 8.2 are explained.

To follow this order has been selected since we wish to reduce the future vision images to be restricted by the e-health service innovation processes of the transition path the interviewees were currently active in, as well due to the lack of transparency on who are the major players in the e-health domain, making it important to first select the consortium members, and with this group formulate the transition path to execute to reach the shared vision.

(1) For the vision development 2015.eu’s agenda needs to be interpreted by an independent party, who next prioritizes the fields of 2015.eu’s agenda on which the Netherlands should focus. A distinction can be made between innovation priorities in the field of e-prevention breakthroughs, and innovation priorities in the field of e-support breakthroughs. 2015.eu’s agenda should be interpreted differently: 1. providing direct contribution to development of e-health services, 2. providing direction to what infrastructure is needed for the e-health services (e-health building blocks). The translation of 2015.eu’s agenda is translated further into priority areas for innovation for the Dutch e-health innovation domain, provided to the national government, local governments and industry. Therefore the independent party intermediates between different levels of aggregation. Both top-down and bottom-up initiatives are possible. TNO is capable to take the role of entrepreneur at CIM level 1. However, TNO should enhance its credibility in the care domain by clear positioning and increasing its network.

(2) Next the process model is established. The in-house knowledge is inventorised, for which a party’s expertise and activity portfolio is the most important factor. In-house knowledge can be used to convince potential partners to join as this will benefit the quality of the end-products and bring learning effects which result from cooperating in a consortium with a large in-house knowledge. From the case study personal relations turned out to be more valuable to the innovation system development than factors like in-house knowledge. For all cases the first partner that was acquired
used its strong relations with the others to build the innovation system further, so a large personal network turned out to be highly important for acquiring the next partners. Consortium innovation is an often returning factor as well, since parties acknowledge the importance of an influential innovation system to realize successful care innovations. After this inventorisation the potential partners are approached, and this process repeats until a sufficient knowledge and funding base is retrieved. By means of detecting the system errors of the innovation system established, lessons can be learned for future. TNO is only capable to take the role of being expert in innovation system development under condition that it improves its knowledge management skills, its in-house knowledge management, increases its network in the care domain and its sales power. Due to the lack of synergy between its own multi-disciplinary departments TNO’s credibility to become expert in this field is currently low, so a reputation boost is needed.

(3) To engineer the transition paths, first the goals are set for in-between stages of the transition path. Next new ideas for e-health service innovation processes are proposed. The factors that followed from the comparative case study to have influence on idea generation are personal commitment, secondly party’s policy and thirdly party’s expertise. Next the innovation processes are selected and confirmed with the goals set as well as confirmed with the initial e-health vision generated in step 1. From this, knowledge is gained on what should be outsourced such that sub-contractors can be approached. At Go/No Go 3, the stage gate keeper decides when enough knowledge and other resources are gained. Therefore the project kick-off can take place. As TNO is qualified to set priorities in the field of e-health innovation for both (local) governments and industry, we expect them to be capable of developing the transition path. However, as other parties in the care domain do not perceive TNO as capable to come up with radical technology breakthroughs satisfying changing demands, TNO should win the trust of others by proving the contrary.

10.2 CONCLUSIONS

In this research the CIM has been applied for several illustration purposes, for which its uses will be evaluated: (1) to map the current/future e-health domain, (2) to map the innovation systems of the cases, (3) to prescribe the steps to take when developing innovation systems for the e-health domain.

The following conclusions can be drawn. By applying CIM to map the current and future e-health domain, we have found some strengths and weaknesses of the current innovation domain, and strengths and weaknesses of the desired e-health innovation system by 2020.

First the innovation systems of the current e-health domain have been analyzed. The majority of interviewees recognized innovation systems in the current e-health domain, or some similar concept like consortium. However, there exists no common awareness on who are the main players in the e-health domain. This expectedly negatively impacts developing innovation systems. Therefore the knowledge and experience present amongst players in the current Dutch e-health domain is not optimally exploited. Both CIM level 1 and 2 are analyzed. The main conclusions are that there is a lack of a common vision on e-health, lack of a common agenda on e-health innovation as there is no entrepreneur CIM level 1, a lack of insights in external trends like the financial instruments available for e-health innovations. In terms of CIM level 2, a vertical communication barrier exists between scientists and SMEs, a horizontal communication barrier exists due to late involvement of the society with new developments, and a passive society towards their own health. Health insurers should be
triggered to offer preventive e-health solutions, which they are currently reluctant with before medical/business evidence has been given.

Secondly the innovation systems of the future e-health domain have been analyzed. In terms of CIM level 1, the interviewees perceived difficulties to formulate a common vision for the e-health future based on CIM. Therefore we can conclude that the lack of common vision based on 2015.eu’s agenda is not only EDA’s fault, but also a lack of the CIM model not prescribing activities to get to the development of the vision, transition path or process model. In terms of CIM level 2, the same system errors were detected as with the current e-health domain. The lack of entrepreneurship at CIM level 2 should be filled by a combination of SMEs, health insurance companies/ and RTOs. Particularly health insurance companies are hard to involve with e-health innovations, since they demand business evidence.

The system errors that have occurred for the cases were mainly at CIM level 1. We have seen TNO takes a central role at CIM level 1, therefore it can work on demolishing these system errors like a lack of a common vision, difficulties with translating CIM level 1 into CIM level 2, lack of an overall program manager bringing forward a common e-health vision, and a lack of capabilities to execute tasks assigned. At CIM level 2 we see a horizontal communication barrier pointing out demand-pull (Municipality) and tech-push (TNO), and at a vertical communication barrier pointing out scientific push by scientists (TNO) and market-push by product-service innovators (Philips).

CIM has proven its added value as heuristic to prescribe the steps to develop innovation systems for e-health (previous section), as well as that CIM can structure the approach to smoothen implementation of 2015.eu’s agenda. If the implementation process will go smooth when using the steps proposed, has not been evaluated during the course of this research.

10.3 SCIENTIFIC IMPLICATION AND RECOMMENDATIONS

We start with the scientific implications. The RQ still unanswered up till now is the following:

**RQ7: What insights are gained from implementing the selected innovation system framework?**

This RQ will be answered based upon our case study. The points below can have two purposes: First, to explain how the CIM theory could have been of better use to this research, and secondly, what propositions to improve the CIM theory can be derived from our findings. In order to do so we confirm if the strengths of the CIM fulfill the selection criteria of chapter 4. As our case study only includes four cases, further research is required to confirm the insights gained.

1. **CIM AS AN ACTOR ORIENTED MODEL**

As this research’s aim was to analyze the role of TNO in different e-health cases, the CIM model fulfilled the actor oriented model requirement. The different nodes of change were used to map the different e-health service innovation processes, and the development towards their innovation systems. Besides using CIM level 2 for managing the actors in the process model, we also managed TNO’s in-house knowledge by mapping the departments. This was not intentionally done upfront, but as a consequence of the lack of transparency of the activities of CIM in the cycles of change. Therefore we found another purpose of CIM managing knowledge, not initially opted for with this research.

2. **CIM AS MODEL WITH MULTILEVEL OF ABSTRACTION**

In terms of different levels of abstraction, CIM fulfilled the needs of this research. We were able to
evaluate the e-health innovation domain both at vision level and at national/local implementation level, and evaluate the interaction between those two domains. We found the translation from vision level (CIM level 1) to implementation level (CIM level 2), not always goes smoothly, making it necessary to stress the importance of starting to develop the process model at an early stage, even before the transition paths are engineered. Furthermore CIM cannot determine if the vision set at CIM level 1 is too optimistic. We conclude this from the fact that some of the action points of 2015.eu’s agenda for 2015 are certainly not feasible. We recommend to develop the process model directly after the vision has been developed, to assure that the transition path can be formulated with enough experts to notice if it is not feasible to reach the vision.

3. **CIM AS A MODEL PRESCRIBING ENTREPRENEURAL ACTIVITIES**

As we have explained in the selection of the theory, the use of different levels of abstraction and different levels of aggregation becomes clear if entrepreneurial activities are performed connecting different levels. The strengths of the CIM model to support this purpose have been proven, since TNO intermediates local, national and EU level initiatives (aggregation levels), and it intermediates between the e-health domain vision development level with the process implementation level (abstraction levels). Furthermore TNO as entrepreneur CIM level 1 aligned the interests to formulate a common vision, and at CIM level 2 the cross-disciplinary entrepreneurship resulted in alignment of the activities performed in the different cycles of change. However to simplify the innovation process management, it would have been of better use if CIM could map entrepreneurial activities instead of just containing an entrepreneurial node.

4. **CIM AS AN ITERATIVE INTERACTIVE MODEL**

Since CIM works with cycles of change, the feedback and feed-forward of the different nodes of change, could be mapped. CIM assumes iterative interaction is appreciated under any circumstance, particularly when is opted for radical innovation and implementation in society. However resistance to change by elderly can be an issue, since their needs are not properly addressed within a dynamic environment. Therefore the iterative approach chosen for co-design with a group of seniors was not appreciated by them [Sharon Prins (TNO), 2011]. Seniors are not fond of a dynamic changing environment, in which a product is adjusted right after they can use it. From this we conclude that the amount of iterations allowed, should be regulated depending on which target group is focused on. The disadvantage of this is however that the strength of using an iterative interactive model is taken away.

Furthermore we have recommended the entrepreneur to develop a list of indicators to evaluate the progress of the implementation of 2015.eu’s agenda and e-health in the Netherlands. Since CIM is an iterative interactive model, its execution is continuously therefore no stage-gates are defined. Therefore we recommend inserting some clear stage gates at which evaluation of the process can be performed by the entrepreneur. At the cases various times the deficiencies of the process where detected afterwards resulting in system errors, which could have been prevented.

5. **CIM AS A MODEL CONSIDERING INSTITUTIONAL FACTORS**

Institutional factors, in particular governmental regulations, have a dramatic effect on the dynamics within and between the networks of e-health service innovation processes. Ultimately, institutional factors determine the maximum rate of circulation that can be realized along the circle. Therefore, governments can exercise enormous influence, in both a positive and a negative way [Berkhout et al., 2006]. A limitation of CIM is that it does not explicitly consider institutions. If CIM would have considered institutional factors, we could have based a prediction of the policies for 2015.eu’s agenda.
for 2015-2020 on it. By circumscribing the market forces to a certain extent, as well as creating frameworks supporting e-health and finally intervene with the market dynamics by means of R&D subsidies, the government will influence the dynamics in the e-health innovation domain. We recommend for future to indicate the government’s direct influence on each of the nodes of change, and also the feedback from the nodes, like lobbies that have been raised. We recommend an outer circle surrounding CIM level 2 to represent the government (Figure 45). By not including the government as the entrepreneur, no influence on fields other than the institutional regulations is given. This is desired as given by the commercial interviewees of interview part 1 and therefore provides a grip for the other parties to deal with the government. Furthermore positioning the government in the social transitions node is not feasible, as this position lacks authority to execute its institutional regulations.

Figure 44: CIM level 2 including direct feedback between all nodes

Figure 45: CIM level 2 including governmental influence

6. CIM AS A MODEL PRESCRIBING BEST PRACTICES
CIM cannot be used as a grip to provide a ranking in the activities defined, such that best practices become visible. As where Hekkert et al. (2007) prescribe functions, activities, and the order of activities to be performed by means of the motors of change, CIM does not provide grip for this. The CIM model and Hekkert’s Technical Innovation Model can be combined. Van der Duin et al. (2007) state the difficulty of defining best practices valid for each type of innovation system, is that innovation systems have a dynamic nature and therefore change over time. This is certainly the case with our cases selected, all positioned in a different stages of the innovation process. Furthermore Van der Duin et al., (2007) state the CIM model main focus is on exchanging knowledge and information, not on how individual organizations can improve their innovativeness. This clarifies our research based on CIM mainly arrived at prescribing the position of TNO in the innovation system, less on prescribing TNO’s individual organization’s strategy, as in what business it should focus on. This same we can argue for the lack of the unified vision in chapter 6. If CIM level 1 would have provided more details on to steps to take to formulate a vision, this can bring great added value to both translating 2015.eu’s agenda and a national agenda on e-health.

7. CIM AS A MODEL WITH DIFFERENT LEVELS OF AGGREGATION
CIM takes into account different levels of aggregation since three levels are mentioned: EU level,
national level, regional level. As explained TNO is involved in initiatives in each three levels, intermediating between them, since TNO believes for successful implementation of 2015.eu’s agenda a bottom-up approach will suit better than solely working top-down.

8. CIM CONSIDERING MONEY FLOWS
In chapter 3 we determined the obstacles “lack of well-founded business cases” and “complex financial EU level instruments.” In chapter 5 we furthermore saw the opposite valley of death (problems with public and private funding) as factor influencing the implementation of e-health in the Netherlands. Thereby an interesting selection criterion to include in chapter 4 would have been to search for a model that explicitly considers money flows. Berkhout et al., (2007) state that a successful innovation cycle emphasizes regular launches of new products, and a successful life cycle (daily business) ensures that the innovation cycle receives financial means at a regular base, to innovate. Since the radical innovations induced by CIM are developed in the innovation cycle, not the life cycle, the CIM not explicitly pays attention to finances. By dividing the STOF model over CIM’s cycles of change, it is possible to more systematically analyze the activities that should be performed with the innovation processes. The four perspectives of the STOF model: Services, Technology, Organization, Finance), defined by Bouwman et al., (2008), correspond to the four most important factors we have determined at the end of section 8.3.1 pointed out as being indispensable for a project’s successful completion. The finance perspective can be emphasized in each of the cycles of change. Figure 32 described the financing of healthcare in the Netherlands. An interesting thought is whether it is possible to describe the money flows in terms of CIM level 2, just as is done with TNO’s in-house knowledge in Figure 27.

From these selection criteria we determine that mainly the top 4 of the selection criteria is aligned: CIM is as an actor oriented model, CIM deals with multiple levels of abstraction, considers entrepreneurial activities and is iterative and interactive so that the action-reaction feedback loops are transparently shown. Not fulfilled are the criterion considering institutions and prescribing best practices. Next we have listed some general practical implications found from the case study analysis.

9. NO BALANCED INVESTMENT
Berkhout (2000) states successful innovation results from balanced investments in all four cycles, as a result from the strong interdependencies. Based upon our analysis of the cases this premise is rejected. For each case positioned in a different phase the emphasis was at one of the cycles of change, so certainly no balanced investment in all. Since the division of Figure 41 was valid for the cases, we assume the division of the fundamental and commercialization development stages on which we did not do any case study in CIM to be sounded as well. Furthermore from interview part 1 it was concluded that a balanced investment in all cycles of change from the beginning will result in only incremental innovations.

10. SYSTEM ERRORS IN TERMS OF CIM
The classification of system errors of Figure 17 mainly focuses on the absence of relations between nodes. We noticed it is undesirable if activities in the cycles of change are performed, however parties’ roles not formalised. This was the case with the discussion on incorporating the control group members in the project group, and make them responsible for activities or not. By formalizing the roles we mean to make them officially by explicitly agree on them and register them. The innovation system will operate more effectively if different partners know what to expect from each other in
11. BIAS TOWARDS MARKET AND TECHNICAL ASPECTS

The CIM model has a bias towards market aspects as well as technical aspects, and less considers the social point of view. We start with the bias towards technology. According to the definitions of an innovation system, Appendix A: List of terminology, Berkhout et al., (2007) state: “The function of each innovation system is the generation, diffusion and usage of technology.” Berkhout et al. (2007) also refer to the following statement by Jaffe and Lerner, (2004): “The single biggest factor determining the rate at which a society improves its ability to deliver human wants and needs is technological innovation”. From our research, we conclude however cultural innovation is highly relevant to create social adoption for the e-health services by 2020. Therefore we can state Berkhout’s CIM is too technology-oriented to fully suit this research. The images of the future envisioned at CIM level 1 also indicate technological innovation, from which we conclude CIM does not cover different fields of innovation which is again another limitation. The bias towards technology by CIM is shown as scientists as well as the technologists are represented in separated nodes, while social parties and market parties are put away together, in what we called in this research the social transition node 42, however Berkhout et al., (2007) define the bottom node as the market transition node, in which social parties are supposedly covered as well.

Next we consider the bias towards economic aspects, again as a consequence of the underrepresented social actors. This is aligned with the definition of Lundvall (2010) of an innovation system, stating that the knowledge generated by the innovation system should be “economically useful.” Research is required into possibilities to increase the involvement of social transitions. We recommend to investigate possibilities of including a social transitions node next to the market transition node. By doing so we can clearly distinguish a cycle of change on business-to-business (B2B) relations between the health insurers and the product-service developers, and a cycle of change dealing with the business-to-consumer (B2C) relations, between the health insurers and the care consumers (patients).

Furthermore we expect that by creating direct feedback between society and technology developers, as well as between scientists and product-service innovators, a smaller chance exists on horizontal and vertical communication barriers to occur. Currently only indirect connections are made between those nodes (Figure 44).

10.4 PRACTICAL IMPLICATIONS AND RECOMMENDATIONS

Recommendations on TNO’s roles both with implementation of 2015.eu’s agenda, at CIM level 1, and at CIM level 2 were given in RQ6. We recommend TNO to aim for the positions defined for the different development stages of the innovation process.

The recommendations for TNO to strengthen its position, based on the roles stated in the answer to RQ6, are as follows:
1. Become more demand driven in its funding and operations
2. Improve its knowledge management skills
3. In-house knowledge management
4. Improve its skills to sell the business idea and acquire partners
5. Improve its skills to acquire co-funders for an EZ-Co project
6. Improve its relation management skills
7. Increase its knowledge on public funding instruments
8. Increase its network in the healthcare domain
9. Improve its credibility in the healthcare domain creating transparency on its position
10. To gain independency by clearly stating what is and what is not part of its activities
11. Eat its own dogfood to increase credibility
12. Develop/carry forward an e-health vision (agenda) to get others on the right track
13. Develop a clear approach on organizing steering/control group responsibilities
14. Deal with the complexities of being large

Next we continue with the practical implications.

- Since the results are based upon TNO’s internal ambitions and capabilities, generalizing the role we have prescribed for TNO to other organizations, is not valid. For example, for a commercial company the plan of action is expected to look differently.
- Since the results are based upon the e-health domain, generalizing the results to other domains without confirming cannot be accepted. The market dynamics in the healthcare field differ from those of the other fields, which might influence the roles TNO can take.
- Recommendations concerning TNO’s capabilities to work on translating 2015.eu’s agenda’s concepts are purely based on opinions of interviewees in the Netherlands. We therefore not assume TNO is the only suitable party to do this, at EU-wide level other qualified organizations (RTOs) exists.
- We have selected TNO e-health service innovation processes, to fulfill the criterion of information-rich cases. The bias here is that our conclusion that TNO can be the entrepreneur of new service innovation processes in the e-health domain is based upon a case study for which TNO has been positioned as the entrepreneur with every case.

10.5 LIMITATIONS AND FUTURE RESEARCH
The limitations and propositions for future research are finally discussed. We start with the reliability and validity of this research. Next, remaining limitations are provided. The limitations given are directly translatable into the recommendations for future research.

For the case study findings a reliability, construct validity, internal validity and external validity check were performed [Yin, 2003]. We defined these as follows [Van der Velde, 2004; Yin, 2003]:

| Reliability: | Extent in which results can be retrieved from repeating the same operations with the measurement instrument. |
| Validity: | Do you measure what you have intended to measure. |
| Construct validity: | Extent in which the content of the measurement instruments represents all relevant aspects of the concept. |
| Internal validity: | Extent in which the results accurately cover reality in terms of the extent to which |
alternative explanations for causal relations have been taken into account.
• **External validity**: Establishing the domain to which the results of the study can be generalized.

**RELIABILITY**

The following steps were taken to assure reliability of the results of this research:

In a case study, the most important method to assure reliability is the development of a case study protocol, as this protocol contains procedures and rules that should be followed in using the measurement instruments. A prescribed approach is used, which makes repetition possible. **Appendixes B and E** cover the details on the interview protocols that have been used. By following the approach given in Chapter 2, complemented with the interview protocols of **Appendix B** and **E**, reliability is enhanced. The amount of TNO interviewees exceeded the amount of any other organization’s interviewees. Therefore less multi perspective was reached than was hoped for. The envisioned role for TNO has become more ambitious, referring to what TNO employees were wishing for. As we aimed to interview at least one representative from each of the parties involved with the service innovation process used for case study, reliability was enhanced as well due to multiple snapshots from different perspectives. Unfortunately this was not always possible due to reasons named in interview protocol 2. This resulted in a bias towards the perspective of the project managers, which we had interviewed at every case. Furthermore the reliability of the conclusions for a case was influenced by the small amount of interviewees. However, we used TNO project documentation to support our findings.

Stability of answers within certain time period or stability over time was not measured as we only interviewed the majority of the interviewees once. Furthermore we opted for a group discussion on the results, which was eventually assessed as infeasible. However, by sending the interviewees the interview results afterwards, participant feedback was received. Unfortunately no reinforcing feedback was received from all interviewees, however we could still conclude that perceptions had not changed. This outcome was expected since the timeframe between the interview and sending the results was a few months. Since we have performed a future prediction of the 2020 e-health domain, the interviewees were not always capable to answer, such that questions needed to be adjusted. This suggests the great uncertainty of what to expect, even by senior managers and senior experts. We anticipated on this by adjusting the questions, as explained in the pilot interview section of **Appendix B**: Interview protocol exploration.

**CONSTRUCT VALIDITY**

Construct validity could be influenced by investigator subjectivity. Yin (2003) proposed three remedies to counteract this: Using multiple sources of evidence, establishing a chain of evidence, and having a draft case study report reviewed by key informants. All these three conditions have been applied to this research.

In this research we tried to act as neutral data collectors [Hoepfl, 1997]: “Non-judgmental and strive to report what is found in a balanced way”. To do so raw data will be noted, so that interpretations can be attributed to their sources. Raw data was noted, so that interpretations were attributed to their sources [Hoepfl, 1997]. Raw data like interview notes, interview transcripts, and results were collected. Interviews had been taped and fully transcribed to confirm completeness of the information used. For
that same reason besides mental notes, field notes had been taken during the observations at the Conference day. For documenting the findings of the interviews an interview summary has been made from the recorded interviews. The coding of the interviews had been peer-reviewed, moreover enhancing reliability.

After the data analysis our own interpretation was confirmed with the interviewees, to assure adequacy.

Only after the interviews of interview part 1 had been conducted, we decided to narrow down to e-health domain instead of focusing on the full e-healthy living domain. This made some parts of the data collected redundant. Since the e-health domain was the sub-domain of e-healthy living most commonly known amongst interviewees, the answers were mainly focused on this already. However, when we perceived not enough details were provided on the specific case of e-health, we approached those particular interviewees, and therefore we still managed to get the data we had wished for. Therefore we diminished the impact of this limitation of our research on the construct validity.

INTERNAL VALIDITY

As with the case study in-depth information is retrieved from the interviews, and flexibility is high (open questions), internal validity is high for case study data collected. However "distortion due to strategic answers" [Verschuren and Doorewaard, 1999], is expected to have negatively impacted this research’s results. As we have explained in the interview protocol part 2, we were not able to interview more than the project manager of some e-health service innovation processes, negatively impacting internal validity as a project manager has another view on how cooperation in the project goes than the project participants themselves.

EXTERNAL VALIDITY

The dilemma we faced with the case study is explained by Verschuren and Doorewaard (1999): Studying only a few cases is needed for achieving in-depth knowledge, however it is more difficult to apply the results to a broader population or to similar cases. However Verschuren and Doorewaard (1999) state that with practice-oriented research, this is often of less importance as often a particular organization is studied. For us this is partially the case as well, since we determined the role for TNO in particular. However we can argue that this role might be valid as well for other RTOs. The steps in setting up innovation systems we gave are based on the four e-health service innovation processes used for the case study. Since the factors we determined that influence the parties’ choices to join a consortium or not, are of more general character making them seem not e-health domain specific, the steps might be applicable to other domains as well.

We end this chapter with the recommendations for further research that follow from the limitations stated in the reliability/validity analysis.
### Limitations

<table>
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<tr>
<th>Limitation</th>
<th>Recommendations further research</th>
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<tr>
<td>1. No empirical evidence this method of innovation system development works</td>
<td>1. Real life implementation of this method. If we would have another 6 months, we would perform another case study in which we would compare the current approach, and the new approach, and verify if the process for setting up innovation systems under guidance of CIM, will result in projects with better results and a more efficient execution process. We can also improve or extent this research’s results.</td>
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<tr>
<td>2. Only 4 cases used to create external validity</td>
<td>2. By using a larger sample of cases, and more interviewees per case, generalizability (external validity) is enhanced. Furthermore with the selection of the cases, it should be taken into account that TNO is not entrepreneur of all cases already, as this might cause a bias with respective to their advised role. A better balance in the division of interviewees selected from different organizations should be taken into account as well. We can again improve on this research’s results by improving or extending it.</td>
</tr>
<tr>
<td>3. Only one sub domain of e-health is used to obtain case study results.</td>
<td>3. The results of this research can be extendable to other domains in the Netherlands, and on the long run to an international base. TNO can become expert in guiding other countries with the implementation of 2015.eu’s agenda.</td>
</tr>
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<td>4. Prediction only goes up to 2020. Nico van Meeteren (TNO) does not have high expectations in terms of ICT developments: “Two innovation experts at TNO calculated it takes about 17 years before an innovation is innovated and implemented in a market like the healthcare market”. So as the future prediction of this research is limited to 2020, there can be no expectations of radical system transitions according to him.</td>
<td>4. Use a larger time frame (&gt;17 years) to assure radical system innovations can be realized in the e-health domain. However, it will be even more difficult for interviewees to come up with a grounded prediction.</td>
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Ultimately the managerial implications and the theoretical implications explained before, also provide possibilities for future research.
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**PERSONAL INTERVIEWS**


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**QUESTIONNAIRES**


**WEBSITES**


APPENDICES

APPENDIX A: LIST OF TERMINOLOGY

Cluster – “Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate. Clusters, broader than traditional industry categorizations, capture important linkages, complementarities, and spillovers in terms of technology, skills, information, marketing, and customer needs that cut across firms and industries. These externalities create a possible rationale for collective action and a role for governments” [Porter, 2000].

Disadvantaged people - “Disadvantaged people are defined as individuals having at least one of the following characteristics: aged 55-74, those with a low level of education (ISCED 0-2) and/or out of the labor market (unemployed, inactive or retired)” [EC-INFSO, May 2011].

Ecosystem – “An industrial system that relies on co-operation between the actors involved, in that they use each other’s waste material and energy as resources and in this way minimize the system virgin material and energy input, as well as the waste and emission output” [Korhonen, 2000].

e-Health - “e-Health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.” [Eysenbach, 2001]; “e-Health is the combined use of electronic communication and information technology in the health sector” [WHO E66134, 1999].

Electronic Health Record (EHR) – “System that provides a structured, digitized, and fully accessible patient record created and maintained by healthcare institutions” [Smolij and Dun, 2006].

Empower - “Make (someone) stronger and more confident, especially in controlling their life and claiming their rights” [Oxford Dictionaries Online 1, 2011].

Independent living – “The ability for older people to manage their life styles in their preferred environment, maintaining a high degree of independence and autonomy, enhancing their mobility and quality of life, improving their access to age-friendly ICTs and personalized integrated social and health care services” [EC-INFSO, Oct 2010].

Innovation System - “Elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge” [Lundvall, 2010]; “The network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies” [Freeman, 1987]; “A heuristic attempt, developed to analyze all societal subsystems, actors and institutions contributing in one way or another, directly or indirectly, intentionally or not, to the emergence of innovation” [Hekkert et al., 2007]. “The function of each innovation system is the generation, diffusion and usage of technology” [Berkhout et al., 2007].
Interoperability – “The ability of the user of one member of a group of disparate systems (all having the same functionality) to work with any of the systems of the group with equal ease and via the same interface” [Encyclopædia Britannica Standard Dictionary Online, 2011]; “The capability of organizations to collaborate effectively in chains, preferably without requiring any human activity, by linking business processes through exchange of information between computer systems according to standards, system of concepts and protocols, particularly aiming to improve service provision and lower costs” [ECP-EPN, 2010].

Open innovation – “The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively” [Chesbrough, 2003].

Performance Indicator – “The measures that describe how well a program is achieving its objectives by telling what to measure to determine whether the objective has been achieved” [USAID, 1996].

Personal Health Record (PHR) – “System that provides a structured, digitized, and fully accessible patient record created and maintained by individuals” [Smolij and Dun, 2006].

Research and Technology Organization – “Organizations that as predominant activity provide research and development, technology and innovation services to enterprises, governments and other clients” [EARTO, 2010]; “RTOs are organizations with significant core government funding (25% or greater) which supply services to firms individually or collectively in support of scientific and technological innovation and which devote much of their capability (50% or more of their labour) to remain integrated with the science base”[Hales, 2001].

Structural Changes – “Includes changes in institutions, rules and the organization of the socio-technical system under study” [Quist, 2011].

Transition – “An important change in a functional system often involving multi-level changes through which society or an important societal subsystem fundamentally changes” [Frost, 2005], or “A transition can be described as a process of change from one semi-stable situation to another. It a common set of changes on different fields: technology, structure, institutions, behavior, culture and intentions” [Geels and Kemp, 2000].

Vision - “A vision indicates knowledge and foresight, and with that it provides a direction to go. The vision should be clear like a blueprint (clarity), have the support of all project- or organizational members (support) and it should be consistent over time (stable)” [Lynn and Akgün, 2001]; “The focus of a vision is not solely on financial improvements, but also considers development in satisfaction and fulfillment and with that improves quality of life” [Berkhout et al., 2007]; “Visions can be related to types of innovations and can also be linked to the process by which these innovations have been developed” [Van der Duin, 2006].
APPENDIX B: INTERVIEW PROTOCOL EXPLORATION

BACKGROUND

This interview protocol aims to reveal the future of the e-healthy living domain by 2020, which complies with the concepts of 2015.eu’s agenda. The interview method is used in this case as to stimulate creativity and out of the box thinking of interviewees so that their opinions, attitudes and observations are revealed. Literature reveals what will happen if we prolong existing trends and search for unbiased results, therefore limit the scope of radical breakthroughs. With this interview the interviewees shared their ideas on desired but still feasible future e-health domain in the Netherlands.

A semi-structured interview has the advantage of the flexibility to go more deeply into important matters, while a list of questions is formulated upfront [van der Velde, 2004]. A checklist with follow-up questions is made as well, dependent upon the expertise knowledge of interviewees per question. The interviewer is unbiased not having an interest in manipulating the outcome. A wide variety of parties interested is involved, all having different stakes. Therefore sufficient level of diversity in interviewees is required. The interviewees are selected based upon their familiarity with 2015.eu’s agenda and active participation in the e-healthy living domain. We expect management level interviewees to be better capable of forming a future vision as they are used to think on strategic level.

As this research particularly demands the image of the 2020 e-HL future based upon TNO’s perspective of 2015.eu’s agenda (RQ 4), the majority of interviewees will be from TNO. TNO interviewees include preferably TNO managers working on the themes of the Information Society or Healthy Living, as a vision on the complicated e-HLD can be outlined from various perspectives inside TNO as well. By choosing interviewees from industry as well a balanced distribution is created with sufficient diversity and with that reliability of the answers is enhanced. If involved with multiple professions the interviewees were casted as in their role of manager.

Table 15 provides the list of 5 interviewees, 3 from TNO, 2 external. The interviews took place between June 2011 and August 2011. We have selected interviewees that were sufficiently independent to formulate relevant, interesting and deviating opinions [Van der Duin and de Graaf, 2010].

Table 15: List of interviewees vision exploration

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Profession</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Dr. Ir. E.R. (Erik) Fledderus</td>
<td>Professor Electrical Engineering, Eindhoven University of Technology and TNO Director of Innovation Future Internet Use</td>
<td>2011, June 16</td>
</tr>
<tr>
<td>Ir. J.H.A. (Jean) Gelissen</td>
<td>Senior Director Philips Research, Strategic Partnerships Lifestyle and Action Line Leader of the action line Health and Wellbeing of EIT ICT Labs Eindhoven</td>
<td>2011, July 14</td>
</tr>
<tr>
<td>Drs. M.J. (Marc) van Lieshout</td>
<td>Senior researcher/advisor at TNO Information and Communication Technology. Expertise: Strategies for the Information Society</td>
<td>2011, July 5</td>
</tr>
<tr>
<td>Dr. N.L.U. (Nico) van Meeteren</td>
<td>TNO Director of Innovation Vital for Life</td>
<td>2011, June 24</td>
</tr>
<tr>
<td>Dr. Ir. P. (Patrick) Strating</td>
<td>Node Director EIT ICT Labs Eindhoven and Principal Scientist at Novay</td>
<td>2011, July 14</td>
</tr>
</tbody>
</table>

Since at a later stage in this research, after conducting the interviews, we have decided to narrow down to the e-health domain instead of considering the full e-healthy living domain, this interview protocol has been kept originally. The limitations in the concluding chapter discuss the influence of this on reliability/validity.
RESULT OF THE INTERVIEWS
The interviews provide information on the experience managers have related to:
- Current trends and main actors e-HLD in the Netherlands
- TNO’s activities in the e-HLD in the Netherlands
- The purpose of 2015.eu’s agenda. Opinions on the usability of 2015.eu’s agenda to e-healthy living.
- Future vision of the e-healthy living domain in 2020. This can be in terms of radical new ICT applications (services) and desired changes.
- The actors to realize this vision and characteristics of a party at the middle node of CIM.

INTERVIEW ANALYSIS
As in-depth interpretations are very important to qualitative interviews, analysis techniques focused on meaning (coding, categorization, deeper interpretation) are preferred over analysis techniques focused on language (linguistic analysis, conversation analysis, narrative analysis, discursive analysis, deconstruction) [Kvale, 1996]. Each interview will be transcribed in full first. As all interviews were recorded this was not time bounded. Before developing the interview questions corresponding code categories (not too broad, not too detailed) are invented and after coding more categories can be added by identifying common denominators.

Next the transcripts will be summarized by highlighting relevant parts and by adding contributing codes in the left margin area of the transcript. Meaning condensation is used while translating answers from Dutch to English, compressing long statements into briefer statements still rephrasing the main sense of what is said [Kvale, 1996]. The translated coded parts are put together and ranked according to the number of references to it by different interviewees. By doing so, conclusions of an interview are checked against other consecutive interviews. Each time a coded part does not fit with another, a new code term is created.

Our assumption is that if multiple interviewees from management level show consistency in ideas as well as that literature supports these thoughts, these might be true. The data collected can finally be linked to the research question it aims to answer. If consistency is large, reliability is large. If the interview study provides clear answer to the part of the research question it is intended to do, credible interviews are conducted (valid). Interviewees are send the transcribed interview summary as well as the thesis chapters the results of their interview is processed in. Moreover we asked them to reflect on the outcome. Unfortunately we assessed it as unfeasible to arrange a meeting with all interviewees together, the interview outcomes can be exposed to an in-depth group interpretation by conceptualizing and discussing the findings within broader frames of reference.

PILOT INTERVIEW
The first interview we conducted was a pilot interview to see how the interviewee reacted to the questions. Simplification of the interview questions was needed, as some questions requested repetition before they were understood. Scientific questions needed to be converted to more tangible questions indirectly retrieving the right answer. Secondly to some questions the interviewee did not have an answer. This can have three reasons. First of all the question could demand too many details and overwhelm the interviewee. Secondly it could be a sensitive topic making the interviewee reluctant to answer. Thirdly the expert knowledge of the interviewee was insufficient to answer. Moreover we reduced the amount of questions of the interview protocol for two reasons. First the interviewee seemed reluctant after turning the page many questions were about to come. A better
strategy was to just ask many follow up questions instead of listing them. Secondly the interviewee used on average 2 minutes to answer a question.

PROCEDURE PER INTERVIEW

1. The persons to be interviewed were approached to check their willingness to contribute to the research by means of a face-to-face interview. To do so, the purpose of the research is explained, its context and the contribution of the interviews to the research so the interviewee knows what to expect. An appointment will be made after which a more detailed description is provided (by email) on what to expect from the interviewees:
   - Purpose of the research and the interview
   - Will take 60 minutes, open interview on personal vision and not formal position statements.
   - The interview consists of three parts:
     1. Current activities of TNO in e-healthy living, added value of an innovation system.
     2. Opinion on EDA’s contribution to e-healthy living domain; expectations for 2020 on ICT developments and adaptation in e-healthy living
     3. Innovation system to realize the envisioned e-HL future including the positioning and activities of actors.
   - Short explanation 2015.eu’s agenda
     - Short explanation healthy living domain (Work-Prevention-Food-Biomedical innovations)
     - Short explanation of CIM
     - All interviews are recorded when permission is provided. Anonymity can be opted for by the interviewees. The reference list contains all interviews so that one can refer back to this.
   - A concept summary can be checked and corrected by the interviewee afterwards. If citations are used permission is asked.
   - The interview’s summary will not be used in any other context than this research without permission of the interviewee in advance.

2. The interview itself consists of four parts:

   a. Acquaintance interviewer and interviewee. Check if the setting of the interview is clear (tape recorder is working), check is the place is suitable (quiet, available long enough, timeframe) and approval of usage results by the interviewee.
   b. Semi-open questions part 1 on current trends in the e-HLD.
   d. Semi-open questions part 3 on the innovation system characteristics.

THE INTERVIEW

SEMI-STRUCTURED INTERVIEW PART 1

To be able to get a clear image of how the interviewee comes to the desired 2020 vision for e-healthy living, we first obtain their perspective on the contents of e-healthy living nowadays and ask for their background.

The purpose of the interview questions below is to act as a checklist. Dependent on the in-depth knowledge of interviewees on each topic, follow-up questions can be asked. As all interviewees are Dutch, the interviews will be conducted in Dutch.
1. Kunt u allereerst iets vertellen over uzelf?
   Mogelijke follow-up vragen:
   Wie bent u, wat is uw rol binnen het gezond leven domein (welke gebieden vooral actief) en wat beweegt u om mee te doen aan dit onderzoek?

2. Met wat voor activiteiten draagt u momenteel bij aan ICT toepassingen in het gezond leven domein?
   Mogelijke follow-up vragen:
   Waarom zijn deze activiteiten kenmerkend voor uw organisatie? Met wie werkt u samen?
   Welke rol heeft elk van de actoren? Hoe verloopt de samenwerking?

3. Welke actoren zijn momenteel het belangrijkste op het gebied van ICT toepassingen in het gezond leven domein? Wie zijn naast u de belangrijkste actoren op het gebied van ICT ontwikkeling en adoptie?
   Mogelijke follow-up vragen:
   Wat zijn hun hoofdactiviteiten? Wat zijn hun interesses en ambities op ICT gezond leven gebied? Met wie werken ze samen?

4. In hoeverre herkent u al een innovatiesysteem voor ICT en gezond leven in Nederland?
   Mogelijke follow-up vragen:
   Voor wie zal kennis over het IS vooral bruikbaar zijn en waarom?

5. Met welke pilots of experimenten op het gebied van ICT toepassingen in gezond leven gebied bent u bekend / bij betrokken?
   Mogelijke follow-up vragen:
   Waarom zijn deze belangrijk volgens u?

**SEMI-STRUCTURED INTERVIEW PART 2**

1. Wat denkt u dat het belang is van de EDA voor het gezond leven domein?
   Mogelijke follow-up vragen:
   In hoeverre ziet u de maatschappelijke relevantie van EDA voor gezond leven?
   In hoeverre ziet u de economische relevantie van EDA voor gezond leven?
   Hoe zou TNO/Philips/EIT ICT labs NL* kunnen bijdragen aan de implementatie van EDA in het Nederlandse gezond leven domein? (*afhankelijk van welke organisatie de interviewee komt)
   In hoeverre vindt u EDA makkelijk te interpreteren? Met welke huidige projecten gerelateerd aan EDA in gezond leven domein houdt u zich bezig/ in hoeverre zijn de projecten uit onderdeel 1 gerelateerd aan EDA?

2. Hoe kunnen ICT en gezond leven beter ingebed worden in de Europese Digitale Agenda?
   Mogelijke follow-up vragen:
   Hoe kan Nederland hier een rol bij spelen?
We zullen nu verder gaan met uw toekomstvisie. Hiervoor gebruik ik de volgende afbeelding van het Cyclische Innovatie model.

3. Wat is uw visie op het gezondleven domein in 2020?

Mogelijke follow-up vragen:
- Op welke gebieden van gezondleven verwacht u een wetenschappelijke doorbraak tussen nu en 2020?
- Welke wensen vanuit de markt verwacht u op het gebied van gezondleven tussen nu en 2020?
- Welke toekomstige ICT ontwikkelingen verwacht u tussen nu en 2020?
- Welke innovaties in gezondleven kunnen we tussen nu en 2020 verwachten?

4. In hoeverre zal de EDA hier invloed op kunnen uitoefenen of een bijdrage aan kunnen leveren?

---

**SEMI-STRUCTURED INTERVIEW PART 3**

1. Wanneer we structurele (wet en regelgeving), culturele en gedragsveranderingen in de toekomst beschouwen, welke verwacht u dan dat er het meest van invloed zijn op de ICT toepassingen in gezondleven? Degene die u noemt zullen we nog wat dieper op ingaan.

2. Wat voor veranderingen op technologisch gebied / cultuur en gedrag / structureel gebied (instituties en wetgeving) zijn nodig om ICT toepassingen in het gezond leven domein te bevorderen?

Mogelijke follow-up vragen:
- Welke korte termijn acties zijn nodig om deze ontwikkeling te realiseren, en welke vervolg stappen? Wat zou een tijdsspan voor deze eerste stappen kunnen zijn? Wat moet er gebeuren op de lange termijn om deze ontwikkeling te realiseren? Wat zijn mogelijke drivers en barrières hierbij?

3. Ik laat u nu een afbeelding van CIM zien (en korte toelichting). Wie zouden bij deze ontwikkeling een rol kunnen spelen en op welke positie zou u deze actoren willen plaatsen [aanwijzen in CIM]?

Mogelijke follow-up vragen:
- Welke fases in ontwikkeling van het innovatiesysteem kunt u onderscheiden? Dus welke actoren zouden vanaf het begin betrokken moeten zijn en welke kunnen later toetreden?
- Welke activiteiten adviseert u elk van de actoren uit te voeren en waarom? Wie zou het initiatief kunnen nemen om de actoren bij elkaar te brengen? Hoe zouden de actoren kunnen
4. **Welke karakteristieken moet een partij hebben die de middelste node kan vervullen?**
   Wie zou dat kunnen zijn?

5. **Met wie zou het interessant zijn om verder te praten over dit onderwerp binnen of buiten uw organisatie?**

---

1 After this the end of the interview has been reached:

2 “If you have nothing to add, I would like to end this interview. If required a follow up appointment can be made). If you like you can receive an exemplar of the interview summary for check-up and perhaps improvement. Thank you very much for your cooperation”.
APPENDIX C: 2015.EU’S AGENDA RELATED TO E-HEALTH

This appendix contains the full list of action points relevant to e-healthy living.

The action points related to the action area of “Interoperability and standards” are as follows [COM (2010) 245, 2010]:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action 21:</td>
<td>“As part of the review of EU standardization policy, propose legal measures on ICT interoperability by 2010 to reform the rules on implementation of ICT standards in Europe to allow use of certain ICT fora and consortia standards.”</td>
</tr>
<tr>
<td>Action 22:</td>
<td>“Promote appropriate rules for essential intellectual property rights and licensing conditions in standard-setting, including for ex-ante disclosure, in particular through guidelines by 2011.”</td>
</tr>
<tr>
<td>Action 23:</td>
<td>“Issue a Communication in 2011 to provide guidance on the link between ICT standardization and public procurement to help public authorities to use standards to promote efficiency and reduce lock-in;”</td>
</tr>
<tr>
<td>Action 24:</td>
<td>“Promote interoperability by adopting in 2010 a European Interoperability Strategy and European Interoperability Framework”</td>
</tr>
<tr>
<td>Action 25:</td>
<td>“Examine the feasibility of measures that could lead significant market players to license interoperability information to report by 2012.”</td>
</tr>
<tr>
<td>Action 26:</td>
<td>“Apply the European Interoperability Framework at national level by 2013.”</td>
</tr>
<tr>
<td>Action 27:</td>
<td>“Support EU-wide cyber-security preparedness exercises, from 2010”</td>
</tr>
<tr>
<td>Action 28:</td>
<td>“As part of the modernisation of the EU personal data protection regulatory framework to make it more coherent and legally certain, explore the extension of security breach notification provisions”</td>
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</tbody>
</table>

The action points related to the action area of “Trust and security” are as follows [COM (2010) 245, 2010]:

<table>
<thead>
<tr>
<th>Action</th>
<th>Description</th>
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<tbody>
<tr>
<td>Action 28:</td>
<td>“Present in 2010 measures aiming at a reinforced and high level Network and information Security Policy, including legislative initiatives such as a modernised European Network and Information Security Agency (ENISA), and measures allowing faster reactions in the event of cyber attacks, including a CERT for the EU institutions”</td>
</tr>
<tr>
<td>Action 29:</td>
<td>“Present measures, including legislative initiatives, to combat cyber attacks against information systems by 2010, and related rules on jurisdiction in cyberspace at European and international levels by 2013”</td>
</tr>
<tr>
<td>Action 30:</td>
<td>“Establish a European cybercrime platform by 2012”</td>
</tr>
<tr>
<td>Action 31:</td>
<td>“Examine the feasibility by 2011 to create a European cybercrime centre”</td>
</tr>
<tr>
<td>Action 32:</td>
<td>“Work with global stakeholders notably to strengthen global risk management in the digital and in the physical sphere and conduct internationally coordinated targeted actions against computer-based crime and security attacks”</td>
</tr>
<tr>
<td>Action 33:</td>
<td>“Support EU-wide cyber-security preparedness exercises, from 2010”</td>
</tr>
<tr>
<td>Action 34:</td>
<td>“As part of the modernisation of the EU personal data protection regulatory framework to make it more coherent and legally certain, explore the extension of security breach notification provisions”</td>
</tr>
<tr>
<td>Action 35:</td>
<td>“Give guidance by 2011 for the implementation of new Telecoms Framework with regard to the protection of individuals’ privacy and personal data”</td>
</tr>
<tr>
<td>Action 36:</td>
<td>“Support reporting points for illegal content online (hotlines) and awareness campaigns on online safety for children run at national level and enhance pan-European cooperation and sharing of best practice in this field;”</td>
</tr>
</tbody>
</table>
| Action 37: | “Foster multi-stakeholder dialogue and self-regulation of European and global service providers (e.g. social networking platforms, mobile communications providers), especially as
regards use of their services by minors. “

Action 38: “Establish by 2012 a well-functioning network of CERTs at national level covering all of Europe”

Action 39: “In cooperation with the Commission carry out large scale attack simulation and test mitigation strategies as of 2010. “

Action 40: “Fully implement hotlines for reporting offensive or harmful online content, organise awareness raising campaigns on online safety for children, and offer teaching online safety in schools, and encourage providers of online services to implement selfregulatory measures regarding online safety for children by 2013”

Action 41: “Set up or adapt national alert platforms to the Europol cybercrime platform, by 2012, starting in 2010. “

The action points related to the action area of “Research and innovation” are as follows [COM (2010) 245, 2010]:

Action 50: “Leverage more private investment through the strategic use of pre-commercial procurement and public-private partnerships, by using structural funds for research and innovation and by maintaining a pace of 20% yearly increase of the ICT R&D budget at least for the duration of FP7.”

Action 51: “Reinforce the coordination and pooling of resources with Member States and industry, and put greater focus on demand- and user-driven partnerships in EU support to ICT research and innovation.”

Action 52: “Starting in 2011 propose measures for ‘light and fast’ access to EU research funds in ICT, making them more attractive notably to SMEs and young researchers in view of a wider implementation within the revision of the EU RTD Framework.”

Action 53: “Ensure sufficient financial support to joint ICT research infrastructures and innovation clusters, develop further eInfrastructures and establish an EU strategy for cloud computing notably for government and science”.

Action 54: “Work with stakeholders to develop a new generation of web-based applications and services, including for multilingual content and services, by supporting standards and open platforms through EU-funded programmes.”

Action 55: “By 2020, double annual total public spending on ICT research and development spending from €5.5bn to €11bn (which includes EU programmes), in ways that leverage an equivalent increase in private spending from € 35 billion to € 70 billion.”

Action 56: “Engage in large scale pilots to test and develop innovative and interoperable solutions in areas of public interest that are financed by the CIP”.

The action points related to the action area of “Enhancing digital literacy, skills and inclusion” are as follows [COM (2010) 245, 2010]:

Action 57: “The EC will propose digital literacy and competences as a priority for the European Social Fund regulation (2014-2020).”

Action 58: “The EC will by 2012, develop tools to identify and recognize the competences of ICT practitioners and users, linked to the European Qualifications framework and to EUROPASS.”

44 “The European Qualifications Framework (EQF) acts as a translation device to make national qualifications more readable across Europe, promoting workers' and learners' mobility between countries and facilitating their lifelong learning” [http://ec.europa.eu/education/lifelong-learning-policy/doc44_en.htm].
develop a European Framework for ICT Professionalism to increase the competences and the mobility of ICT practitioners across Europe.”

Action 59: “Make digital literacy and skills a priority of the “New skills for new jobs’ Flagship to be launched in 2010, including the launch of a multi-stakeholder sectorial council for ICT skills and employment to address demand and supply aspects”.

Action 60: “Promote a higher participation of young women and women returners in the ICT workforce through support for web-based training resources, game based e-Learning and social networking”.

Action 61: “Develop in 2011 an online consumer education tool on new media technologies (e.g. consumer rights on the internet, e-Commerce, data protection, media literacy, social networks etc.) This tool will provide customized information and education materials for consumers, teachers and other multipliers in the 27 Member States”.

Action 62: “Propose by 2013 EU-wide indicators of digital competences and media literacy.”


Action 64: “Based on reviews of options, make proposals by 2011 that will make sure that public sector websites (and websites providing basic services to citizens) are fully accessible by 2015.”

Action 65: “Facilitate by 2012, in cooperation with Member States and relevant stakeholders, a Memorandum of Understanding on Digital Access for persons with disabilities in compliance with the UN Convention”.

Action 66: “Member states should implement by 2011 long term e-skills and digital literacy policies and promote relevant incentives for SMEs and disadvantaged groups.”

Action 67: “Member States should implement by 2011 the provisions on disability in the Telecoms Framework and the Audiovisual Media Services Directive”.

Action 68: “Member States should mainstream eLearning in national policies for the modernization of education and training, including in curricula, assessment of learning outcomes and the professional development of teachers and trainers”.

The following action points elaborate what the EC, MS and interested stakeholders have to do in order to accomplish ICT benefits for the EU society [COM (2010) 245, 2010]:

Action 75: “The EC will undertake pilot actions to equip Europeans with secure online access to their medical health data by 2015 and to achieve by 2020 widespread deployment of telemedicine services.”

Action 76: “The EC will propose a recommendation defining a minimum common set of patient data for interoperability of patient records to be accessed or exchanged electronically across Member States by 2012.”

Action 77: “Foster EU-wide standards, interoperability testing and certification of e-health systems by 2015 through stakeholder dialogue.”

Action 78: “Reinforce the Ambient Assisted Living (ALL) Joint Programme to allow older people and persons with disabilities to live independently and be active in society.”

45 “Europass is a set of documents that you can use to show your skills and competences clearly and unambiguously” [http://www.europass.nl/en/default.asp].
**APPENDIX D: SUMMARY LIST OF PROPOSED INDICATORS**

This appendix contains the full list of proposed scoreboard indicators by the Commission’s High level group, for the period 2010-2015, related to this research [EC-INFSO, May 2011].

<table>
<thead>
<tr>
<th>Broadband</th>
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<tbody>
<tr>
<td>• Total number of fixed broadband lines.</td>
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<tr>
<td>• Fixed broadband penetration.</td>
</tr>
<tr>
<td>• New entrant’s share in fixed broadband lines.</td>
</tr>
<tr>
<td>• Share of fixed broadband lines equal to or above 2 Mbps.</td>
</tr>
<tr>
<td>• Share of fixed broadband lines equal to or above 10 Mbps.</td>
</tr>
<tr>
<td>• Total fixed broadband coverage (as % of rural population).</td>
</tr>
<tr>
<td>• Mobile broadband penetration – dedicated data service cards/modems/keys only.</td>
</tr>
<tr>
<td>• % of households having a broadband connection.</td>
</tr>
<tr>
<td>• % of enterprises having a fixed broadband connection.</td>
</tr>
<tr>
<td>• 3G coverage (as % of the total population).</td>
</tr>
<tr>
<td>• % of population accessing the internet through a mobile phone via UMTS (3G).</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Internet usage</th>
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<tbody>
<tr>
<td>• % of households with access to internet at home.</td>
</tr>
<tr>
<td>• % of population who are regular internet users (at least once a week).</td>
</tr>
<tr>
<td>• % of disadvantaged people who are regular internet users (at least once a week).</td>
</tr>
<tr>
<td>• % of population who are frequent internet users (every day or almost every day).</td>
</tr>
<tr>
<td>• % of population using a laptop to access the internet, via wireless away from home or work.</td>
</tr>
<tr>
<td>• % of population who have never used the internet.</td>
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</table>

<table>
<thead>
<tr>
<th>Take up of internet services (% of population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• % of population looking for information about goods and services online.</td>
</tr>
<tr>
<td>• % of population reading/downloading online newspapers/news magazines.</td>
</tr>
<tr>
<td>• % of population playing or downloading games, images, films or music.</td>
</tr>
<tr>
<td>• % of population using online banking.</td>
</tr>
<tr>
<td>• % of population uploading self-created content to be shared.</td>
</tr>
<tr>
<td>• % of population seeking online information about health.</td>
</tr>
<tr>
<td>• % of population looking online for a job or sending a job application.</td>
</tr>
<tr>
<td>• % of population doing an online course (in any subject).</td>
</tr>
<tr>
<td>• % of population looking online for information about education, training or course offers.</td>
</tr>
<tr>
<td>• % of population interacting online with public authorities.</td>
</tr>
<tr>
<td>• % of population sending filled forms to public authorities, over the internet.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Take up of internet services (% of internet users)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• % of internet users looking for information about goods and services online.</td>
</tr>
<tr>
<td>• % of internet users reading / downloading online newspapers / news magazines.</td>
</tr>
<tr>
<td>• % of internet users playing or downloading games, images, films or music.</td>
</tr>
<tr>
<td>• % of internet users using online banking.</td>
</tr>
<tr>
<td>• % of internet users uploading self-created content to be shared.</td>
</tr>
<tr>
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</tr>
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</tr>
<tr>
<td>• % of internet users doing an online course (in any subject).</td>
</tr>
<tr>
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</tr>
<tr>
<td>• % of internet users interacting online with public authorities.</td>
</tr>
<tr>
<td>• % of internet users sending filled forms to public authorities.</td>
</tr>
</tbody>
</table>
Appendix E: Interview Protocol e-health Service

Innovation Processes

Background

Interview protocol service innovation processes aims to provide clear details on the innovation system of each e-health service innovation process. This interview is referred to as “interview part 2” in the main document. CIM is used as an innovation system framework to map the project and detect for system errors. We try to foresee possible barriers of successful completion of the project and prescribe activities how TNO can manage the innovation system. In order to do so we will perform a comparative case study. Moreover we aim to prescribe how the actors can best cooperate in future e-health service innovation processes.

Reason why the interview method is used to gain this data is that again creativity and out of the box thinking are required. We can compare the prescribed roles as stated in the project proposal with the actual roles the interviewees mention and therefore see how they perceive the actual performance of different participants in the project. As the project participants can be perceived as experts we strive to get their future prediction of the state of the project as well. We aimed to speak to multiple interviewees per project for multiple perspectives and to enhance reliability of the results.

However obtaining an appropriate amount of interviewees per case was difficult. Reasoning behind the reluctance to participate with our research was both from inside TNO as well as from external interviewees themselves. The main reasons for unwillingness to participate were that this could harm the trustful relationships between parties, it could create new expectations, absence of a clear commercial value for spending time to cooperate on our research, or it was not feasible due to the limited hours of time an interviewee has dedicate to the particular project of our interest. In Table 16 the list of interviewees is given per case. The interviews took place between August 2011 and October 2011.

Table 16: List of interviewees e-health projects

<table>
<thead>
<tr>
<th>Case</th>
<th>Method</th>
<th>Position</th>
<th>Interviewee</th>
<th>Profession</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Coaching</td>
<td>Face-to-Face Interview</td>
<td>Business Developer and Representative of the commissioner in the Steering Group</td>
<td>Ir. E. (Ed) Mos</td>
<td>Business Consultant ICT and policy at TNO. Specialised in innovation in the public sector and care domain</td>
<td>2011, July 21</td>
</tr>
<tr>
<td></td>
<td>Face-to-Face Interview</td>
<td>Project Manager</td>
<td>Mr. F.A. (Friso) van der Meulen</td>
<td>Researcher and Project Manager ICT and Sustainable Productivity at TNO</td>
<td>2011, August 10</td>
</tr>
<tr>
<td></td>
<td>Face-to-Face Interview</td>
<td>Business Developer and Review Project results</td>
<td>Ir. O.D. (Oscar) Rietkerk</td>
<td>Senior consultant care and ICT at TNO</td>
<td>2011, September 20</td>
</tr>
<tr>
<td></td>
<td>Face-to-Face Interview</td>
<td>Chairman Steering Group</td>
<td>Dr. J. (Janine) Swaak</td>
<td>Manager Business Development at Novay</td>
<td>2011, August 15</td>
</tr>
<tr>
<td></td>
<td>Online Questionnaire</td>
<td>Representative in the Steering Group</td>
<td>H. (Henny) Breukers MBA</td>
<td>Adviser Sports and Healthy Lifestyle at Municipality Enschede</td>
<td>2011, October 5</td>
</tr>
<tr>
<td></td>
<td>Online Questionnaire</td>
<td>Representative in the Steering Group and content-wise advisor</td>
<td>Ir. C.M. (Koen) Huizer</td>
<td>Senior Direction Business Development at Philips Research. Innovation</td>
<td>2011, October 7</td>
</tr>
</tbody>
</table>
RESULT OF THE INTERVIEWS

Content-wise results:
- Future vision of the e-health domain and map of the innovation system at 2020.
- Description of the role of the middle node for establishing the innovation system.
- Description of the activities of the middle node performs during execution of the project.

Process-wise results:
- The development of an innovation system over time.
- Procedure with steps to establish innovation systems
- Classification of the projects into stages.
- System errors according to CIM level 1 and 2.

PROCEDURE PER INTERVIEW

1. The persons to be interviewed will be approached to check their willingness to contribute to the research by means of a face-to-face interview. To do so, the purpose of the research is explained, its context and the contribution of the interviews to the master thesis so the interviewee knows what to expect. An appointment will be made after which a more detailed description is provided (by email) on what to expect from the interviewees:
   - Purpose of the research and the interview
   - Will take 60 minutes, open interview on personal vision and not formal position statements.
   - The interview consists of three parts (in accordance with the results of the interviews):
     1. The future expectations of the e-health project by 2020 (follow up).
     2. The role of the middle node during initiation of the project and execution (specifically TNO).
     3. Difficulties with the execution of the project (System errors in terms of CIM).
     4. Short explanation of the innovation model CIM
     5. All interviews are recorded when permission is provided. Anonymity can be opted for by the interviewees. The reference list contains all interviews so that one can refer back to this.
     6. A concept summary can be checked and corrected by the interviewee afterwards. If citations are used permission is asked.
     7. The interview’s summary will not be used in any other context than this research without permission of the interviewee in advance.
2. The interview itself consists of three parts:
   a. Acquaintance interviewer and interviewee. Check if the setting of the interview is clear (tape
      recorder is working), check is the place is suitable (quiet, available long enough, timeframe)
      and approval of usage results by the interviewee.
   b. The semi-structured interview.
   c. Acknowledgements for participation, explanation of the remaining procedure.

**CASE ANALYSIS**

The case analysis consisted of personal interviews, project and other relevant document analysis.
Interview analysis will be done by coding and categorizing as explained for interview protocol 1
exploration interview. We concluded there that if consistency is large, dependability is large as well
(reliability). Due to varied reasons we did not manage to select a large range of innovation projects or
speak to multiple interviewees per project. Main argues were no time to put effort in an interview and
fear that these interviews will negatively influence the trust relations between parties. In order to still
process enough cases, we adjusted our demands of information rich cases to that at least an interview
with the project manager (PM) should be included. The PM namely overviews the project as a total as
he/she has contact with everyone involved. Moreover as the main research question of this research is
how to establish innovation systems, it is interesting to contact the business developer as well which
we expect to be more closely involved at the beginning stage when the innovation system was
established. We managed this for one case, the Smart Coaching. For the innovation process with the
minimum demand of interviewing the PM, reliability can be created by confronting the PM with
control questions related to answers we obtained from documents, literature or other interviews.

**THE INTERVIEW**

**SEMI-STRUCTURED INTERVIEW**

The purpose of the questions below is to act as a checklist. These subjects are the ones that should be
addressed in the interview. The subjects which already have been asked in the open questions part, do
not have to be asked again. The checklist takes the form of detailed questions. Therefore the
interviewer always has a clear wording to rely on. It is however always possible to change the
questions in the context of the conversation. We tailored the questions to the specific case and job
position of the interviewee. As an example we give the questions for Friso van der Meulen (TNO),
project manager of the Smart coaching project.

```
1. Waarom ben je het SC project gaan leiden? Welke kennis en ervaring komen hier goed bij
   van pas?
2. Wat is volgens u het doel van het SC project? Waarom past dit goed binnen de huidige
   activiteiten van TNO op gezond leven gebied? Wat kunnen we komende jaren verwachten
   van TNO op dit gebied?
3. In welke volgorde zijn de verschillende partners betrokken bij het project en wat was
   hiervan de achterliggende gedachte? Welke stappen zijn te onderscheiden?

* Korte uitleg CIM

4. Welke rol heeft elk van de partners op het begin van het SC project werkpakket 1? Welke
   activiteiten horen bij deze rollen? Welke kennis en vaardigheden van deze partner maken
   hem specifiek geschikt voor deze rol? Welke activiteiten mist u op het begin? Wie van de
```
huidige partners zou dit kunnen vervullen?

5. Hoe verwacht u dat deze rollen veranderen gedurende werkpakket 2? Welke nieuwe activiteiten voeren elk van de partners uit? Welke kennis en vaardigheden van deze partner maken hem specifiek geschikt voor deze rol? Welke partners vooral aanwezig?

6. Als we specifiek kijken naar de rol van TNO, in hoeverre sluit deze rol dan aan bij de door u beoogde rol van TNO? Hoe kan dit verbeteren?

7. Hoe verloopt de samenwerking tussen de verschillende partners? Hoe vaak heeft u face-to-face overleg? Wat kan verbeteren en hoe? Wie is hier verantwoordelijk voor?

8. Welke huidige en nieuwe actoren zouden mee moeten doen in vervolgprojecten? In welke volgorde moeten de actoren hiervoor benaderd worden? In hoeverre zijn de rollen van huidige actoren anders in vervolgprojecten?


10. Welke barrières (institutioneel, technologisch, cultureel, gedrag) verwacht u voor het SC project in elk van de fases? In hoeverre wordt hier al wat mee gedaan tijdens het project? Wie is hier verantwoordelijk voor?

11. Het SC project is onderdeel van het programma gezondleven. Welke vervolgprojecten verwacht u aansluitend op SC?

12. Merk je een verschil in aanpak tussen de partijen?

13. Tot slot zou ik graag nog met u de risicoanalyse doorlopen, indien deze gemaakt is.

QUESTIONNAIRE (BY E-MAIL)

We managed to get permission to send a short questionnaire as alternative for interviews having limited time. Unfortunately this was not always with success neither due to unwillingness or lack of response. As an example we provide the following questionnaire of the smart coaching project, accepted to be filled in by 2 respondents:

1. PERSONALIA

Naam: 

Organisatie: 

Werkgebied: 

Stuur- of Klankbordgroep: 

2. VRAGEN

Visie-deel
<table>
<thead>
<tr>
<th>Vraag 1: Wat voor ontwikkelingen verwacht u in de toekomst (2020) op het gebied van e-health?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vraag 2: Wat zijn de belangrijkste partijen in Nederland betrokken bij ontwikkelingen in het e-health domein, en welke taken vervullen zij hierin?</td>
</tr>
</tbody>
</table>

**Smart-coaching deel**

| Vraag 3: Hoe bent u bij Smart Coaching terecht gekomen? Hoe is dit kenmerkend voor de huidige activiteiten van uw organisatie op dit gebied? |
| Vraag 4: In hoeverre beschikken de partijen aanwezig bij Smart Coaching over de juiste kennis en vaardigheden om dit succesvol te realiseren? Welke partij(en) zou(den) volgens u nog een toegevoegde waarde kunnen bieden? |
| Vraag 5: Hoe ziet u de rol van de stuurgroep en de klankbordgroep? |
| Vraag 6: Hoe verloopt de informele en formele kennisuitwisseling tussen de stuurgroep, klankbordgroep en projectgroep (of hoe verwacht u dat dit zal gaan verlopen)? Kunt u schetsen hoe u verwacht dat een bijeenkomst gaat verlopen? |
| Vraag 7: Welke stadia in het ontwikkeling proces onderscheidt u en waar bevindt het smart coaching project zich momenteel? |
| Vraag 8: In hoeverre verwacht u dat nog nieuwe partijen toe zullen treden, waarom en wanneer? |
| Vraag 9: In hoeverre verwacht u barrières op het gebied van wet- en regelgeving, technologie of cultuur om de smart coach diensten te realiseren en te implementeren in Nederland? In hoeverre wordt hier al aan gewerkt / Wie zouden zich hier het beste op kunnen richten? |
| Vraag 10: Wat voor vervolgprojecten op het gebied van Smart Coaching verwacht u op de lange termijn? Met welke huidige en nieuwe partijen zouden deze vervolgprojecten uitgevoerd kunnen worden? |

Heeft u nog overige opmerkingen?

Hartelijk dank voor uw medewerking!
## APPENDIX F: ACTIVITY TABLES

### ACTIVITY TABLE SMART COACHING PROJECT

*Table 17: Activity table Smart Coaching project [TNO, Feb 2011; Van der Meulen, 2011]*

<table>
<thead>
<tr>
<th>Work package</th>
<th>Responsible actor</th>
<th>Activities</th>
<th>Time [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Package 1: Conceptual model</td>
<td>TNO</td>
<td>A1.1 Research existing coaching and e-coaching solutions</td>
<td>13,3 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.2 Determine criteria of good concepts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.3 Analyze available sensors and information sources for (real-time) measurement of required information</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.4 Analyze effective personalization and feedback mechanism</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.5 Generate effective concepts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.6 Pick one favorite concept per application area</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.7 Select and implement research methods for the concept evaluations</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A1.8 Explorative research into patent possibilities or to infringement of the rights of the smart coaching concept</td>
<td></td>
</tr>
<tr>
<td>Work Package 2: Concept development</td>
<td>Novay</td>
<td>A2.1 Develop the monitoring functionality</td>
<td>34,3 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A2.2 Develop feedback systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A2.3 Feedback on the design (e.g. a focus group study)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A2.4 Compose the concept (e.g. a mock-up)</td>
<td></td>
</tr>
<tr>
<td>Work Package 3: Concept Evaluation</td>
<td>TNO</td>
<td>A3.1 First evaluation with professional users of the functionality and the functions of the new concept</td>
<td>28,3 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A3.2 Second evaluation with professional users</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A3.3 Evaluation of the sub questions in a semi-controlled environment with test persons</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A3.4 Content-wise evaluation</td>
<td></td>
</tr>
<tr>
<td>Work Package 0: Project Management</td>
<td>TNO</td>
<td>A0.1 Operational knowledge management</td>
<td>24,1 %</td>
</tr>
<tr>
<td></td>
<td>TNO</td>
<td>A0.2 Relation management stakeholders</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Novay</td>
<td>A0.3 Progress and Quality control</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TNO</td>
<td>A0.4 Operational project management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TNO</td>
<td>A0.5 Project proposal follow-up phase</td>
<td></td>
</tr>
</tbody>
</table>
### Table 18: Activity table eCardioCare project [TNO, 2009]

<table>
<thead>
<tr>
<th>Workpackage</th>
<th>Milestones</th>
<th>Time [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WP1: Value web</strong></td>
<td><strong>MP1: Availability of a value web for eCardioCare</strong></td>
<td><strong>WP1 [25%] of which:</strong></td>
</tr>
<tr>
<td></td>
<td>A1.1 Interviews with actors from the care chain to understand the care delivery process (roles/financial structure)</td>
<td>TNO [81%]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Philips [6,5%]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Achmea [6,4%]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fluent [6,1%]</td>
</tr>
<tr>
<td></td>
<td>A1.2 Information gathering current use of eCardioCare</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A1.3 Standardization status and analysis of the impact on the value chain</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A1.4 Analysis of the impact of current DTC on offering eCardiocare in the compulsory insurance package</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A1.5 Create the value web</td>
<td></td>
</tr>
<tr>
<td><strong>WP2: Preparations and Scale up</strong></td>
<td><strong>MP2: Tools for motivational meetings</strong></td>
<td><strong>WP2 [5%] of which:</strong></td>
</tr>
<tr>
<td></td>
<td>A2.1 Testimonials given by medical professionals and patients of the use of Motiva in practice</td>
<td>TNO [84%]</td>
</tr>
<tr>
<td></td>
<td>A2.2 Inventorise current standardization and protocols of Motiva and propose an ICT development path to connect Motiva and software used by cardiologists.</td>
<td>Philips [8%]</td>
</tr>
<tr>
<td></td>
<td>A2.3 Collect care protocols from the hospitals that use Motiva, and develop a widely applicable concept care protocol.</td>
<td>Achmea [7%]</td>
</tr>
<tr>
<td></td>
<td>A2.4 Involve eHealthNu and other triggering platforms</td>
<td>Fluent [1%]</td>
</tr>
<tr>
<td></td>
<td>A 2.5 Develop a Motiva management game to illustrate the advantages</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A2.6 Powerpoint slides to communicate results</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A2.7 Create a broad basis by organizing meetings with umbrella organizations</td>
<td></td>
</tr>
<tr>
<td><strong>WP3: Scale up</strong></td>
<td></td>
<td><strong>WP3 [43%]</strong></td>
</tr>
<tr>
<td>MP3: Four health care insurers offer eCardioCare to hospitals currently using it.</td>
<td>MP3 [3%] of which: TNO [36%] Philips [42%] Achmea [22%]</td>
<td></td>
</tr>
<tr>
<td>MP4: Purchase Motiva with temporary arrangement as part of the DTCs for patients with chronic heart failure.</td>
<td>MP4 [15%] of which: TNO [26%] Philips [2%] Achmea [51%] Fluent [21%]</td>
<td></td>
</tr>
<tr>
<td>MP5: 1000 patients committed to eCardioCare.</td>
<td>MP5 [15%] of which: TNO [70%] Philips [30%]</td>
<td></td>
</tr>
<tr>
<td>MP6: Availability of a regular DTC to purchase Motiva for chronic heart failure patients.</td>
<td>MP6 [10%] of which: TNO [24%] Achmea [52%] Fluent [21%]</td>
<td></td>
</tr>
</tbody>
</table>

**A3.1 Support the DTC negotiations for which preparation in WP1 and WP2 are taken.**

**A3.2 Scale up of eCardioCare in the nine hospitals in which Motiva is already implemented for a while.**

**A3.3 Implement eCardiocare in new hospitals and support first connections of patients throughout this project**

**A3.4 Stimulate a standard DTC for eCardioCare**

| WP4: Knowledge Retention and Transmission | MP7: Knowledge retention/transmitted | MP7 [9%] of which: TNO [92%] Philips [5%] Achmea [3%] |
| A4.1 Document the project results and methodology used, advice on lessons learnt from the project in terms of tackling the barriers for scale up. | | |

| WP5: Project Management | | WP5 [18%] |
| MP1 | TNO [20%] |
| MP2 | TNO [15%] |
| MP3 | TNO [10%] |
| MP4 | TNO [10%] |
| MP5 | TNO [10%] |
| MP6 | TNO [10%] |
| MP7 | TNO [25%] |

**A5.1 Project Management**
### ACTIVITY TABLE WECARE

Table 19: Activity table WeCare project [AAL Project Consortium, 2010]

<table>
<thead>
<tr>
<th>Workpackage</th>
<th>Deliverables</th>
<th>Time [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WP1: User involvement and co-design</strong></td>
<td>Deliverables:</td>
<td><strong>WP1</strong> [13%] of which:</td>
</tr>
<tr>
<td></td>
<td>1. Plans for user involvement and co-design</td>
<td>TNO [62%]</td>
</tr>
<tr>
<td></td>
<td>1.2 User models, use cases, scenarios</td>
<td>Ericsson [0%]</td>
</tr>
<tr>
<td></td>
<td>1.3 User requirements in each country</td>
<td>ShareCare [5%]</td>
</tr>
<tr>
<td></td>
<td>1.4 Findings from the process of user involvement and co-design</td>
<td>ANBO [23%]</td>
</tr>
<tr>
<td></td>
<td>1.1 Planning user involvement and co-design</td>
<td>Skytek [10%]</td>
</tr>
<tr>
<td></td>
<td>1.2 Develop user models, use cases and scenarios</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.3 Co-design</td>
<td></td>
</tr>
<tr>
<td><strong>WP2: Technology development</strong></td>
<td>Deliverables:</td>
<td><strong>WP2</strong> [31%] of which:</td>
</tr>
<tr>
<td></td>
<td>2.1 Technical specification of WeCare 2.0 service</td>
<td>TNO [0%]</td>
</tr>
<tr>
<td></td>
<td>2.2 First release of WeCare 2.0 service</td>
<td>Ericsson [34%]</td>
</tr>
<tr>
<td></td>
<td>2.3 First release of trial environment</td>
<td>Sharecare [31%]</td>
</tr>
<tr>
<td></td>
<td>2.4 Final release of WeCare 2.0 service</td>
<td>ANBO [0%]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Skytek [35%]</td>
</tr>
<tr>
<td></td>
<td>2.1 Definition and design of WeCare 2.0 architecture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2 implementation of WeCare services</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 operational pilot environments</td>
<td></td>
</tr>
<tr>
<td><strong>WP3: trials</strong></td>
<td>Deliverables:</td>
<td><strong>WP3</strong> [13%] of which:</td>
</tr>
<tr>
<td></td>
<td>3.1 plans for trials</td>
<td>TNO [0%]</td>
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<td></td>
<td>3.2 Findings from each trial</td>
<td>Ericsson [0%]</td>
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<td>3.3 Report on all trials, monitoring and evaluation</td>
<td>Sharecare [32%]</td>
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<td>3.1 Trial planning per country</td>
<td>ANBO [53%]</td>
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<td>3.2 Monitoring and evaluation</td>
<td>Skytek [15%]</td>
</tr>
<tr>
<td><strong>WP4: Business models and valorization</strong></td>
<td>Deliverables:</td>
<td><strong>WP4</strong> [18%] of which:</td>
</tr>
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<td></td>
<td>4.1 Initial strategic BM</td>
<td>TNO [8%]</td>
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<tr>
<td></td>
<td>4.2 Specific business models per country and/or client group</td>
<td>Ericsson [12%]</td>
</tr>
<tr>
<td></td>
<td>4.3 Specifying marketing plans per country/market segment</td>
<td>Sharecare [34%]</td>
</tr>
<tr>
<td></td>
<td>4.1 Develop initial business models</td>
<td>ANBO [8%]</td>
</tr>
<tr>
<td></td>
<td>4.2 Marketing route per country</td>
<td>Skytek [38%]</td>
</tr>
<tr>
<td><strong>WP 5: Project management and dissemination</strong></td>
<td>Deliverables:</td>
<td><strong>WP5</strong> [25%] of which:</td>
</tr>
<tr>
<td></td>
<td>1. Project / quality plan and implementation</td>
<td>TNO [75%]</td>
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<td></td>
<td>2. Progress and evaluation reports</td>
<td>Ericsson [13%]</td>
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<td></td>
<td>3. Financial reports</td>
<td>Sharecare [2%]</td>
</tr>
<tr>
<td></td>
<td>4. Articles</td>
<td>ANBO [5%]</td>
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<td></td>
<td>5. Reports on dissemination results</td>
<td>Skytek [5%]</td>
</tr>
<tr>
<td></td>
<td>5.1 Project management</td>
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</tr>
</tbody>
</table>

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46 Despite the fact that the Skytek’s technical platform is developed for every country and not particularly for the Netherlands, without building this platform the trials in the Netherlands could not start so Skytek’s total hours spend are included in this list.
APPENDIX G: STEPS TO ESTABLISH THE INNOVATION SYSTEMS OF THE SERVICE INNOVATION PROCESSES

In this Appendix we schematically display the steps in building up the innovation systems for the e-health service innovation processes analyzed with our case study.

STEPS TO ESTABLISH THE WECARE PROJECT INNOVATION SYSTEM

Figure 46: Steps in building up the innovation system of the WeCare project
1. Idea generation
   Middle node: Idea creator

2. Involve commercial partners with market and/or technical and/or product knowledge
   Middle node: Acquisition manager

3. Involve an independent contractor with scientific knowledge
   Middle node: Client

4. Involve a social partner representing the public interest
   Middle node: Acquisition manager

5. Assign project management to an independent party
   Middle node: Facilitator

6. Network of activities
   Middle node: Project manager

**Figure 47:** Steps in the development of the eHealthNu project’s innovation system
Figure 48: Steps in the innovation system development of the eCardioCare project
APPENDIX H: TABLE WITH RELEVANT FACTORS PER CASE

In this table the factors playing a role per step in development of the innovation system are given. These should be taken into consideration by acquisition managers. Beforehand we aimed to dedicate weights to the factors, however we did not succeed as we perceived difficulty coming up with prioritization criteria. By performing the analysis we conclude this is feasible, as the distribution of the factors over the cases analyzed is large, indicating that for different e-health innovation processes different factors dominate. Despite this analysis is clearly biased by the amount of information available per case, we aimed to be as objectively as possible. When multiple factors were stated to influence the same step within the same service innovation process, we aimed to dedicate a value in accordance to influence to this step. As an example: if two factors were influencing step 1, we give one of the factors value 1, one of the factors value 2, or if they are equally valued no value at all. These are indicated between brackets. The average value of the factor per case is next considered in determining the relevance of the factor.

<table>
<thead>
<tr>
<th>Factors:</th>
<th>Relevant to the SC project</th>
<th>Relevant to the WeCare project</th>
<th>Relevant to the eHealthNu project</th>
<th>Relevant to the eCardioCare project</th>
</tr>
</thead>
</table>

47 This step is not considered in the rating for which factor is/are most important to the WeCare case, since it exceeds the scope of this research which is the Netherlands.

48 As in step 2 multiple partners joined the consortium as a consequence of the same factors, multiple times is referred to these factors {x}. This to justify the comparison of the eHealthNu project with the other projects since for the other cases more details were gained on the process of innovation system development, resulting in a separate step for each party that joined.
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Step 1: Idea generation</td>
<td>Party's policy</td>
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<tr>
<td>Step 3: Involve a large commercial partner with product and technology knowledge [3]</td>
<td>Step 6: Involve the partners from other countries</td>
</tr>
<tr>
<td>Step 5: Involve a social co-funder representing public interests</td>
<td>Step 4: Involve a commercial partner with product knowledge [2]</td>
</tr>
<tr>
<td>Step 5: Involve a large commercial partner with product and technology knowledge [3]</td>
<td>Step 6: Involve the partners from other countries</td>
</tr>
<tr>
<td>Step 3: Involve an independent contractor with scientific knowledge</td>
<td>Step 3: Involve a product supplier [2]</td>
</tr>
<tr>
<td>Step 1: Idea generation</td>
<td>Step 1: Idea generation</td>
</tr>
<tr>
<td>Step 4: Involve a commercial co-funder with market knowledge [2]</td>
<td>Step 1: Idea generation</td>
</tr>
<tr>
<td>Step 7: Involve a sub-contractor with product knowledge [2]</td>
<td>Step 1: Idea generation</td>
</tr>
<tr>
<td>Step 6: Involve the partners from other countries</td>
<td>Step 5: Assign project management to an independent party [3]</td>
</tr>
<tr>
<td>Step 6: Involve the partners from other countries</td>
<td>Step 5: Assign project management to an independent party [3]</td>
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### 8. Consortium innovation

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</table>

### 9. Trust in the party leading the consortium

<table>
<thead>
<tr>
<th>Step 2: Inventorise in-house knowledge</th>
<th>Step 6: Novay becomes subcontractor⁴⁹</th>
<th>Step 5: Assign project management to an independent party</th>
</tr>
</thead>
</table>

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⁴⁹ This step is not considered in the rating for which factor is/are most important to the SC case, since it exceeds the scope of this research.