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Innovation in Healthcare

An analysis of the regional preconditions in Skåne for innovation in digital healthcare

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PREAFACE

This master thesis was conducted during 2014 at the department of Industrial Engineering and Management, Lund University, LTH. The thesis represents the final part of the M.Sc. Industrial Engineering and Management program.

I want to thank everyone in the READi for Health project team and FoU-centrum Skåne for letting me do my master thesis on this fascinating subject. Special thanks to my industry supervisor Ann Tronde and supervisor Carl-Johan Asplund for the help along the way.

Finally, I want to thank everyone who participated in the in-depth interviews for sharing their view of the region.

Oskar Fällman Karlsson

Lund, Mars 2015

ABSTRACT

Title:	Innovation in Healthcare, An analysis of the regional preconditions in Skåne for innovation in digital healthcare.
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Supervisors:	Carl-Johan Asplund, Industrial Management and Logistics, Lund University, Faculty of Engineering, Sweden Ann Tronde, Project leader "Regional Digital Agendas for Healthcare", FoU-centrum Skåne, Skåne University Hospital Lund
Problem formulation:	The upcoming changes in the demographic structure will put pressure on the healthcare system in Skåne. Tax financed hospitals with more beds, doctors, nurses and other personnel will not be the solution to cope with the upcoming demands. Increasing healthcare productivity is one way, where digital healthcare is a potential part of the solution. One of the major limitations of the digital healthcare market is not the shortage of technology but rather the innovation-uptake is slow in healthcare compared to other sectors. The problem is to understand why the technology uptake is slow, which barriers prevents uptake and what decelerate continued innovation in the healthcare sector.
Purpose:	The main purpose aim to describe and analyze the regional preconditions in Skåne for innovation in digital healthcare. The goal has been to identify strengths, opportunities and various barriers that prevents or delay innovation in the region. Identifying and proposing innovative health strategies with the TOWS-framework.

Sub purposes are to identify upcoming global trends in healthcare and gather a list of digital healthcare projects in the region.

Methodology: The methodology for gathering data for this master thesis consists of a combination of primary and secondary data. Collected from secondary research, explorative quantitative survey study, semi structured interviews with key actors, attending and observing national and local eHealth events.

Conclusions: The region of Skåne in the south of Sweden got the possibilities for a good climate for innovation in healthcare. There is a possibility to gather ideas and projects for incremental innovation in the region. Both the healthcare professionals and patients are sitting with valuable expertise and knowledge, which at this time is not fully utilized. To get a more radical change in the healthcare sector some barriers need to be broken down. These changes need a more strategic and political approach, many of them need to be brought up on a national level. Today security laws regulation the use of information need to be modified to allow the use of unidentified healthcare data. Making it easier for the academia and companies to use this information would allow them to pursue new research areas and possible innovations.

For new entrepreneurs and businesses there is need to learn how to use the reimbursement model to support their business plans. It is also important that the way into the healthcare sector, procurements, is built to handle and promote these new ventures.

Skåne has a gap in expertise regarding semantic interoperability, both in the business and academic sector. This is not a unique problem for Skåne and can be seen in other regions as well. Collaborations with other regions and

worldwide expertise is needed to fill this gap and promote advances in this field.

Comparing to other countries, Sweden are ranked 3rd on the list of innovation uptake in healthcare just beaten by Denmark and Estonia. Third place in digital healthcare solution implementation is good but we can’t sit down and be satisfied with the result. Even if you are in first place you need to constantly revaluate your position and look for areas to improve. The region have most of the building blocks to get a good climate for innovation in digital healthcare. Region Skåne have to join the blocks together, here is a unique opportunity to facilitate cross-border meetings, be a collaborate voice, and put digital healthcare on the agenda. There is a need for a link into healthcare to get providers, doctors and nurses to share their ideas and needs to business, entrepreneurs, and the academia. Lobbying to politicians and policymakers should be done to raise the awareness and try to change some regulations and laws that acts as barriers for innovation today.

Keywords: Digital healthcare, eHealth, healthcare, innovation, Skåne

Sammanfattning

Titel:	Innovation inom hälso- och sjukvården, en analys av de regionala förutsättningarna i Skåne för innovation inom digital hälsovård.
Author:	Oskar Fällman Karlsson
Supervisors:	Carl-Johan Asplund, Professor i Industriell ekonomi och logistik, Lunds universitet, Lunds Tekniska Sverige Ann Tronde, Projektledare "Regional Digital Agendas for Healthcare", FoU-centrum Skåne, Skånes universitetssjukhus Lund
Problem-formulering:	De kommande förändringarna i den demografiska strukturen kommer att sätta press på sjukvården i Skåne. Skatte finansierade sjukhus med fler sängar, läkare, sjuksköterskor och annan personal kommer inte att vara lösningen för att klara de kommande kraven. Öka produktiviteten i vården är ett sätt, där digital hälsovård är en potentiell del av lösningen. En av de stora begränsningarna av marknaden för digital hälsovård är inte bristen på teknik utan snarare innovationsupptag är långsam i sjukvården jämfört med andra sektorer. Problemet är att förstå varför teknikupptaget är långsam, vilket hinder förhindrar upptag och vad saktar ner fortsatt innovation inom vårdsektorn.
Syfte och delsyften:	Syftet med examensarbetet är att beskriva och analysera de regionala förutsättningarna i Skåne för innovation inom digital hälsovård. Målet har varit att identifiera styrkor, möjligheter och olika hinder som förhindrar eller fördröja innovation i regionen. Identifiera och föreslå innovationsstrategier med hjälp utav TOWS-ramverket.

Delsyften är att identifiera kommande globala trenderna inom hälso- och sjukvården samt samla in en lista med e-hälsoprojekt i regionen.

Metodik: Metoden för att samla data till detta examensarbete består av en kombination av primär- och sekundärdata. Informationen är insamlade från sekundär forskning, explorativ kvantitativ enkätstudie, semistrukturerade intervjuer med nyckelaktörer, delta på nationella och lokala e-hälsoevenemang.

Slutsatser: Regionen Skåne i södra Sverige har möjligheterna till ett bra innovationsklimat inom hälso- och sjukvården. Det finns möjligheter att samla idéer och projekt för inkrementell innovation i regionen. Både vårdpersonal och patienter sitter med outnyttjad värdefull kompetens och kunskap. För att få en mer radikal förändring inom sjukvården behöver vissa hinder brytas ner. Dessa förändringar behöver en mer strategisk och politisk strategi, många av dem måste föras upp på en nationell nivå. Dagens säkerhetslagar som reglerar användningen av information behöva ändras för att tillåta bruk av oidentifierade sjukvårdsuppgifter. Att göra det lättare för akademi och företag att använda denna typ av information skulle möjliggöra det för dem att satsa på nya forskningsområden och potentiella nya innovationer.

För nya företagare och företag måste det framgå hur man använder befintlig ersättningsmodeller för att stödja sina affärsplaner. Det är också viktigt att vägen in i sjukvården, upphandlingar, är byggd för att hantera och främja nya satsningar.

Skåne har en brist både inom näringslivet och den akademiska sektorn i kompetens avseende semantisk interoperabilitet, Detta är inte ett unikt problem för Skåne och kan ses i andra regioner. Samarbeten med andra regioner och världsomspännande kompetens behövs för att fylla detta gap och främja framsteg på detta område.

Jämfört med andra länder är Sverige rankat 3 på listan över av innovations upptag inom hälso- och sjukvården, slagen av Danmark och Estland. Tredje plats i implementering av digitala hälsolösningar är bra, men vi kan inte sitta ner och vara nöjda med resultatet. Även om du är på första plats måste du ständigt omvärdera din position och leta efter områden att förbättra. Regionen har de flesta byggstenarna för att nå ett bra innovationsklimat inom digital hälsovård. Region Skåne måste sätta ihop blocken, här finns ett unikt tillfälle att underlätta gränsöverskridande möten och satte digital hälsovård på agendan. Det finns ett behov av en länk in i sjukvården för att få professionen, läkare och sjuksköterskor att dela sina idéer och behov till företag, entreprenörer och den akademiska världen. Lobbying till politiker och beslutsfattare bör göras för att öka medvetenheten och försöka ändra de regler och lagar som fungerar som barriärer för innovation idag.

Nyckelord: digital hälsovård, eHälsa, sjukvård, innovation, Skåne

Abbreviation List

EHR	Electronic Health Record
EMR	Electronic Medical Record
ICT	Information and communication technology
PESTEL	Political, Economic, Social, Technical, Legal and Environmental
PCP	Pre-commercial procurement
PPI	Public Procurement of Innovative
SWOT	Strengths, Weaknesses, Opportunities, and Threats
SUS	Skåne University Hospital
WHO	World Health Organization

Glossary

Digital health

Digital healthcare is transfer of health resources and healthcare services with use of information and communication technologies to help address the health problems and challenges. These technologies include both hardware and software solutions. Digital Health includes eHealth, mHealth, Wearables, EHR/EMR, Connected Health, Big Data, Quantified self, Interoperability, Health IT and many other.

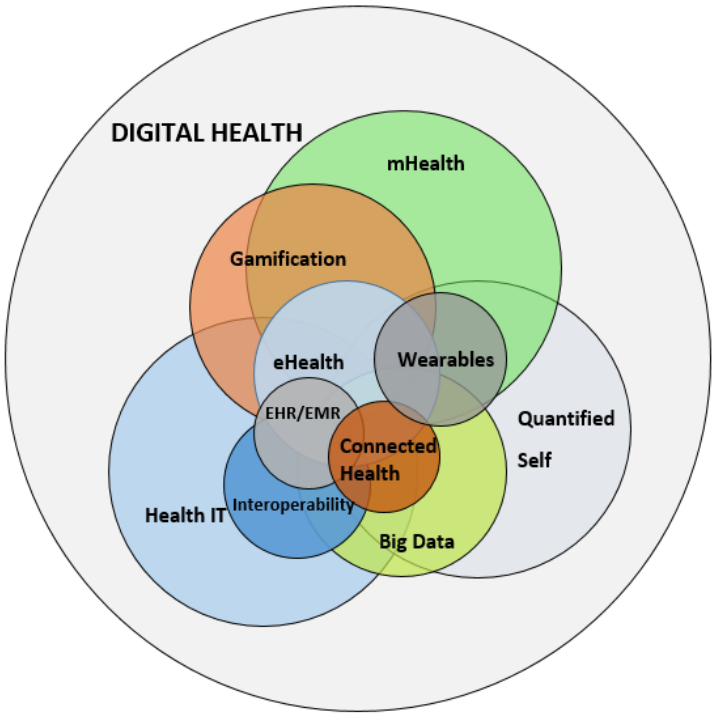

Figure 1the Digital Health Landscape

eHealth

EHealth is one of the central terms that is commonly used today to describe a range of digital healthcare. There is many definitions of eHealth. For this master thesis the definition to be used are gathered from WHO and the European Commission “HEALTH-EU”.

”eHealth is the overarching term for the range of tools based on information and communication technologies used to assist and enhance the prevention, diagnosis, treatment, monitoring, and management of health and lifestyle.”

Broken down eHealth is the transfer of health resources and healthcare by electronic means. The three main areas are:

- The delivery of health information with the help of Internet and telecommunications.
- Using IT and electronic to improve public health services, e.g. through the education and training of health workers.
- The use of electronic commerce and electronic business practices in health systems management.

Mobile Health, mHealth, is a component of eHealth and was coin in 2005. The definition was used at the 2010 mHealth Summit of the Foundation for the National Institutes of Health (FNIH) was "the delivery of healthcare services via mobile communication devices".

Innovation and Invention

There is a distinct difference between innovation and invention. According to Innovation Unit, UK, Department of Trade and Industry (2004) innovation is the successful exploiting of new ideas. Which is a view shared by Tidd, Bessant and

Pavitt describing innovation as the process turning opportunity into new ideas and putting these into widely used practice. Invention is coming up with the new ideas, a new product, process or service in the first place. A new invention doesn’t guarantee commercial success and in many cases need innovations around it before getting adopted by the market.

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1 Introduction

In this chapter the background and problem definition will be described. The purpose and delimitations of the thesis will be presented. This section ends with the disposition of the master thesis and a comprehensive work plan over the theoretical and empirical framework to give the reader an overview of the workflow.

1.1 Background

"We know that in healthcare we lag at least 10 years behind virtually every other area in the implementation of IT solutions. We know from a wide range of other services that information technology applications can radically revolutionize and improve the way we do things" Estonian President Toomas Hendrik Ilves, Chair of the independent high-level eHealth Task Force (May 2012)

Implementation of IT solutions and innovation in healthcare is lagging behind when compared to other sectors. These solutions have the possibility to change the way healthcare is performed today, and make it possible to cope with the future demands on the system. Reports shows that life expectancy is increasing and a growing proportion of the world's population is living into old age. The result of people getting older are that people acquire more diseases during their life span, some of which are chronic and require more extensive and expensive healthcare. Taking the United States as an example, about 80% of all older adults, people above 65 years old, have one chronic condition, and 50% have at least two. Sweden is not far behind with the numbers 75% and 42%. These chronic diseases stands for 70% of today's overall healthcare costs.

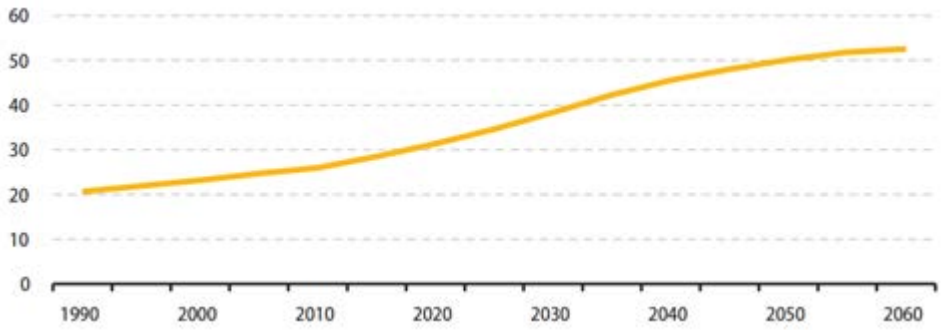

Figure 2 Population aged 65+ in relation to the population aged 15-64

A reason for this change is the upcoming "Silver Tsunami" which refers to the ageing workforce around the world. One of the driving factors for this phenomenon are the Post-World War II baby boom that created an unusually large birth rate during the years 1946 to 1964. These people have now got into their fifty's and late sixty´s and are accounting for one part of the changing demographic pyramid. It has been predicted that in less than 50 years there will be just two persons of working age, between 15-64 years old, for every person above 65 in the European Union. Today that number are about 4:1, and the trend is similar around the world.

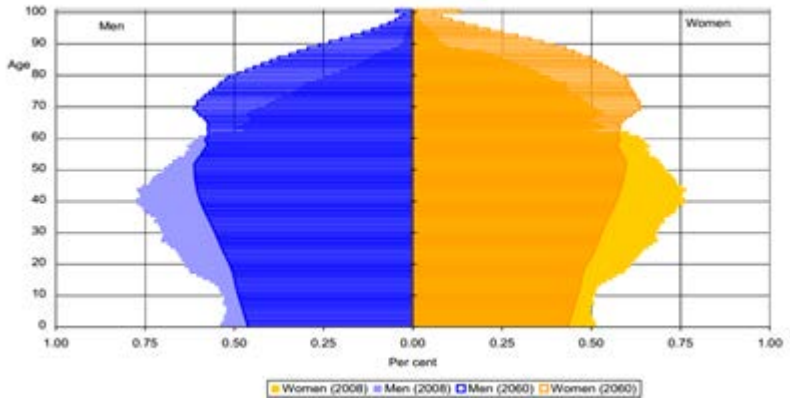

Figure 3 Population pyramids, EU27, 2008 compared to 2060

The result of the changing demographic pyramid will be fewer future taxpayers and fewer people becoming doctors, nurses and other healthcare professionals compared to the total population. Thus, tax financed hospitals with more beds, and packed with doctors, nurses and other personnel will not be the solution to cope with the upcoming demands.

1.2 Problem Definition

The upcoming changes in the demographic structure will put pressure on the healthcare system. Tax financed hospitals with more beds, packed with doctors, nurses and other personnel will not be the solution to cope with the upcoming demands. Increasing healthcare productivity is one way, where digital healthcare and eHealth is a potential part of the solution.

As Toomas Hendrik Ilves said, one of the major limitations of the digital healthcare market is not the shortage of technology but rather the innovation-uptake is slow compared to other sectors.

The problem is to understand why the technology- and innovation-uptake is slow, which barriers prevents uptake and what prevents faster innovation in the healthcare sector.

1.3 Main purpose and sub purposes

The main purpose aim to describe and analyze the regional preconditions in Skåne for innovation in digital healthcare. First sub purpose is to identify strengths, opportunities, weaknesses and threats to find various barriers that prevents or delay innovation in the region. Second sub purpose has been to applying the TOWS framework in order to propose a tentative future actions for digital health in south of Sweden

Intermediate goals are to identify upcoming global trends in healthcare and gather a list of digital healthcare projects in the region.

1.4 Delimitations

The geographical frame of this master thesis is limited to Skåne. The analysis will be based on the regional conditions and therefore may not be directly applicable to other regions. The thesis will consist of strategies based on the SWOT analysis of the region. Focus for the strategies will be on the triple helix and healthcare sector.

1.5 Target Group

The target groups for the master thesis are both the stakeholders in Region Skåne, the academia, politicians, healthcare and business sector.

1.6 Disposition of the master thesis

This section shows the disposition of the master thesis. Ending with a comprehensive work plan over the theoretical and empirical framework to give the reader an overview of the workflow.

CHAPTER 1 – Introduction
In this chapter the background and problem definition will be described. The purpose and delimitations of the thesis will be presented with a work plan over the theoretical and empirical framework.

CHAPTER 2 – Research approach and methodology
This chapter contains a description of the different methodology that can been used when gathering information. The research approach with the choice of methodology, research strategy and how information where gathered.

CHAPTER 3 – Theoretical framework

The theoretical framework chapter describes the theories and models used for the analysis of the gathered empiric data. The framework consist of two methods that has been used in combination with each other to map the region, PESTEL and SWOT. The tool to form strategies from the SWOT analysis, TOWS, is described in the last section.

CHAPTER 4 – Key areas of interest, Healthcare and ICT-challenges

This chapter have a short summary explaining the different key ICT areas that has been identified as important for innovation in healthcare. They are security, semantic interoperability, cloud computing, pre-commercial procurement and big data.

CHAPTER 5 – Background analysis of Skåne

This chapter will present the current situation of Skåne and where it´s heading. It consist of a summary of the population growth, the regions vision, industries and a market analysis. The chapter includes a summary of the innovation support structure existing in region Skåne today.

CHAPTER 6 – Upcoming trends

This chapter describes upcoming global trends. These trends will affect how healthcare is going to be delivered both on a local and global level. Therefore is it important to have upcoming trends in mind when looking at new innovations, products and delivery systems.

CHAPTER 7 – Summary of data

The empiric chapter presents the gathered research data from the in-depth interviews and survey results. In the later part of the section all the gathered data including a PESTEL analyze are represented in the SWOT analyze of the region.

CHAPTER 8 – Analysis

This chapter shows the analysis of the regional SWOT and the process to get strategies and action from it. The section ends with a broader analysis of the regional preconditions for innovation in digital healthcare.

CHAPTER 9 – Conclusions and Recommendations

This chapter presents the conclusions of the regional conditions in Skåne for innovation in digital healthcare. It ends with a list of complementary actions that that have come to light during the process.

CHAPTER 10 – Reflections over main contributions

This chapter adds some reflections regarding the innovation in healthcare in Skåne. The chapter ends with some interesting question has come to light during the process and could be considered topics for future academic research.

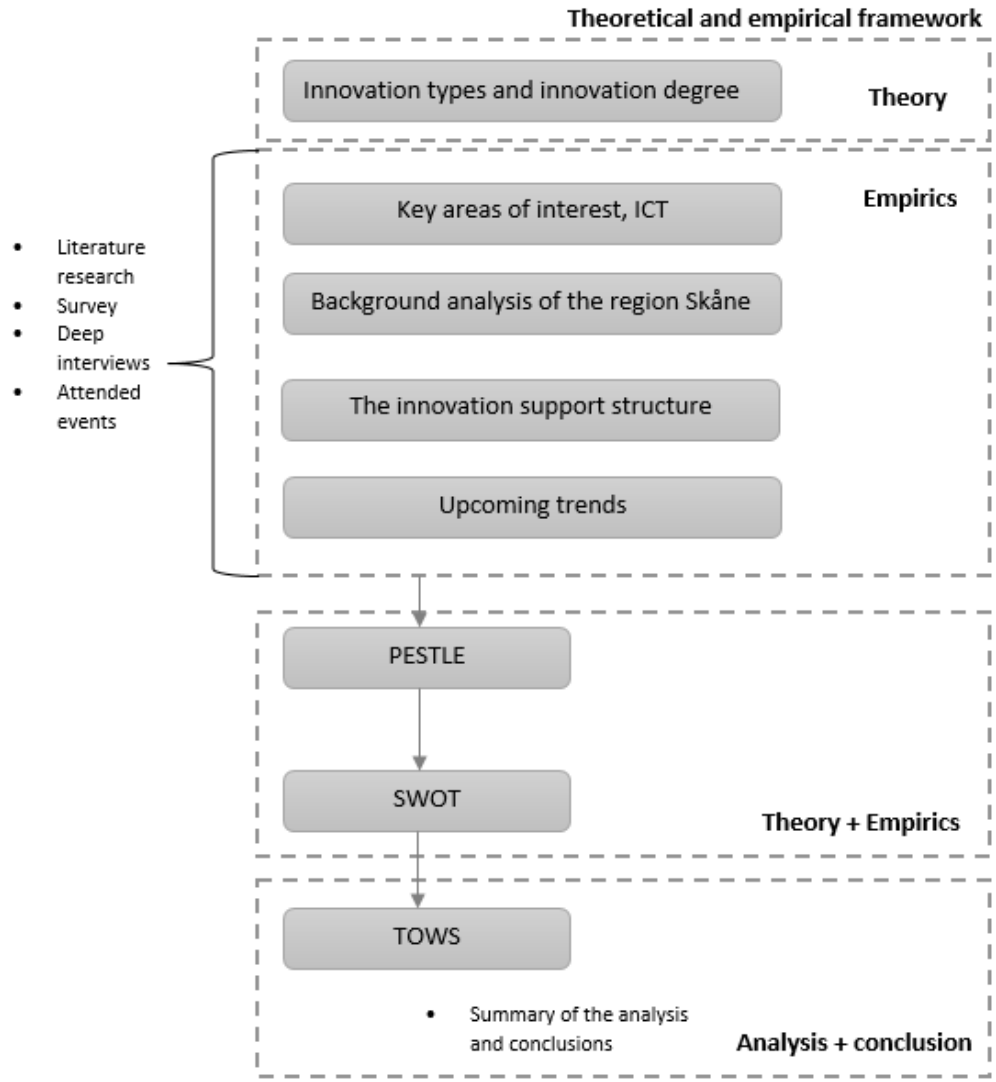

Figure 4 the theoretical and empirical framework of the master thesis

2 Research approach and methodology

This chapter contains a description of the different methodology that can been used when gathering information and doing the analysis. The research approach with the choice of methodology, research strategy and how information where gathered.

2.1 Research strategy

Depending on the character of the report and the subject that's going to be studied different research strategies may be applied. Here is a description of three of the most common research strategies, these strategies are often are used simultaneously.

2.1.1 Exploratory

In order to gain knowledge and understanding regarding a problem an exploratory strategy could be applied. The strategy can provide a foundation for relevant question formulations and enable specification of the task which in turn makes it possible to define different alternatives of action.

According to Saunders there are three principal ways of conducting exploratory research:

- Literature research
- Interviewing key expert in the area
- Conducting focus group interviews

The advantage of an exploratory research method is that it is flexible and adaptable to change. When new data appear and new insights occur as a researcher you need to be willing to change the direction you are heading.

2.1.2 Descriptive

Descriptive research is used when trying to provide an accurate description of observations of a phenomena. The objective of descriptive research is to map the terrain of a specific phenomenon.

2.1.3 Explanatory

Explanatory research aim to understand relationships between different variables. Studying a situation or a problem in order to explain the relationships that exist between dose variables. How different factors are connected and affect each other.

2.2 Research method

2.2.1 Quantitative research

When preforming a quantitative research the goal is usually to find relations between different variables to able to make some type of generalization that later could be applied to populations beyond the sample population.

Measurement is a central concept, it provides the ability to perform more exact estimations, describe small differences and finding significant causality. Examples of methods in quantitative research are surveys, structured interviews and structured observations. These methods enable the use of large sample populations.

Quantitative data is collected at a distance with minimum interaction from the researcher. The researcher therefore has little to no influence on the result. This is critical in order to achieve reliability, see 2.4.1 Reliability.

2.2.2 Qualitative research

In contrary to quantitative research the objective of a qualitative data collection is to describe a certain situation by viewing it from the perspective of the research

subject. Data gathered in the process is often presented in the form of words. The results generated are often case specific and provide contextual understanding, but are difficult to generalize beyond the sample population.

Examples of methods of collecting qualitative data are unstructured interviews and focus groups. Because of the nature of these methods it´s common when preforming a qualitative research to use a smaller sample population. It´s important to take into account the risk the researcher has of influencing the data that's being collected.

2.3 Data collection methods

2.3.1 Survey

A survey study is a type method to collect information in an organized and methodical way. The method is measuring of specific situations or conditions. The survey method is typically used for studies with descriptive or explanatory strategy allowing the collection of a large amount of data from a sizeable population in a highly economical way. The data is often obtained by using a questionnaire handed out to a sample population. The questionnaire is standardized which allows for easy comparison of the gathered data.

It's often used to collect quantitative data. The data collected can be used to suggest possible relationships between variables.

To ensure reliability it´s important to spend time ensuring that the sample is representative for the population, designing and piloting the questionnaire to secure that the question is relevant and understandable. This is a way to try to ensure a good response rate.

2.3.2 Interviews

There are usually three different type of interviews that can be used when doing a research. Those are structured, semi-structured, and unstructured. There is some differences between them which makes them suitable for various intents and purposes.

2.3.2.1 Structured interviews

Structured interviews require to follow a very particular set of rules. Each question that is outlined should be read word for word by the researcher without any deviation from the protocol. In some cases, the interviewer is also required to show consistency in behavior across all interviews. This includes body posture, facial expressions, and emotional affect. Reactions to participant responses should be kept to a minimum or if possible avoided entirely.

Structured interviews are the type used most often by quantitative researchers. The style is useful when looking for very specific information. The benefits are that it keeps the data concise and reduces researcher bias.

2.3.2.2 Semi-structured interviews

Semi-structured interviews are a bit more relaxed than structured interviews. While researchers using this type are still expected to cover every question in the protocol, they have some wiggle room to explore participant responses by asking for clarification or additional information. Interviewers also have the freedom to be more friendly and sociable.

Semi-structured interviews are most often used in qualitative studies. The style is most useful when one is investigating a topic that is very personal to participants. Benefits include the ability to gain participants' trust, as well as a

deeper understanding of responses. Data sets obtained using this style will typical be larger than those with structured interviews.

2.3.2.3 Unstructured interviews

In this type of interviews researchers only need a checklist of topics that should be covered during the interview. There is no order and no script. The interaction between the participant and the researcher is more like a conversation than an interview.

Unstructured interviews are most often used in qualitative studies. They are best used when researchers want to find as much information as possible about their topic. The benefit is that unstructured interviews often uncover information that would not have been exposed using structured or semi-structured interviews. The researcher and participant are not limited by the protocol. It is typical that data sets collected using unstructured interviews will be larger than the other two techniques.

2.3.3 Secondary research

Secondary research is gathering and reanalyzing data that have already been collected, this data is often referred to secondary data. Secondary data include both quantitative and qualitative data and they are used in both explorative, descriptive and explanatory research.

2.4 Quality of results

To ensure a good quality of a research are obtained, criteria such as reliability and validity should be evaluated.

2.4.1 Reliability

Reliability is a measurement on how well a method will provide the same or almost the same results each time when iterated. It shows how much influence different factors have had on the research method. Reliability is often used when preforming a quantitative research showing how stable a measurement is.

2.4.2 Validity

According to Bryman and Bell validity is one of the most important research criteria's. When performing a research it is central to be able to validate whether the conclusions that are generated are related or not. Validity is divided into intern- and extern validity. Where intern validity are the compliance between the researcher's observations and the theoretical ideas developed. Extern validity is instead whether the results can be generalized and applied outside the studied population.

2.4.3 Triangulation

Triangulation is the use of two or more independent sources of data or data collection methods to analyze research findings within a study. It is primarily associated with quantitative researches but can be used to increase reliability for qualitative studies. A combination of qualitative and quantitative methods are often used in order to control the validity of the results.

2.5 The selected method

To ensure a good reliability different kind of methodologies where used to gather information for this master thesis. The thesis is based on information from literature- and desktop research, survey answers, interviews with key stakeholders, gathered information from attended global and local events.

2.5.1 Secondary research

To get an understanding of the field and where the knowledge base are a literature research where preformed. Information where gathered from different types of academically literature search databases like LUB, LOVISA and LIBRIS. When searching databases some of the keyword that were used where, eHealth, connected healthcare, mHealth and innovation. Reports and articles were also gathered from the European Commission.

2.5.2 Survey

The main goal of the survey was to gain knowledge and get a better understanding of the regional ecosystem. Using a survey made it possible to get answers and opinions from a large amount of people in a fast and economical way. Method for the analysis where an explanatory survey study. The choice of an explanatory strategy where determent upon the relative new business area digital healthcare and eHealth is considered to be and the lack of previous studies in the area. The survey was a part of “READi for Health” and the survey was performed in four different countries, with four different first languages. As this master thesis focus on Skåne the other regions will not be included.

2.5.3 Interviews

To verify trends and findings in the survey and from desktop research interviews were held with key stakeholders. The interviews method choice where semi-structured interviews because of the ability to get answers on key question and

also capturing more subjective opinions and needs. Swedish examples of the guides that was used can be seen in Appendix 2-4. Different guides where used depending on the business area of the interviewee.

2.5.4 Attended events

In order to gather information on the current situation on a local-, national-, and global level events where attended. This to see what expert in the field where thinking and to capture upcoming global trends. Over the course of time a total of six different events and day seminars was attended. During the events notes on interesting seminars where gathered and unstructured interviews where held with seminar participants.

- Hur ska då sjukvården lyckas öka sin produktivitet i en omfattning tillräcklig för att möta framtidens behov?, 13 Februari, Mats Olsson, Medeon Science Park
- Medicinteknik i Skåne, Lund, 12 Mars
- Vitalis 2014, Gothenburg, 8-11 April
- Connect and be READi for Health, Lund, 24 April, Mats Ekstrand, Medicon Village
- Strödstrukturer för innovation i Skåne, 20 Maj, Media Evolution City, Malmö
- Digital Health Days 2014, Stockholm, 25-26 August

3 Theoretical framework

The theoretical framework chapter describes the theories and models used for the collection and analysis of the gathered empiric data. The theoretical framework, se figure 3, consist of two methods that can be used in combination to each other to map the region, PESTEL and SWOT. The third method is applying the TOWS framework on the findings in the previous steps to form suggested strategies.

3.1 Innovation types

Innovation refers to changes that can be categorized in different ways. This thesis will use a categorization called “the 4P´s of innovation”. When talking about innovations there will be product-, process-, position-, and paradigm innovations. The model was developed by John Bessant and Joe Tidd (2009) and they explains the different types like this:

- *Product innovation* – changes to a product or services that already exist. A good example is the ball pen, changing the way a pen is delivering the ink to the paper.
- *Process innovation* – changes in the ways a product or service are manufactured or delivered. It can be a changes and optimization in the underlying manufacturing process or new delivery systems like just-in-time.
- *Position innovation* – changes in the context, how a product or service is perceived and how it’s used. An example showing the power of re position is the glucose-based drink Lucozade developed for children and invalids in convalescence. The dink become associated with sickness and later abandoned. When it re-launched they positioned the product as a performances enhancing drink for athletes. Giving the drink a new image.
- *Paradigm innovation* – changes in the underlying mental models which shape what an organization does. The most common known example is

Henry Ford who changed the car manufacturing industry. From being a product for wealthy few to become mass-produced for a price everyone could afford.

3.2 Innovation degree

When talking about innovation they can be classed into two groups, incremental and radical. An incremental innovation is often an improvement in the production cost or function of an already existing product on the market. Most innovation can be categorized into this field. A radical innovation on the other hand explores new technology and creates a change that transforms existing markets, industries or can even create new ones.

Combining the 4P´s with the innovation degree gives the potential innovation space where an organization can operates within, see figure Figure 4.

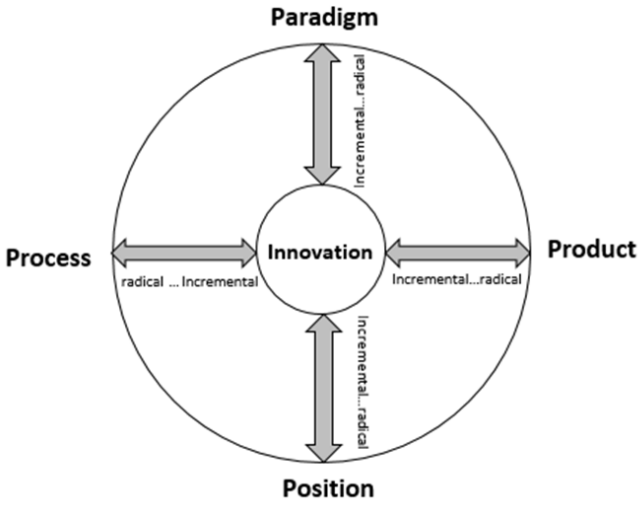

Figure 5 the Innovation Space

3.3 PESTEL

PESTEL stands for Political, Economic, Social, Technical, Environmental and Legal. Johnson, Scholes, & Whittington describes it as a tool for assessing the external influences from the environment of a region, business or organization. A PESTEL analysis can be done alone or as a tool to provide context for example a SWOT. The tool can help to highlight environmental shifts and changes that might have been overseen if only a SWOT analysis would have been done.

- *Political* – Laws, global issues, legislation and regulations which may have an effect a business either immediately or in the future.
- *Economic* – Taxes, interest rates, inflation, the stock markets and consumer confidence all need to be taken into account.
- *Social* – The changes in lifestyle and buying trends, media, major events, ethics, advertising and publicity factors.
- *Technological* – Innovations, access to technology, licensing and patents, manufacturing, research funding, global communications.
- *Legal* – Legislation which have been proposed and may come into effect and any passed legislation's.
- *Environmental* – Environmental issues either locally or globally and their social and political factors.

3.4 SWOT

SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. It´s a tool developed in the 1960-1970 and used to evaluate projects, products, organization, places, or business ventures.

- *Strengths* are characteristics of the business or project that give advantage over others. Strengths are internal positive factors

- *Weaknesses* are characteristics that place the organization or project at a disadvantage relative to others. Weakness are internal negative factors.
- *Opportunities* elements that could exploit to its advantage. Opportunities is external positive factors
- *Threats* external elements that could cause trouble for the business or project. Threats are external negative factors

These are often gathered with the help of a matrix, see below, that's why a SWOT analysis also might be known as a SWOT matrix. It is important to have in mind that a SWOT analyze is often drawing up a list of current company strengths, weaknesses, opportunities and threats. This leads to generating strategies based on the current situation. If a change is going to happen in the organization's environment a strategy built on past situations is very likely to be badly suited to the upcoming changes. When actions built on the old SWOT is launched new strength, weaknesses, opportunities and threats will have arisen.

	Strengths characteristics of the business or project that give advantage over others	**Weaknesses** characteristics that place the organization or project at a disadvantage relative to others
Internal factors	S	W
	Opportunities elements that could exploit to its advantage	**Threats** external elements that could cause trouble for the business or project
External factors	O	T

Figure 6 SWOT matrix

3.5 TOWS

It´s a tool for matching threats and opportunities with the weaknesses and strengths of a company or organization. The tool was created by Heinz Weihrich and it can be considered a variant of the SWOT analysis but it's more focused on strategic planning. In order to use the tool preferably an SWOT analysis and a ranking of the most important factors should have been done beforehand. In

every quadrant of the TOWS matrix there will be a combination of internal and external factors. The goal is to consider how to use them to create a good strategic plan. There is some questions that are good to ask yourself when doing each quadrant of the matrix.

- *Strengths and Opportunities (SO)* – How can you use your strengths to take advantage of these opportunities?
- *Strengths and Threats (ST)* – How can you take advantage of your strengths to avoid real and potential threats?
- *Weaknesses and Opportunities (WO)* – How can you use your opportunities to overcome the weaknesses you are experiencing?
- *Weaknesses and Threats (WT)* – How can you minimize your weaknesses and avoid threats?

	Strengths 1. 2. 3.	**Weaknesses** 1. 2. 3
Opportunities 1. 2. 3.	**SO** Strategies that use strengths to maximize opportunities.	**WO** Strategies that minimize weaknesses by taking advantage of opportunities.
Threats 1. 2. 3.	**ST** Strategies that use strengths to minimize threats.	**WT** Strategies that minimize weaknesses and avoid threats.

Figure 7 TOWS matrix

4 Key areas of interest, Healthcare and ICT-challenges

This chapter have a short summary explaining the different key ICT areas that has been identified as important for innovation in healthcare. These are security, semantic interoperability, cloud computing, pre-commercial procurement and big data.

4.1 Security,

Information security is considered important means protecting information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction in order to provide:

- *Integrity* – which means guarding against improper information modification or destruction, and includes ensuring information nonrepudiation and authenticity
- *Confidentiality* – which means preserving authorized restrictions on access and disclosure, including means for protecting personal privacy and proprietary information
- *Availability* – which means ensuring timely and reliable access to and use of information.

In Sweden there is “Patientdatalagen” (2008:355) and Patientdataförordningen (2008:360) which regulates the use of personal information and EMR.

4.2 Semantic interoperability

Semantic Interoperability ensuring that the precise meaning of exchanged information is understandable by any other application that was not initially developed for this purpose. Thus, enables systems to combine received

information with other information resources and to process it in a meaningful manner. Semantic interoperability is the highest level of interoperability followed by structural and foundational.

4.3 Cloud Computing

Cloud computing is a model for enabling on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services). The service is flexible and can be increased or decreased rapidly with minimal management effort or interaction from the service provider. Cloud computing makes it easier and affordable for start-ups to acquirer computer systems and computing power compared to traditional on-site IT resources. With the benefit of being scalable with the growth of the company.

4.4 Pre-commercial procurement

Pre-Commercial Procurement (PCP) refers to the public procurement of research and development on new innovative solutions before they are commercially available. PCP works in conjunction with Public Procurement of Innovative Solutions (PPI).

In some cases, public sector challenges can be addressed by innovative solutions that are nearly or already in small quantity on the market and don't need new research and development (R&D). This is when Public Procurement of Innovative solutions (PPI) can be used effectively.

PCP and PPI makes it possible to develop a forward-looking innovation procurement strategy driven by demands and needs. This enables the public sector to modernize public services faster and drive innovation forward.

This procurement tool is meant to promote innovation through:

- a competitive research and development process,
- a risk sharing strategy between the bidders and the procurer,
- a buying process,

4.5 Big Data

Big data often refers to unstructured data that are too big to fit on a single server. The amount of data that's generated today is enormous. For instance the average company has 427 times the amount of data that ever recorded in the Library of Congress. The volume, unstructured form and constant flow of new information makes it hard to use tradition analysis methods, resulting in the use of machine learning.

Healthcare is considered one of the emerging markets for the use of big data. The EMR are getting more structured and with the help of natural language processing technologies physician's and nurse's notes can be captured and classified. The beliefs are that if all data could be integrated, categorized and then analyzed we´d know a lot more about the patient conditions with the help of information we already have. With eHealth, tele-medicine, mHealth and all connected devices there will be massive amount of data that will be generated. The big challenge is not to gather big data, it´s how to use this vast amount of information.

5 Background analysis of the Skåne region and healthcare

This chapter will present the current situation of Skåne and where it´s heading. It consist of a summary of the population growth, the regions vision, industries and market analysis.

5.1 Skåne

Skåne is located in the southern parts of Sweden and 2012/2013 consisted of a population of 1 263 088. By the year 2022 the population is expected to rise to 1 369 000 people, which is an increase of 8.4%. The population in the region is increasing at a faster rate than the nation as a whole. This is the result mainly because of the migration to Skåne from other provinces have been greater than the emigration. The rising population will put higher demands on the infrastructure of the region, including the healthcare system. Michael E Porter and Elizabeth Olmsted Teisberg mean that today's healthcare system is delivered with a 1800s organization. These thesis is backed up by professor Regina E. Herzlinger who says "Yes, medical treatment has made astonishing advances over the years. But the packaging and delivery of that treatment are often inefficient, ineffective, and consumer unfriendly." The Swedish social minister Göran Hägglund want to reform our 150 years old healthcare organization. It comes clear that current healthcare systems are building on old organizational structure.

Skåne has a vision to be Europe´s most innovative region 2020. The foundation of the strategy is substantial investment in reinforcing Skåne's innovation culture and capacity. According to the strategy a culture which grows out of the creativity,

openness and diversity that Skåne has today. When looking at Sweden as a whole country it is considered one of the innovation leaders in the European Union. On eHealth solution implementation Sweden gets ranked 3rd in Europe, beaten by Estonia and Denmark.

There is a strong business sector and market in Skåne. Big global mobile industry companies have ongoing research and/or development activities, such as Ericsson, ST Ericsson, Sony, Qualcomm, and TeliaSonera to name a few. There is also a lot of other high-tech ICT companies located in the region like SICS Security who has located a research team in the region. This resulting in strong research in key areas like, ICT (Security, cloud computing, mobile, gamification, Internet of Things, data analysis, sensor, camera) as well as biomedical engineering, life science and medicine.

World leading international research facilities in material science are being built, Max IV and ESS (European Spallation Source). These will not only strengthen the regions research capability's but also the attractiveness of the region. There is hopes that the facilities will have spin-off effects that might generate job opportunities and increase the economic growth for the region.

The region has a strong platform for higher education. Skåne has world class research institutions combined with four universities making it one of Europe´s leading educational and scientific centers. University of Lund, founded in 1666, is Scandinavia's largest campus for research and higher education. It´s ranked as one of the top Universities in northern Europe. Malmö University is one of Sweden´s newest higher education institutions and it´s growing rapidly. Kristianstad University is a smaller institution specializing in among other things health sciences and engineering. The fourth is the Swedish University of Agricultural Sciences with its main campus in Alnarp.

When combining Skåne with the Øresund Region which includes Greater Copenhagen, a total number of over 135,000 students, 12 universities and 10,000 scientists is located in the area. The region is housing scientific networks like the Medicon Valley Alliance, Øresund IT, Øresund Food and Øresund Environment.

The region has one of Sweden's oldest hospitals, the infirmary in Lund established 1768. To enhance the competitiveness of the region the 1 January 2010 the University hospitals in Malmö and Lund merged to one collective University hospital. The goal was to enhance the service in a Swedish and an international context, to enhance the scope of clinical research and to enhance the hospital's attractiveness as a workplace.

In 2013 Sony Mobile Communication, Region Skåne and Lund University founded MAPCI (Mobile and Pervasive Computing Institute at Lund University). MAPCI is a research institute that focus on distributed cloud technology. One of the main goal is to take on the role of a bridge-builder between existing mobile research center in southern Sweden and the industry.

5.2 Market analysis

The healthcare system in Sweden are to most extend government funded with taxes. It's decentralized into 21 regions and county councils. The result of this decentralization are that the healthcare market in Sweden becomes fragmented with every independent region and county council. Looking at the domestic market of region Skåne it´s considered quite small with its 1 million citizens.

To try and cope with the small market Region Skåne have started to collaborate with the two other big regions in Sweden, Region Stockholm and Region Västra Götaland. Making them together a bigger player and bigger potential market.

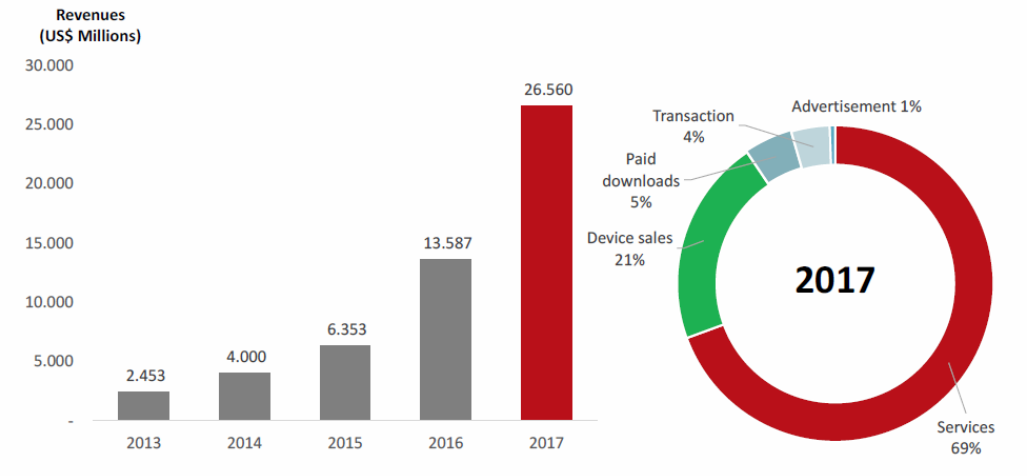

Figure 8 Global mHealth market revenue in USD (2013-2017)

Because of the relative small domestic market in Sweden it´s important to take a look globally. The global eHealth market is forecast to grow tremendous over the upcoming years. Report forecast the global teleHealth market to grow from 7.6 to 17.6 billion Euros already by 2017. Another report shows that only taking the global mHealth app market to account it´s revenue will reach USD 26 billion by 2017. That number would be equal to a 0.5% share of the global healthcare market. It´s still an uncertain how much the market will grow in the future but everyone are agreeing that the market is still in an early phase.

Region Skåne can benefit from this growing market segment. A strong innovation, adaptation and exportation can give a better quality of life for citizens, growth for the industry and tools for managing the upcoming demands on the healthcare system. Innovation in ICT can provide with better and cheaper healthcare services. One estimations done for the European Commission shows that the introduction of better ICT and telemedicine alone might improve efficiency of healthcare by 20%.

5.3 The innovation support structure in Skåne

A recently released report performed by CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy, Lund University) shows that the innovation support structure is fragmented. The innovation support structure in Skåne is consisting of 93 different actors. Of them 53 have some specific sectorial focus and 60 of them are working regionally. The diversity among the organizations are good but some areas are still missing. Geographically most enterprises are established in southwest part of Skåne. A lot of them have some sort of connection to the different Universities in the region, Lund's University, Swedish University of Agricultural Sciences and Malmö University all have some organization linked to them.

There has been a debate around the number of actors and the question if they are too many or too few. People are not unanimous on the issue and they have not come to any consensus in the matter. It´s clear that entrepreneur's might have a hard time knowing where to go but on the other hand the new organizations' that have started are filling gaps and missing areas.

There is already established collaborations between some of the bigger organizations. Networking between the innovations support structures in Skåne have come up on the agenda. Region Skåne has taken an active role and started to invite to seminars and discussion meetings. The idea is to promote collaboration and create a shared vision for the region. This is a way of overcoming the fragmented structure and make it easier for people to seek support. The long term agenda is to get Skåne known outside the region as a good place for new entrepreneurs.

These goals are embedded in *International Innovation strategy for Skåne*. The strategy highlights personal health as one of the great potential innovation areas

for the future. Points on the importance of partnerships between various clusters as essential for inventiveness and innovation in the region.

Today’s innovation system is focused on the early phases. Continued financing for the later growth phase is harder to get which entrepreneurs can attests to.

The innovation strategy also push public-sector players such Region Skåne and Skåne municipalities to support the development of system innovations through PCP and PPI.

6 Upcoming global trends in healthcare

This chapter describes upcoming global trends in healthcare. These trends will affect how healthcare is going to be delivered both on a local and global level. Therefore is it important to have upcoming trends in mind when looking at new innovations, products and delivery systems.

6.1 Value-based healthcare

In the new area of healthcare the patient must be in the center. The flow should follow the patient horizontally through the organization. Today's management is based largely on the producer's performance in the form of, capitation, visits, hospital days, and operations. Any improvement of the organization is therefore often performed on unit level and their unit's perspective. The result is vertical silos where the patient flow is left out of the picture. People in systems of care are aware of these problems and have given it its own name: NAP (någon annan patient), which is read someone else's patient.

Peter Lindgren raises, in the report "Ersättning i sjukvården modeller, effekter, rekomendationer", the need to evaluate different compensation system. Sweden has a unique opportunity to study the effects of reforms of our remuneration model. Central data warehouse and systems makes it possible for many county councils have a good overview of their healthcare system. Combined with both national records and quality registers makes a good foundations to evaluate different models with relevant control groups.

Work is being done in this area, a joint study is being performed by KI, Swedish Hip Arthroplasty Register and Harvard Business School. Results from this study shows better coordination of the care chain, 17% increased operational productivity, higher focus on health outcomes and avoiding complications, 98% satisfied patients and no waiting. It's important to follow what comes out from

this study as it might change the way healthcare is going to be performed and compensated in the future.

6.2 The enlightened patient

Patients are acquiring more and more knowledge about their disease and symptoms. This results that doctors and physicians are engaging with a more enlightened patient, a patient knowing more which requires a different approach than before.

One of the most known enlightened patients are e-Patient Dave de Bronkart. How he by doing his own research survived a grade 4 kidney cancer which were diagnosed at a very late stage. The doctors gave him a median survival time at just 24 weeks, he had tumors in both lungs, several bones, and muscle tissue. Going online and searching for other patients who have survived similar conditions he found which treatments he should use and how he should prepare himself before going into them. As he said at a seminar on “Digital Health days 2014 in Stockholm” quoting Donald Lindberg, director of the National Library of Medicine.

“If I read and memorized two medical journal articles every night, by the end of a year I’d be 400 years behind.”

Nowadays a single person or doctor can’t know it all, there is a new age of information. Doctors will have a different role in the future.

6.3 Patient groups

An increasing numbers of patients have begun to organize themselves into different patient groups, pressure groups, self-help groups and Internet communities. This is a result of the increasing patient power and individual’s choosing to take a more active role in the healthcare system. People think about

the healthcare like they think about other services. It´s a rising demand to be informed and involved. Gathering in groups helps them to get more knowledge about their specific disease and helps them to be more equal with the doctors and the system.

One of the most known patients groups is PatientsLikeMe where patients can share their experience, give and get support to improve their life and the lives of others. It also works as a patient powered research network and a real-time research platform to help make advances in medicine.

6.4 Sharing data

People and patients are getting opened minded of sharing their personal data. A survey of 2,125 PatientsLikeMe members in the U.S. says that they are opened to the idea of sharing their health data online if it helps clinicians improve care, helps other patients, or advances medical research. Another survey done by Makovsky Health/Kelton shows that 90% would share their data as long as it was anonymous.

Another trend that has been started in the last year is companies giving away data from clinical trials to the academia for further research. Johnson & Johnson is one of the first who has decided to give all the data from their pharmaceutical clinical trials to researchers at Yale University. It is a part the Yale University Open Data Access (YODA) project and they are also giving anonymized patient data from its pharmaceutical arm Janssen. The data is not just for the Yale University, other researcher who request it will get access to the data.

In Europe the members of the European Parliament have voted in favor introducing legal measures to increase the transparency of clinical trials in Europe. The law will force all trials to be registered on a publicly accessible EU clinical trials register before they can begin. Within a year after the trial ends a

summary of the trial results is required to be posted along with a lay summary for the general public.

This is a good start but can be compared with a similar law made by the United States in 2007, the FDA Amendment Act. Like the European it requires all trials conducted in the United States to be registered and summary results to be published on a national publicly accessible register, clinicaltrials.gov, within a year of trial completion. An audit of clinical trials made in 2012 showed that almost 80% failed to publish their results within a year after completion. Hopefully the European companies will perform better than the American counterparts, the law should be considered a step in the right direction.

6.5 Standards

Standards is a part of the second level of interoperability, Structural. In healthcare, standards provide a common language and defines the syntax of the data exchange to enable interoperability between systems. In order to improve healthcare delivery data should be able to get shared between clinician, lab, hospital, pharmacy, and patient regardless of application or application vendor.

To improving interoperability various platforms have been started on a global level such as Continua, HL7, IHE Europe, epSOS, the study on the eHealth Interoperability Framework, the eHealth Governance Initiative, the establishment of the eHealth Network6.

A report made by eHealth Stakeholder Group on Perspectives and Recommendations on Interoperability launched in March 2014 shows that several local eHealth actors are not well informed about the interoperability initiatives that’s going on and instead tend to build local isolated eHealth programs.

6.6 mHealth application

Most stakeholders agree that mHealth application will have a great impact on the healthcare during the upcoming years. It will improve patient outcome, prevention and help people and patient to take better care of their own health. A study released in May 2014 shows that mHealth applications will have the biggest impact areas to reduce non-compliance and hospital readmission costs.

Smartphones and tablets penetration combined with user and patient demand are considered be the main drivers for mHealth uptake. The biggest barriers mHealth app developers see is to overcome is the lack of data security and lack of standards.

Comparing two reports regulation is consider a barrier but one report points it as a main market barrier during the commercialization phase and the other only puts it as a hygiene factor. Other interesting facts are that clinical requirements and clinical studies are ranked as low hygiene factors. These are in traditional healthcare ranked as important factors. Clinical requirements and studies might not be the first thing a mHealth developer thinks about but should be considered important if the application will deliver any form of advice or guidance to the consumer.

7 Summary of data

The empiric chapter presents the gathered research data from the depth interviews and survey results. In the later part of the section all the gathered data including an earlier PESTEL analyze are represented in the SWOT analyze of the region.

7.1 Interviews

The focus on the interviews where on key stakeholders in the triple helix structure and to improve areas where there was lacking survey responses. Like the survey many people were having different roles and cross sector responsibilities. There where private healthcare provider who both can be put into healthcare and business sector as an entrepreneur. Professor from the academia who were pursuing new business. PhD student who both work in the healthcare sector and with academic research. From the business sector there was a good spread of companies, from big commercial mobile technologies, large ICT, smaller data analysis to one man private healthcare provider. From the innovation resources and infrastructure and policy makers one from each sector got interviewed. In total nine interviews where preformed taking from 1 to 1,5h each.

7.1.1 Results from the interviews

From the interviews it comes clear that Region Skåne perceived as a fractured organization. People from academia, healthcare and business point out the difficulties to find who to talk to and where to go in different matters.

Three of the respondents have pointed out that it´s hard to be informed on what's going on in the region. It´s hard to find information of events, discussion meetings and seminars concerning digital healthcare, eHealth and other topics. They are missing a support structure and a place to find information on upcoming activities.

When it comes to innovations a respondent from the business sector thinks that the right way to go forwards is to make small pilot or test units working close to the profession. The strengths of this approach is to have a short life cycle, constantly feedback from the end users and iterate. Looking over the ocean at Silicon Valley their constant innovation is a result of generations of product iterations and failures. The idea is to show a proof of concept, showing what the new technologies are capable of doing. In a later state using this to tear down perceived barriers and take the innovation into the healthcare system.

It is important to have a well-structured system after a project, hackathon or brainstorming meeting. There must be a system to facilitate the projects after they are done or the new ideas that comes up. When using hackathons or brainstorming sessions both the healthcare and business sector pointed out the importance of narrow it down to targeted areas and involving a good mix of expertise from all sectors. The participants is of the utmost importance to get a great innovation process.

Most of the interviewed people raised the triple helix structure and mobile industry as strengths for the region. However one of the respondents are critical to why companies should be located in Skåne. The opinion was that there is at least 20 or more locations worldwide that have the same or better conditions as Skåne. *"There is nothing that unique which could insist companies to move here."*

Issues highlighted was the integrity issue combined with regulatory demands, personal data and privacy protection. These are a challenge and considered barriers for innovation in digital healthcare in the region. Over the years regulations and laws has become more and more complex and the cost have gone up. There is a need for it to be simpler, easier and cheaper to do product development for healthcare applications.

The remuneration systems is lifted up as one of the biggest barrier for innovation and new investments. In Sweden the health clinics remuneration system is based on payment per treatment (tariffs) and a fixed remuneration (capitation). The existing remuneration model doesn't reward progress in quality or preventive care. This resulting in local process improvements and investment which in some cases doesn't improve the system as a whole. The IT investments are risking to be optimized for the specific clinic and not for a horizontal patient value chain.

One of the interviews responded that the innovation system is fragmented. The feel is that there are many who talk about innovation but no one is doing anything concrete. There is a need to be more focused and have more targeted investments in digital healthcare to succeed. It's hard to get money for the early phases of development and especially when try to go into the growth phase. Advice is easy to get but it is difficult to draw in any money.

Higher education institutions do not have access to training in electronic medical record. Doctors and nurses are expected to be trained during their practice from their supervisor. Thus, their training will be depending on their supervisor's expertise and time. It is common that care professional are not fully trained in what EMR can perform. There is a tendency to facilitate the insertion into the journal by skipping parameters. This is due to a complicated system but allows new nurses to learn bad practices from the beginning. Instead by having courses in EMR there is time to show what EMR´s are capable of and pushing for the importance of insert all parameters for future records. New doctors and nurses would have a better foundation when starting to practice in the hospitals and they can raise the competence of the profession from below.

7.2 Response rate from the survey

In Skåne a total number of 1514 surveys where sent out by email to different stakeholders and business sectors. Of them 435 completed the full survey

making it a response rate of 29%. Taking into account that the survey where sent out by email to individuals who didn't have any relations with the project the response rate can be considered good. The spread between businesses sectors can be seen below.

Table 1 Response rate per business sector

Business sector	Skåne
1. Politician or policy maker	58
2. Academic research	22
3. Business	60
4. Healthcare	241
5. Patient organizations/foundations	20
6. Wellness organizations	3
7. Innovation resources/infrastructure	27
8. Funding or investments	4

The respondents were free to choose what business sector they represented. Analyzing the survey it come clear that many persons who we initial thought represented one sector have chosen to identify themselves as another. This making it hard to perform any analysis of sectorial response rate.

7.2.1 Politician or policy makers

The response rate from politician and policy makers can be considered representative for the region. There is a broad spread of responsibility among the politicians and policy makers that answered the survey. This indicates that the intentions with a wide distribution of the survey is fulfilled. Among the responders there is representatives from 15 of Skånes 33 municipalities. The spread is from the large down to small municipalities. Looking from a political point of view almost all parliamentary parties have at least one representative that answered the questioner. There is 28 from the region council and also representatives from the association of municipalities.

7.2.2 Academic research

Most of the people from academia that we have got in contact with are from Lund's University. Looking at the respondents there is a mixture of faculty's from LTH (The Faculty of Engineering at Lund University) and Faculty of Medicine. There is no respondents from faculty of economics, law or natural science. From LTH there is a mixture of biomedical- , electronic engineers, design and computer science. The largest part of participants are biomedical engineers.

This explains the strong expertise in biomedical engineering, life science, eHealth and analytic and sensor technology. These are areas where Skåne have a long tradition of research. Most respondents have at least answered that they have three of more expertise which shows that they are multidisciplinary. However, there is no expertise in semantic interoperability among the responders in Skåne.

7.2.3 Business sector

From the business sector there is 53 unique companies' represented. They are ranging from small start-ups to big multinational cooperation's. About 30% of respondents represent entrepreneurs, small companies and big companies respectively. However, only 8% of the respondents represent medium size companies. In Sweden 99.4% of all companies consist of entrepreneurs and small companies with fewer than 50 employees.

7.2.4 Healthcare

In the healthcare sector there is an additional 10 unique municipalities that answered, giving a total number of 25. There is also some representatives from the association of municipalities that have considered them as healthcare.

A large group are from Skåne University Hospital and Region Skåne. However, a lot of the responders are from smaller organizations and municipalities.

7.3 Survey results

The unawareness of standards is confirmed by the survey handed out in Skåne. It´s clear that the business, see Figure 18, and academia, see Figure 19, are not aware or not using medical terminologies and standards.

The United States and United Kingdom has started to collaborate around the use and sharing of health IT information and tools. The agreement strengthens efforts to cultivate and increase the use of health IT tools and information designed to help improve the quality and efficiency of the delivery of healthcare in both countries.

One part of the collaboration is around interoperability standards for improvement of data sharing and clinical care. There is also a focus on patients accessing and sharing their data. Thus, it´s important for small countries like Sweden to monitor this collaboration and its outcome.

Looking at the healthcare sector and splitting it in public and private sector some differences shows. The private sector are using mobile e-tools to a lot higher degree then paper-based tools, see Figure 21. In the public sector it´s the other way around. If the question is crossed with “Our responsibility is…” you get an interesting result, see Figure 20. Tertiary and secondary care, which accounts for the largest part responders, both have relative low score on the use of mobile e-tools compared to other sectors.

The healthcare sector they ranked “Difficult to find time to elaborate ideas in parallel to regular assignments” as the single major difficulty/barrier for creating innovations based on ideas from their profession, see Figure 22. The healthcare sector has already a high workload so it might be hard to implement free time to pursue own ideas like great innovative companies are doing, such as 3M, W L Gore or like Google used to do with their now abandon 20% time rule. There is

also the question if healthcare professionals is the right people to pursues and evolve their ideas, partnership with other actors might be more suited.

Looking at the collaborations for both business and the academia both have a relative low collaboration with Interest groups (e.g. customer focus groups, patient organizations), see Figure 23 and Figure 24. Business thinks that partnership is the most important factor for them to develop innovative products. It´s along with healthcare expertise the biggest challenge to create innovations in digital healthcare, see Figure 25. Not a single person from the academia have answered that partnership with costumers are among the most important factors, see Figure 26. The respondents where only allowed to check three alternatives which might be the reason. Long term funding for research getting 100%. The biggest challenge for academia is to get hold of healthcare expertise followed by knowledge of customers need. There is a demand for access to healthcare expertise and customer knowledge from both the business sector and academia. Here is an opportunity to facilitate partnership and exchange of experience and knowledge among stakeholders, physicians, healthcare experts and customers. This to help entrepreneurs to get hold of real needs. According to Alan Cooper, modern user experience design expert, the ideal approach for innovation is "goal directed." Innovation should start with the needs and goals of the customer or end-user. How the problem should be solved and the solution for it comes next.

"Technology is worth nothing if it doesn't solve an important problem or improve lives." Robert Pearl, M.D., CEO of the Permanente Medical Group

All business sector has answered almost identical on the question *"In our opinion, eHealth research should be more… (multiple answers allowed)"*. It's clear that they think that research should be more interdisciplinary (involving several stakeholders in the ecosystem). This reinforces the importance of cross boarder meetings and relations to get a good climate for innovation.

7.4 PESTEL

7.4.1 Gather the information

Information for the PESTEL analysis was based data from READi for Health survey, interviews, events and desktop research.

Political

- Patient centred point of view from politicians
- Willingness to support and lower barriers for PCP
- National eHealth agenda lack global view
- Stockholm´s lack of interest in the region
- Not a capital city (distance to government, lack of funding, harder to recruit personnel and competence)

Economic

- Hard to get access to financial capital in the growth phase
- Unclear business models for eHealth solutions
- 20 different regional councils in SE with responsibility in healthcare, which results in a fragmented market, difficulties to reach common standards and IT/IS infrastructure

Social

- Consumers – early adopters (ICT) and buying power
- Openness and willingness to collaborate between companies and sectors.
- Understanding for collaboration driven innovation.
- Good language skills
- A decreasing proportion of working age population
- Shortage of engineers and healthcare professionals

- Engaged and knowledgeable patient / citizens
- Strong social safety net

Technological

- Key area expertise, sensor, mobile, camera, design, Life science
- Expertise in semantic interoperability is not available

Legal

- Data protection laws, hard to get access to health data
- Costly to get access to health data
- Legal requirements for security and protection of personal data

7.5 SWOT

7.5.1 Gather the information

Information for the SWOT analysis was based on the PESTEL and complimented with data from READi for Health survey, interviews, events and desktop research. In the stage of analyzing the survey a plan was structured to make sure the analyses of questionnaire responses where done consistently and in a way that works as a good input for the thesis, see Appendix 1. This to ensure the capture of information that were relative to the SWOT analysis. Depending on what category the information was considered to be it got labelled with one or a combination of the following S, W, O, T letters representing Strength, Weakness, Opportunities and Threats. New information that come from the semi-structured interviews, events and the desktop research where then added. For region Skåne this list consisted of a vast amount of information and entries.

7.5.2 Sort information

The most important step is to sort the information into the different categories, strength, weakness, opportunities and threats. When doing this it's important to keep in mind what is an external and internal factor. During the first gathering phase and labelling it's easy to mislabel an element. When working in teams it´s important to try and get a common understanding of what the different categories, external and internal factors really means. This shows the importance of a good theoretical framework to commonly work along as a team.

7.5.3 Classify the information

To get an easier overview of each category the elements where classified into different subcategories. Those where built upon the different business groups and what sector the element affects. The focus was on triple helix and healthcare. It was necessary to introduction a more a general subcategory for some elements.

7.5.4 Validate the SWOT

The SWOT analysis where discussed with the READi for Health team at Region Skåne and the project manager at Mobile Heights. To verify, get second opinions and inputs to the result it was also show to a couple of key ICT business actors and stakeholders at SUS. With the input and verification from the stakeholders the result of the SWOT analysis gives a good picture of the region. The list is not ranked at this stage.

	Strengths (part 1)
Internal factors	GENERAL • Triple Helix • One of Northern Europe's top universities, Lund University • Geographical location, Øresund Region • Sweden as a brand (credibility) • Strong social safety net • Safe society conditions for social innovations • Access to science parks, incubators, test beds, clusters, IT-infrastructure • Business and innovations support for both life science and ICT • A long tradition in successful export/internationalization • Consumers - early adopters (ICT) and buying power • Openness, willingness and strong experience in collaboration between companies and sectors (with established silos) • Understanding for collaboration driven innovation POLITICIAN AND POLICY MAKERS • Patient centered point of view from politicians (including patient safety and service) • EHealth considered to be a driver for improvement of healthcare • Willingness to support and lower barriers for PCP HUMAN CAPITAL • Key areas expertise ICT, Life science and MedTech • Language skills • International experience • Experienced leaders in ICT and Life Science BUSINESS • Companies are born global • Big multinational ICT companies • Decent number of solid SME's • Strong experience in standardization from telecom industry - global networks • Proved capacity in commercializing and industrializing complex system solutions (connected system solutions) for a global market • Strong business in key areas, MedTech, life science, ICT (mobile, security, gamification, cloud, loT, data analysis, wearable's, camera) and sensors • Mobile business with experience in whole value chain (hardware, software, design, etc.) • International collaborations • Design expertise UI/UX /user interface - user experience) in world class. Design companies able to build quick prototypes in iterative development processes. • Connectivity expertise

	Strengths (part 2)
Internal factors	ACADEMIA • Department of Biomedical Engineering (including eHealth track) • Full spectrum of faculties available in Skåne • Strong research in key areas, biomedical engineering, life science, ICT (cloud, mobile, security, gamification, loT, data analysis, camera), eHealth, medicine and sensor • SICS Security research team located in Skåne • MAPCI (Mobile and Pervasive Computing Institute)-Cloud and security aspects • World leading international research facilities in material science; Max IV and ESS (European Spallation Source) HEALTH CARE • Computer-based tools are standard in healthcare • Health care professionals with great interest and ideas in eHealth • Patient centered point of view (including patient safety and service) • Co-location of Universities and Skåne University Hospital • Secondary and tertiary care in addition to primary and home care PATIENT / PATIENT ORGANISATIONS • EHealth considered to be a driver for improvement of healthcare • Larger number of active patient / relative organizations established in Skåne (from rare diseases to chronic disorders) • Engaged and knowledgeable patient / citizens

	Weaknesses (part 1)
Internal factors	GENERAL • Unclear business models for eHealth solutions • Live and laurels (societal attitude) • PCP and innovation procurement is not well known or used • The innovation support structures is fragmented and there is no common picture of the business environment • Lack of focus on customer/marketing within innovation support structure • Working in silos • Region of Skåne perceived as a fractured organization making communication difficult • Internal and external branding of Skåne and Øresund • More competition than collaborations between actors • Cloud technology not implemented - Health care in Sweden has not embraced the opportunities with cloud technology (data protection laws) • Few projects where all competences are used • Lack of funding opportunities POLITICIAN AND POLICY MAKERS • Lack of long term vision and strategy for eHealth • Lack of available PCP policy • Hard to find regional policies and strategies and lack of version control • Lack of resources to handle innovative procurement processes • Lack of implementation strategy and processes for pilot projects HUMAN CAPITAL • Low awareness about healthcare standards and certifications (e.g. CE) • Low general knowledge about cloud INNOVATION SUPPORT • Life science - Not as focused in internationalizations the ICT sector

	Weaknesses (part 2)
Internal factors	BUSINESS • Poor collaborations with interest groups • Difficult to access healthcare expertise, test beds and knowledge of customers' needs • Low utilization of innovation support • Lack of capital for expansion (seed money) • Lack of competence/expertise at VC companies with eHealth • Lack of expertise in semantic interoperability and interoperability ACADEMIC / RESEARCH • Academics lack of focus on access to market and internationalization • Academics have a low collaboration with public bodies and interest groups • Lack of expertise in semantic interoperability and interoperability • Little training in health informatics included in education program for health care professionals HEALTH CARE • Lack of global view for healthcare solutions • Old-fashioned IS/IT infrastructure and EHR-system, does not promote efficient use of knowledge and resources and negative effects an patient safety • Clinical information system lack interoperability • Complex healthcare organizations • Strong hierarchy in healthcare reduce flexibility and openness • Healthcare suffers from constant reorganization • Healthcare professionals do not have time, motivation and knowledge to elaborate their ideas • Lack of innovation strategy • Bad experience in current IT systems tend to make people negative to IT solutions • Clinics have their own budgets and makes their own priorities • Slow or no uptake/use of global standards (e.g. IHE and Continua) PATIENT AND PATIENT ORGANISATION • Patients nor comfortable to share their innovative ideas, proposals and data with their care givers (share with patient organizations/ communities, family and friends) • Public procurement does not include requirements global standards (e.g. Continua)

	Opportunities
External factors	GENERAL • The global eHealth market is forecasted to grow • Structured gathering of healthcare data (e.g. bio banks, quality registers) • International networks (e.g. ECHAlliance) • Horizon 2020 and other project funding programs • Product differentiation. MedTech (home, primary care, secondary/tertiary care) • Cost for health care: reconsider health care products and consumer products • Accelerators for scale of both public and private business HUMAN CAPITAL • Demand for ICT and Life Science expertise is increasing • Local access to ICT experienced citizens (early adopters of technology) POLITICIANS AND POLICY MAKERS • Flexibility in reimbursement model BUSINESS • Global market • Lifestyle and preventive care trend • New business models (definition of business models for eHealth) HEALTH CARE • Access to global specialized healthcare / expertise that is not available in the region • Rising demand on the healthcare system PATIENT AND PATIENT ORGANISATION • Access to global patient communities • Willingness and interest to contribute to eHealth innovation for improvement of care • Openness to new technology and care models • Empowerment of patients and citizens, will be a driving force for the development and implementation of eHealth

	Threats (part 1)
External factors	GENERAL • Security & integrity issues • Not a capital city (distance to government, lack of funding, harder to recruit personnel and competence) • Stockholm's lack of interest in the region • Risks and benefits of eHealth not equally highlighted in media (negative aspects dominates) • Insecure stability of SME's over time (healthcare requires stability when procuring new technology) • Old-fashioned way of thinking "free and equal care" creates barriers for testing and implantation of new solutions (limiting patients to pay for healthcare) • Initial up take of wrong / low quality products and services may result in resistance and in lack or trust in eHealth • 20 different regional councils and 300 municipalities in SE with responsibility in healthcare, which results in a fragmented market, difficult to reach common standards and IT/IS infrastructure, and inefficient use of public resources • Lagging behind the key players in Europe • Interpretation of legislation for security and protection of personal data POLITICIAN AND POLICY MAKERS • Government changes on national and regional level prevents long term strategic change management and implementation of eHealth • Lack of clarity regarding regulations for eHealth solutions HUMAN CAPITAL • Loss of competence within key areas • Slow moving labor market, people tend to stay at their jobs BUSINESS • Closure/relocation of key companies • Too long time to market for eHealth solutions and unclear regulations results in business avoiding healthcare market in favor for other less regulated markets • Healthcare unattractive sector for tech companies due to fear for bad will in case of adverse events • Too complex business model (buyers, payers, innovators, developers, customers – who will pay for it?) • Hard to get access to health data (data protection laws) • Costly to get access to health data

	Threats (part 2)
External factors	ACADEMIA / RESEARCH • Reduced number of international students because of tuition fees • Shortage of engineers, life science and healthcare professionals • Academic qualifications based on scientific publications does not stimulate commercialization of inventions • Intellectual property - current set-up of ownership of IP does not promote commercialization • Hard to get access to health data (data protection laws) • Costly to get access to health data HEALTH CARE • Shortage of healthcare professionals

8 Analysis

This chapter shows the analysis of the regional SWOT and the process to get strategies and action from it. The section ends with a broader analysis of the regional conditions for innovation in eHealth.

8.1 Ranking the outcome

After the SWOT for the region where preformed it’s time to analyze the result. The list from the SWOT analysis is consisting of a great number of strength, weaknesses, opportunities and threats. It´s a common thing to have a large number of factors but this makes it hard to work with. To reduce the number to a more hand able figure a selection of the most important factors in each category need to be done. This is one of the most important steps as these elements will be used in the creations of the future actions and strategies. The ranking was performed by the project team with inputs and ranking from each member.

8.2 TOWS

Using the reduced list from the SWOT analysis it can be inserted into the TOWS matrix. At this stage the list is not ranked individually of importance, the number is only used for mapping the categories with each other’s. Strengths with opportunities, strengths with threats, and weakness with opportunities last weakness with threats.

The goal is to get strategic options and actions building on the unique conditions of the region.

	Strengths 1. Patient centered point of view from politicians, policy makers and healthcare leaders 2. Key areas expertise ICT (sensor, mobile, design, camera, security), Life science and MedTech 3. Strong experience in standardization from telecom industry 4. Department of Biomedical Engineering (eHealth track) 5. Healthcare professionals with great interest and ideas in eHealth 6. Geographical location (Oresund)	**Weaknesses** 1. Clinical information system lack interoperability, low awareness of healthcare standards and certifications 2. Unclear business models for eHealth solutions 3. Working in silos 4. Difficult access healthcare expertise, test beds and knowledge of customers' needs 5. Old-fashioned IT infrastructure and EHR-system 6. Lack of long term vision and strategy for eHealth 7. The innovation support structure is fragmented 8. Complex healthcare organization 9. Lack of funding opportunities and capital
Opportunities 1. Product differentiation - MedTech/eHealth solutions (healthcare products vs. consumer products) 2. Lifestyle and preventive care trend 3. Flexibility in reimbursement model 4. Local access to ICT experienced citizens 5. Patient organization has a willingness and interest to contribute to eHealth innovation 6. Structured gathering of healthcare data (e.g. bio banks, quality register) 7. Empowerment of patients and citizens, will be a driving force for the development and implementation of eHealth	• Cross boarder meetings, develop new products and services (S2,S5-O1,O2,O7) • Show the benefits of proper use of data (S1-O6) • Look into the use of the existing reimbursement model (S2,S4-O3) • Gather and spread patients and customers need to the academia and business (S2,S4-O5)	• Use the reimbursement model to create and communicate new business models for eHealth (W2-O3) • Look into the commercial side of eHealth, outside of healthcare (W9-O1,O2,O4,O7)
Threats 1. Too complex business models (who will pay for it?) 2. Too long time to market for eHealth solutions and unclear regulations results in business avoiding healthcare market 3. Hard and costly to get access to health data 4. Stockholm's lack of interest in the region 5. Lagging behind key players in Europe 6. Fragmented healthcare market (20 regional council and large number of municipalities	• Form closer strategic relations with Copenhagen (S6-T5) • Use department of Biomedical Engineering for promoting the region (S4-T5) • Lobby the benefits of access and use of health data to politicians (S1-T3)	• Promote the region both national and international (W9-T5)

8.2.1 Strength and Opportunities (SO)

- *Cross boarder meetings, develop new products and services (S2,S5-O1,O2,O7)*
  Combining the ICT expertise in the region with the health care professionals and patients to get hold of ideas and real needs from within. There is a great possibility in product differentiation and use of position innovation when looking at healthcare and consumer products.

- *Show the benefits of proper use of data (S1-O6)*
  At the moment it's hard to get hold of all the structured healthcare data that's gathered (e.g. bio banks, quality register). This data is a goldmine of information but it can't be used today because of the regulation and laws. Therefore is it important to lobby and show the benefits of proper use of anonym's unidentified data to politicians and policy makers. How the use of data can help the quality of life for the citizens and patients.

- *Look into the use of the existing reimbursement model (S2,S4-O3)*
  There is a presumption that the current reimbursement model doesn't favor innovation in digital healthcare with focus on preventive care. An expert in the area from healthcare opposes this belief and argues that in Skåne, this is entirely possible. An important action is to look into the existing reimbursement model and consult expert both form healthcare, business and the academia to evaluate new business models built upon the existing model.

- *Gather and spread patients and customers need to the academia and business (S2,S4-O5)*
  Patient organizations is sitting on a lot of knowledge about their specific dieses and patients. The organizations are a good way to reach out and gather real need from the patients, ideas for how to improve the healthcare services and their every day of life. This is information the patient today doesn't share with the healthcare system but rather with their peer group and patient organization.

8.2.2 Strength and Threats (ST)

- *Form closer strategic relations with Copenhagen (S6-T5)*
  The region should use the geographical closeness to Denmark and the fact that they are a part of Medicon Valley. A good strategic relation would be beneficial for both regions. Both in terms of market and knowledge sharing.

- *Use department of Biomedical Engineering for promoting the region (S4-T4,T5)*
  The department of Biomedical Engineering with an eHealth track is a unique program which should be use to promote the region. Both to raise the awareness from Stockholm and to attract international business and capital to the region. Could be used to compete with Kalmar to get e-hälsomyndigheten to decide to locate in the region if that is a strategic goal.

- *Lobby the benefits of access and use of health data to politicians (S1-T3)*
  Lobbying the benefits of access and the use of health data should be used to both national and local politicians. The security and integrity laws should be revisited. A possible solution might be to also create laws to punish misuse of information instead of focusing on security and locking it up in a vault. Safety is an important aspect to uphold but it shouldn't hinder the use of information. Sweden should be in the forefront of innovation and open up un-personified data for research and development.

8.2.3 Weaknesses and Opportunities (WO)

- *Use the reimbursement model to create and communicate new business models for eHealth (W2-O3)*
  In order to address the weakness of unclear business models actions should be done to look into existing reimbursement models and how it can be used. It´s important to communicate the results and findings.

- *Look into the commercial side of eHealth, outside of healthcare (W9-O1,O2,O4,O7)*
  A possible way to address the lack of funding is to look more into the commercial side of eHealth. The region has local access to early adopters and ICT experience citizens. Launching a product on the commercial part of the market can be easier and then use the customers to demand and push it into the healthcare.

8.2.4 Weaknesses and Threats (WT)

- *Promote the region both national and international (W9-T5)*
  It's important to when using the strengths and opportunities in the region to think about promoting Skåne both national and international. The region is lacking funding's and Stockholm is not showing really interested in the region. Therefore it´s important to raise the awareness and advertise the region as a good place for innovation in digital healthcare.

8.3 Analyze

Skåne got a god political climate for innovation in healthcare. According to the survey most politicians have a patient/citizens point of view and see the benefits from new technological advances in the field. The region has an innovation agenda with the goal to be one of the most innovative regions year 2020. In the *International Innovation strategy for Skåne* personal health is represented as a possible field for advancement. The nation as a whole has a strategy for eHealth, *Nationell eHälsa*. Combining the strategies shows that eHealth is considered an important field for the future of healthcare. To make it easier for innovative uptake in healthcare all parts agree that the PCP and PPI need to be established and used. Without a new way into the public sector it's hard for entrepreneurs or new players to enter. Today's procurements doesn't favor radical innovation as

much as process innovation, often the cheapest offer wins the procurement contract. Depending on the procurement some underlying needs might not surface. In May 2014 made the Swedish Competition Authority and VINNOVA an agreement to work on PPI. This means that they shall encourage the promotion, supply methods and support for innovation procurement. At the current time for this thesis no outcome from the collaboration has been presented. This is a collaboration that should be monitored and a goal for Region Skåne could be to try to become a test bed for PCP and PPI.

An important factor raised from the business sector and healthcare is the nature and longevity of a procurement. The winning player need to be able to support the product or service for an extended amount of time. Depending on the product/service this might make it hard for a single entrepreneur to get a contract and in such case a joint venture with an established player might be needed. The pharmaceutical industry might be a good partner for this type of ventures. They have worked with the healthcare regulations for decades. The industry is going through a time of changes. Patents are starting to expire and generic drugs are taking market shares. Looking into digital healthcare might be a chance for the pharmaceutical companies to diversify their portfolio, develop new kinds of value adding products and services. AstraZeneca presented at a local event that they are already looking into this field.

8.3.1 Knowledge and expertise

Skåne is today one of Europe's most innovative regions. To gather good ideas and help new innovation out on the market Region Skåne has started Innovator Skåne. Innovator works a springboard pitching out the idea to potential partners who can and take it to the next level. This organization is relative known among the employees in Region Skåne but sense its start in September 2013, 283 ideas have been submitted but only a few has reached potential partners and even less the market. Innovator might not be the right way to go for everyone. Looking at

the business and academia it comes clear that they getting hold of healthcare expertise and customers need is the two biggest challenges. Healthcare on the other hand don't have the time to elaborate their ideas. Talking about innovation there is two distinct types, radical- and incremental innovation. When many people think about innovation they think about the big radical ones, e.g. steam engine, electricity, and forget about all the incremental that helps to refine it. A good source to get incremental ideas is from the people on the floor using the product or service. These innovations and ideas can be in any of the four innovations types, product, process, position or even paradigm. Therefor getting hold of what healthcare professionals and customers/patients think most be considered important. Here can Region Skåne or an organization fill an important role to be the link from healthcare, patients to the business and academia. To facilitate cross boarder meetings and organize events for co-productions and information sharing.

8.3.2 Financial Capital

Looking at the financial aspects access to long-term funding's is an important factor and an area where the region is lacking. Especially when going from the start phase into the growth phase. This even though 96 innovation companies is located in the region. From attended events it's clear that Stockholm considered themselves as the innovative capital of Scandinavia. They are not looking at or promoting the southern parts which makes it harder for a region like Skåne to attract outside investors. Promoting the region and a try to raise the awareness both nation and international should be an important action. Region Skåne should also use the fact that they are a part of Medicon Valley, the Øresund region and close distance to Copenhagen. Denmark have come a long way on some fronts and a closer relationships should be beneficial for both regions. Like the market development-fund to help companies with their products on their final way to the markets. There is some cultural and social aspects affecting the movement of people. It´s hard to get people to travel from Malmö to Lund to come to meetings

or events, it´s even harder to get people to travel over the bridge. It's a good thing to keep in mind but not an obstacle that cannot be overcome.

8.3.3 Standards

Looking at the regional strengths there is a great expertise in development standards derived from the mobile industry. This knowledge is something the region should try and capitalize on. Both the business and academia have a low awareness about medical standards. The healthcare is not using global interoperability standards. It's important to raise this awareness to promote interoperability between systems. The region and Sweden should form strategic alliances with interoperability and standardization organizations such as Continua, at the moment some work is starting to be done on a national level. Skåne and Sweden is such a small market that if a company wants to go global the use of international standards is almost considered a most. Especially with potential outcome from the collaboration formed between the United States and United Kingdom.

8.3.4 Fractured organization

To capitalize on all the strengths it's important to have a solid organization. The fact that Region Skåne is perceived as a fractured organization by stakeholders is something that needs to be addressed. There should be established a part of the organization that are responsible for innovation in healthcare and acts as a front into the healthcare. Might even use the concept developed by Hennepin County Medical Center and appoint a Chief Imitation Officer. A person whose job is to look outside the organization for good ideas to bring back. Taking inventions and innovations from around the world, improve and later applied them to the own organization. This is an approach well known to businesses outside of healthcare, Procter and Gamble have developed their concept C&D, Connecting and Developing. Taking ideas from outside and refine them for the companies specific needs and launch them on the market. For this to work it´s important to

get away from resistance to innovations from outside “not invented here” syndrome to “proudly found elsewhere”. This drastically changed their R&D organization “from 7,500 people inside to 7,500 plus 1.5 million outside”. (Huston and Sakkab 2006)

When looking at the organization it´s important to follow the work around value-based healthcare and the outcome. A shift in the compensation model to a more horizontal approach could drastically change the healthcare system. This is an area that is interesting to look into, as the joint study showed an increased productivity and satisfied patients when changing the care chain.

8.3.5 Empowered patients and homecare

One way to manage the upcoming demands might be to give more responsibility to the patients themselves. Giving away reasonability includes not just a responsibility to keep a healthy life style and try to prevent diseases, but also to take an active participation in case of a disease. Moving more advanced healthcare home to the patients themselves, advance home care, is one other way. By doing healthcare activities in the patients home hospitals can free up beds and therefore cope with a higher demand without investing in new hospital buildings. One active projects in advance home care in the region is itACiH, IT-stöd för Avancerad Canservård i Hemmet. The project is a cross boarder collaboration with eleven different partners from different sectors like business, academia and healthcare. It´s partly funded by VINNOVA in context of its focus on challenge driven innovation. There is an experience that patients prefer to be treated at home as long as they feel safe with the care provided. With the upcoming changes in the demographic pyramid and the expected rise of cancer patient homecare becomes an attractive opportunity that may reduce overall costs. In a longer perspective the project aim to use the knowledge gathered to support other groups of patients. The big questions is how to implement the solutions into the healthcare system and with a consortium like this who will be the provider.

8.3.6 Product examples

Outside on the global market there is some good examples of both product, process and position innovations going on in the digital healthcare and healthcare sector.

Google glass, a convenient way of displaying information in your field of view, now being tested and used in clinical environment on hospitals around the world.

The Swasthya Slate, an off-the-shelf Android tablet combined with cheap sensors, processors, and other components. The result a platform with the capability to monitor electrocardiogram measures, blood pressure, blood sugar, urine protein, and several other biometrics. All this to a fraction of the cost of a comparable device and still having an accuracy within 99% of far more complex machines. Not everything need to be measured to a thousandth of a degree, take the body temperature as an example. People are fine with a tenth of a degree and value portability, size and price instead. Could this type of process and position innovations change the healthcare?

The introduction of AI decision systems is not a question of if rather than when it will happen. An example from the Mayo Clinic, their system got algorithms to detect brain aneurisms in processed images and predict how likely it's a correct answer. The systems has a 95 percent accuracy of detecting aneurysms and since it was introduced made significantly improvements in patient outcomes. The clinic also recently announced a partnership with IBM's Watson team to use the natural language processing and data analytics capabilities of Watson. The goal is to help them ensure that eligible patients are considered for clinical trials and in the long run use it to accelerate medical research. With the help of cloud computing and mHealth applications this type of AI could in the future be more portable. This will as any mobile application put high demands on security within the applications and the communication between devices.

9 Conclusions and Recommendations

This chapter presents the conclusions of the regional preconditions in Skåne for innovation in digital healthcare. It ends with a list of complementary actions that that have come to light during the process.

9.1 Regional preconditions in Skåne for innovation in digital healthcare

Skåne got the possibilities for a good climate for innovation in healthcare. There is a possibility to gather ideas and projects for incremental innovation in the region. Both the healthcare professionals and patients are sitting with unused valuable expertise and knowledge. To get a more radical change in the healthcare sector some barriers need to be broken down. These changes need a more strategic and political approach, many of them need to be brought up on a national level. Today security laws regulation the use of information need to be modified to allow the use of unidentified healthcare data. Making it easier for the academia and companies to use this information would allow them to pursue new research areas and possible innovations in the field.

For new entrepreneurs and business there need to be clear how to use the reimbursement model to support their business plans. There is also important that the way into the healthcare sector, procurements, is built to handle and promote these new ventures.

Skåne has a gap in expertise regarding semantic interoperability, both in the business and academic sector. This is not a unique problem for Skåne and can be seen in other regions as well. Collaborations with other regions and worldwide expertise is needed to fill this gap and promote advances in this field.

Comparing to other countries, Sweden are ranked 3rd on the list of innovation uptake in healthcare just beaten by Denmark and Estonia. Estonia has had the opportunity to build their whole system and infrastructure from the ground up.

It´s a country who has in the last decades been able to leapfrog over some old technologies and now can able considered one of the most advanced society when looking at ICT implementations. Sweden on the other hand was one of the first countries in the world where healthcare embraced and become computerizes. This are resulting in a broad knowledge about working in computer system. On the other hand Sweden's healthcare system is built upon a computer system built in the 90ties. This resulting in some of the interoperability's seen today. The IT system of Region Skåne consist of over 700 different individual computer systems. Interoperability problems comes with this type of structure.

9.2 Thought on the research methodology

Using the TOWS matrix to analyses the SWOT and identifying and proposing innovative digital health strategies and actions has been effective. One thing that would have improve the thesis and the outcome would been to benchmark the region against other regions. Learning from best practice and other deployed innovative strategies. This could be regions from Denmark or Estonia ranking high on the innovation uptake in healthcare or from a totally different innovative sector like Silicon Valley in California.

When preforming the interviews it would have been preferably to be two rather than one person. The benefits would be to have one asking the questions and being totally focused on the person being interviewed, and the other taking notes and checking body expressions from both the interview and interviewer. This to not miss anything.

9.3 List of strategies and actions

Down below is list of strategies and actions Region Skåne and University should look into. These are actions from the TOWS analysis and others that has come to light during the process.

9.3.1 Region Skåne

- Make a single point of entry for entrepreneurs, business and academia to get into the healthcare system. To be a link from healthcare and patients to businesses and academia. In the same time address fact that Region Skåne is perceived as a fractured organization by its stakeholders.

- Facilitate cross boarder meetings and organize events for co-productions and information sharing.

- Lobby the benefits of allowing the use of unidentified healthcare data to politicians, policy makers and healthcare leaders. Making it easier for the academia, entrepreneurs and businesses to use this information would allow them to pursue new research areas and possible innovations in the field.

- The region should form strategic alliances with interoperability and standardization organizations. Learn from Denmark who already doing this.

- Form closer strategic relations with Copenhagen.

- Look into the outcome of Denmark's market development-fund.

- Keep on working with the innovation structure to promote collaboration and create a shared vision for the region. This is a way to overcome the fragmented structure and make it easier for entrepreneurs. The long term agenda is to get Skåne known outside the region as a good place for new businesses and entrepreneurs.

- Look into the existing reimbursement model and consult expert both form healthcare, business and the academia to evaluate new business models built upon the existing model.

- Use the department of Biomedical Engineering, Medicon Valley, the Øresund region and close distance to Copenhagen to promote and raise the awareness both nation and international.

- Monitor the collaboration between Competition Authority and VINNOVA. A goal for Region Skåne could be to try to become a test bed for PCP and PPI.

- The University's should have access to EMR. Doctors and nurses should be able to get trained in the EMR before going out on their practice. Therefore a new procurement of an EMR system should include an education version.

9.3.2 Academia

- Data analytics and scientist will have a big role in the upcoming years. Gartner finds that by 2015 the demand for data and analytics resources will reach 4.4 million jobs globally, but only one-third of those jobs will be filled. This will not only affect healthcare but most other industries.

- Should open up the course eHealth to all faculties on LTH. Innovation in healthcare needs a multidisciplinary team with a wide range of expertise. Interdisciplinary collaborations is important and LTH has a wide range of faculties with all their own unique competencies.

- Should be a revalidation of the tuition fees. Sweden will need more engineers and human capital in the years to come. One way is to get free mover-students who after their education decides to stay and work in the country.

10 Reflections over the main contributions

This chapter adds some reflections regarding the innovation in healthcare in Skåne. The chapter ends with some interesting question has come to light during the process and could be considered topics for future academic research.

10.1 Regional preconditions in Skåne for innovation in digital healthcare

Third place in eHealth solution implementation is good but we can't sit down and be satisfied with the result. Even if you are in first place you need to constantly revaluate your position and look for areas to improve. Sweden and specially Skåne with Øresund Region have things to learn from our neighbors in Denmark.

"EHealth development in Estonia was certainly helped by the good cooperation with healthcare service providers and doctors", explained Raul Mill, Member of the Board of the Estonian eHealth Foundation

The region have most of the building blocks to get a good climate for innovation in digital healthcare. We need to join the blocks together, here has an organization a unique opportunity to facilitate cross-border meetings, be a collaborate voice, and put digital healthcare on the agenda. There is a need for a link into healthcare to get providers, doctors and nurses to share their ideas and needs to business, entrepreneurs, and the academia. Lobbying to politicians and policymakers should be done to raise the awareness and try to change some regulations and laws that acts as barriers for innovation today.

"Perhaps what we need is not simply another "big idea", but rather better ways of distributing the smaller ideas."

10.2 Topics for future academic research

During the process some question has come to light that might be interesting for further academic research.

- How does the academic reimbursement model effect inventions, innovations and commercialization? Compare to Denmark.
- How can the existing reimbursement model be used to compensate proactive healthcare?
- How did the introduction of tuition fees affecting the Universities and the innovation climate in Sweden?

10.3 Digital healthcare projects in Skåne

Here is a list of digital healthcare projects in Skåne gathered from the READi for Health survey.

- E-journal
- E-tjänsten mina vårdkontakter
- EU projekt om hjärtsvikt med elektronisk våg och blodtryck i hemmet med överföring och till detta ett interaktivt utbildningspaket. dessutom finns ett antal påbörjade projekt från koncernrådet för eHälsa.
- HSA/Katalogtjänst
- Samordnad vårdplanering på distans
- Patologi på distans
- Digitala utbildningar för personal inom vård och omsorg
- Telemetri
- itACiH
- Genomfört proof of concept 2009 för diabetesuppföljning.
- KOL-projektet Infracloud-projektet med Region Skåne och Ericsson
- Digitaliserat beslutsstödet RETTS/Predicare
- Simulator för käkkirurgi
- Tandläkarstudenter
- Arbetat med teknik för att behandla cancer
- Cellnovo
- Trialbee
- En ny digital och mobil upplaga av Triagehandboken.
- Cellavision, använding av Smarta Vågar, etc
- Många olika appliaktioner såsom distansronder, signalhantering (ekg-tagning) mm
- Juvopal
- Take Good Care AB,
- Lund Medical AB,
- Dianovator AB (m-health)
- CardioLund Research AB

Appendix 1. Survey results

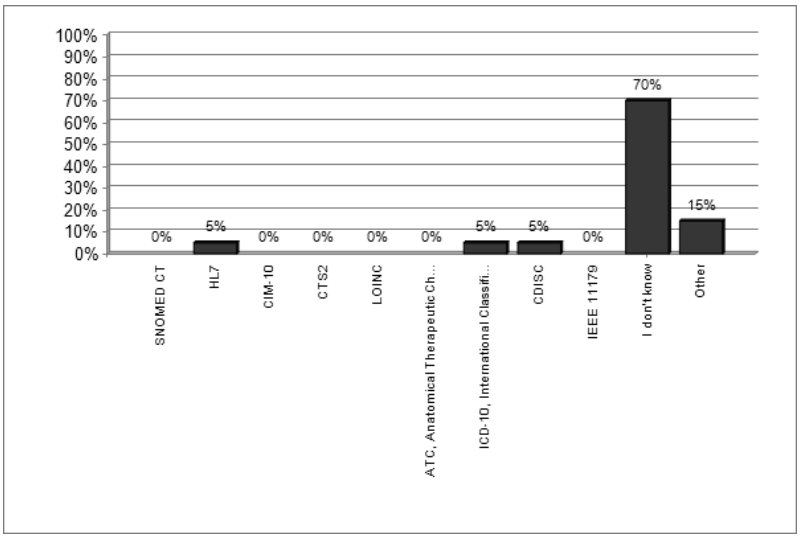

Figure 9 (Business) We use the following medical terminology/standards in our business… (multiple answers allowed)

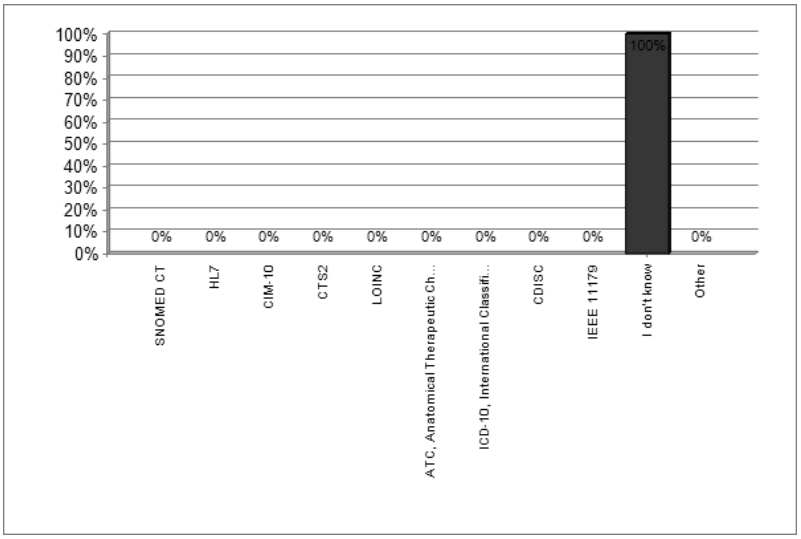

Figure 10 (Academia) We use the following medical terminology/standards in our research… (multiple answers allowed)

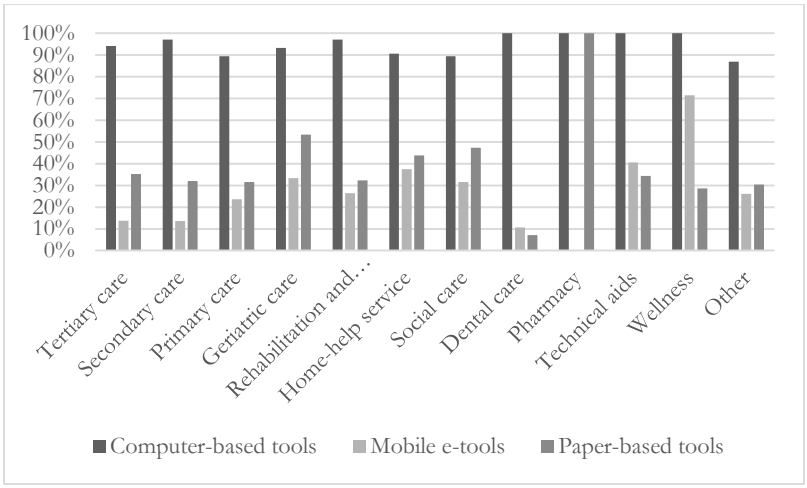

Figure 11 in our organization we primarily use … crossed with our responsibility is…

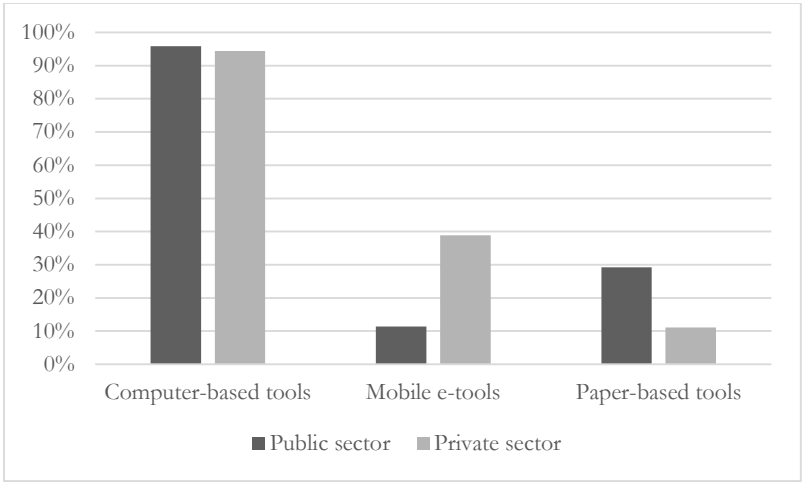

Figure 12 in our organization we primarily use…

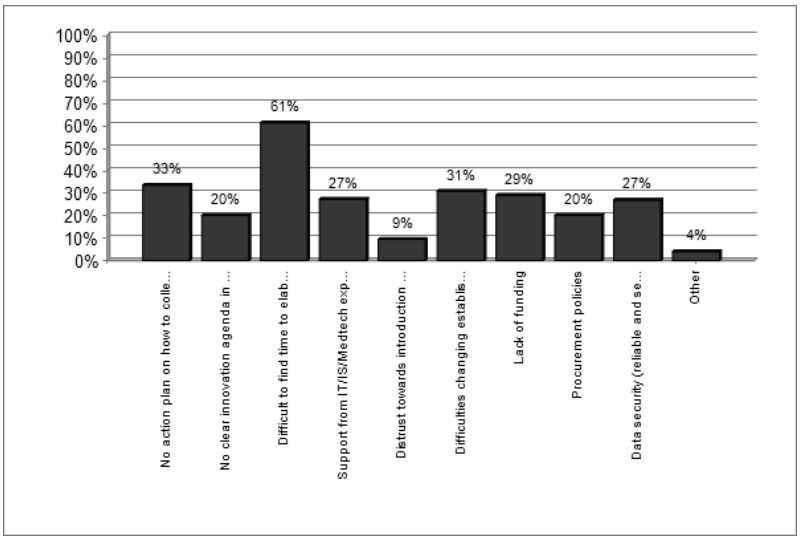

Figure 13 The 3 major difficulties/ barriers in creating eHealth innovations based on ideas from our healthcare professionals are...

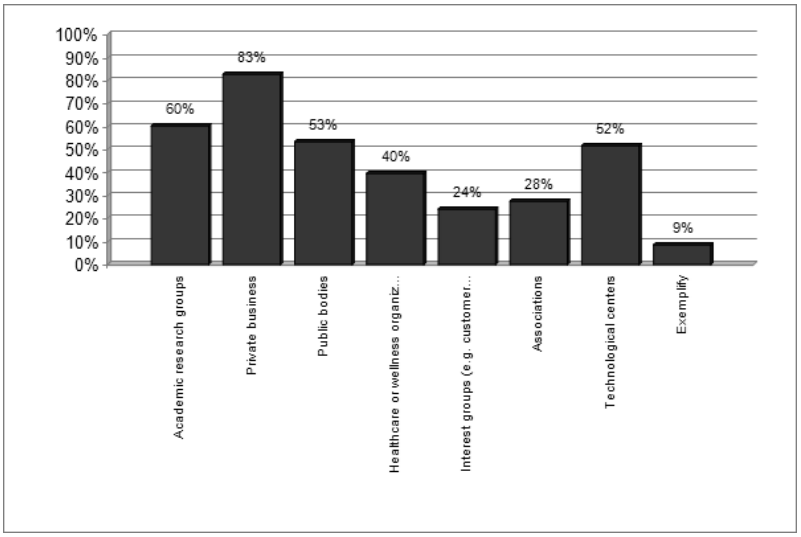

Figure 14 (Business) Our company/research group is collaborating with... (multiple answers allowed)

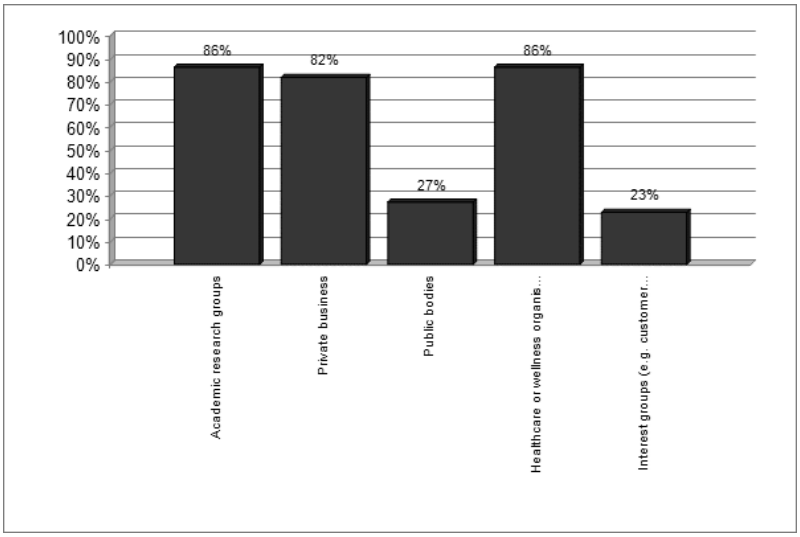

Figure 15 (Academia) Our company/research group is collaborating with... (multiple answers allowed)

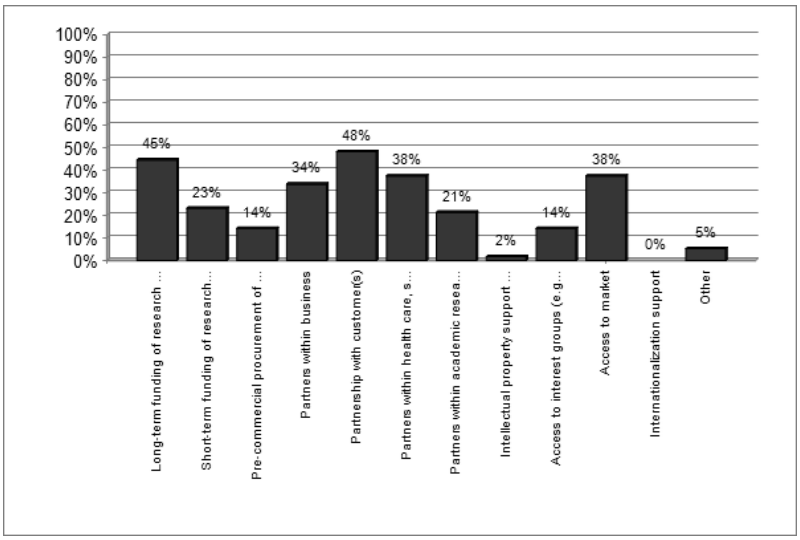

Figure 16 (Business) The 3 most important factors for our business to be able to develop innovative products are...

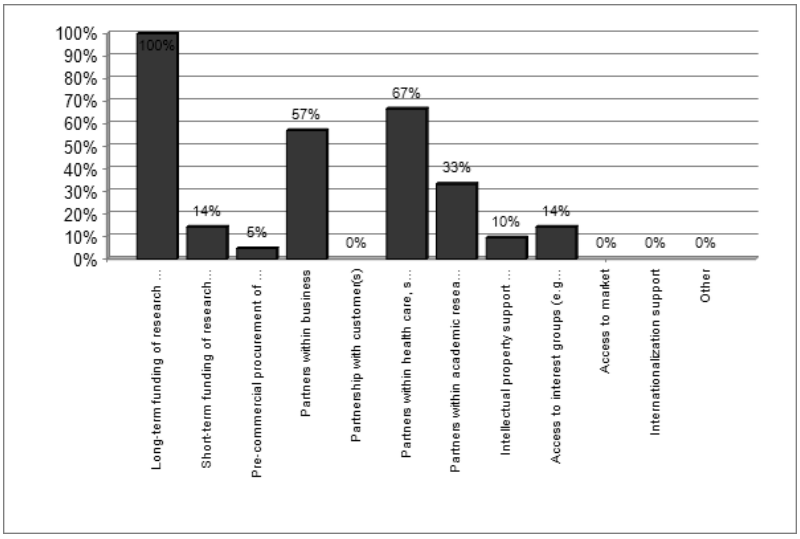

Figure 17 (Academia) The 3 most important factors for our business to be able to develop innovative products are...

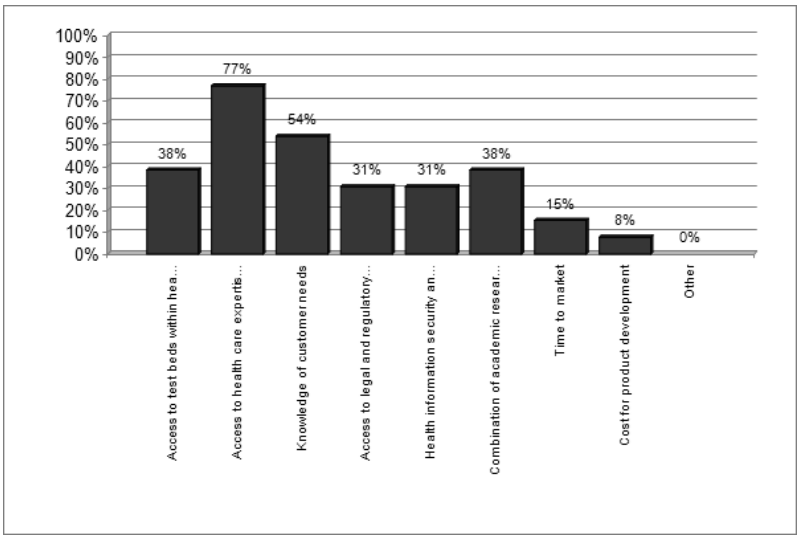

Figure 18 (Academia) The 3 major challenges in creating eHealth innovations for our business are...

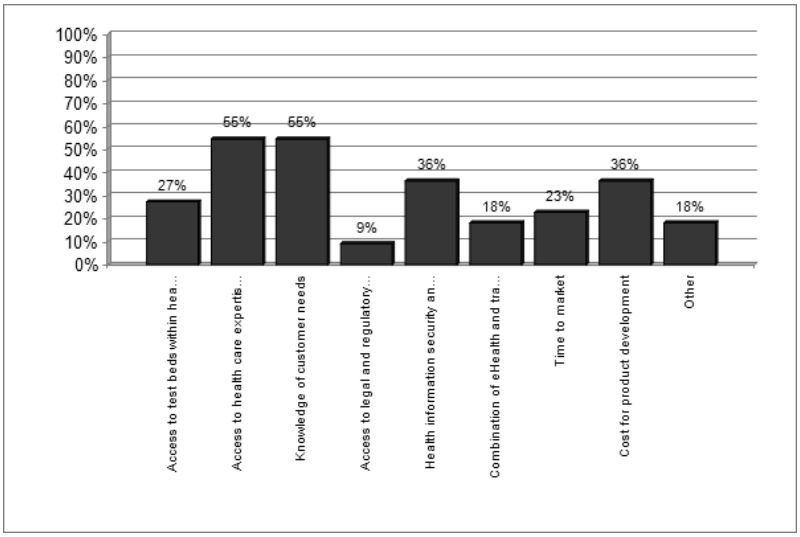

Figure 19 (Business) The 3 major challenges in creating eHealth innovations for our business are...

Appendix 2. Djupintervjufrågor – Akademi Forskning

Datum:_____

Namn: _____**Titel:**_____

Universitet:_____**Institution:**_____

Vilka faktorer är viktigast för att stimulera er forskning? *Vad har ni? Vad saknar ni?* *Finansiering, partnerskap företag/kunder, intressegrupper, samarbetspartners, testbäddar, marknaden, stöd inom internationalisering*
Bedriver ni forskning inom området e-hälsa? Alternativ forskning som kan appliceras på e-hälsa? *Vilka områden anser du kommer vara nyckelområden för vidare utveckling?*
Exempel på hur er forskning lett till framgångsrika innovationer inom e-hälsa? **Andra framgångsrika exempel på innovationer inom e-hälsa i regionen?** *Vilka barriärer har ni stött på?* *Hur kan man underlätta dessa?* *Hur ser ni på de regulatoriska krav som ställs?*
Vilka möjligheter och utmaningar har ni stött på i er forskning inom e-hälsar? *Vad har ni gjort för att komma över dem?* *Hur samverkar ni för att bygga upp kompetenserna kring e-hälsa?* *Vilka forum saknar ni?* *Några exempel på erfarna forskare inom e-hälsa?* *Vilka är nyckelaktörerna för ett framgångsrikt e-hälsoprojekt/ utveckling av e-hälsoprodukter?*

Vilka tycker du är de främsta styrkorna i regionen för att stimulera innovationer inom e-hälsa, locka till sig investeringar och företagsetableringar? *På vilka områden är regionen svagare?* *Hur kan vi övervinna dessa svagheter?* *I vilka konstellationer kommer innovation och produktutvecklingen att ske?* *Vad behöver göras för att katalysera och facilitera utvecklingen av e-hälsoprodukter?* *Varför händer det inte?* *Vad behövs för att bygga upp denna bransch/ skapa en marknad?*
Möten över gränser, vilka konstellationer ser ni som framgångsrika? *Hur skapar man en sprudlande verkstad för e-hälsa?* *Vilket stöd behövs? Från vem?*
Hur ser ni på rådande intäktsmodell, finansiering för att driva e-hälsoinnovation? *Vem betalar för proaktiv sjukvård?* *Några förslag på förändringar som behöver ske?*
Vilka anser du är de viktigaste områdena att bedriva forskning och utveckling med avseende på e-hälsa?
Ytterligare information som du vill dela med oss? **Nyckelpersoner som du tycker att vi bör kontakta?**

Appendix 3. Djupintervjufrågor – Hälso- och sjukvård

Datum:_____

Namn:_____**Titel:**_____

Organisation:_____**O /P:**_____

Vilka IT stöd använder ni i vardagen? **Vilka elektroniska lösningar efterfrågas? Underliggande behoven?** **Hur uppfattas IT i organisationen?**
Finns det en strategi för upptag av idéer från medarbetare som kan ledda till innovationer? *Ja: Hur välkänd är den ute i organisationen?* *Nej: Varför inte?*
Vilka möjligheter och utmaningar har ni stött på vid implementering utav e-hälsolösningar? *Vad har ni gjort för att komma över dem?* *Hur samverkar ni för att bygga upp kompetenserna kring e-hälsa?* *Vilka forum saknar ni?* *Vilka är nyckelaktörerna för ett framgångsrikt e-hälsoprojekt/ implementering av e-hälsolösningar?*
Vilka tycker du är de främsta styrkorna i regionen för att stimulera innovationer inom e-hälsa, locka till sig investeringar och företagsetableringar? *På vilka områden är regionen svagare?* *Hur kan vi övervinna dessa svagheter?*

I vilka konstellationer kommer innovation och produktutvecklingen att ske? *Vad behöver göras för att katalysera och facilitera utvecklingen av e-hälsoprodukter?* *Varför händer det inte?* *Vad behövs för att bygga upp denna bransch/ skapa en marknad?*
Möten över gränser, vilka konstellationer ser ni som framgångsrika? *Hur skapar man en sprudlande verkstad för e-hälsa?* *Vilket stöd behövs? Från vem?*
Vilka anser du är de viktigaste områdena att bedriva forskning och utveckling med avseende på e-hälsa?
Hur ser ni på rådande intäktsmodell, finansiering för att driva e-hälsoinnovation? *Vem betalar för proaktiv sjukvård?* *Några förslag på förändringar som behöver ske?*
Ytterligare information som du vill dela med oss? **Nyckelpersoner som du tycker att vi bör kontakta?**

Appendix 4. Djupintervjufrågor – Näringsliv

Datum:_____

Namn: _____**Titel:**_____

Organisation:_____

Har ert företag utvecklat e-hälsoinnovationer / produkter? *Vilka barriärer finns för kommersialisering?* *Hur kan man underlätta kommersialisering?* *Hur ser ni på de regulatoriska krav som ställs?*
Vilka möjligheter och utmaningar har ni stött på i ert arbete med e-hälsoinnovationer? *Vad har ni gjort för att komma över dem?* *Hur samverkar ni för att bygga upp kompetenserna kring e-hälsa?* *Vilka forum saknar ni?* *Några exempel på erfarna entreprenörer inom e-hälsa?* *Vilka är nyckelaktörerna för ett framgångsrikt e-hälsoprojekt/ utveckling av e-hälsoprodukter?*
Vilka tycker du är de främsta styrkorna i regionen för att stimulera innovationer inom e-hälsa, locka till sig investeringar och företagsetableringar? *På vilka områden är regionen svag?* *Hur kan vi övervinna dessa svagheter?* *I vilka konstellationer kommer innovation och produktutvecklingen att ske?* *Vad behöver göras för att katalysera och facilitera utvecklingen av e-hälsoprodukter?* *Varför händer det inte?*

Vad behövs för att bygga upp denna bransch/ skapa en marknad?
Möten över gränser, vilka konstellationer ser ni som framgångsrika? *Hur skapar man en sprudlande verkstad för e-hälsa?* *Vilket stöd behövs? Från vem?*
Känner ni till Innovationsupphandlingar? *Vad finns det för möjligheter, hinder och utmaningar?*
Hur ser ni på rådande intäktsmodell, finansiering för att driva e-hälsoinnovation? *Vem betalar för proaktiv sjukvård?* *Några förslag på förändringar som behöver ske?*
Ytterligare information som du vill dela med oss? **Nyckelpersoner som du tycker att vi bör kontakta?**

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