THE POTENTIAL OF DATA IN APPLIED SERVICE DESIGN

A case study of how data can be used to empower citizens with type 2 diabetes

SERVICE SYSTEMS DESIGN
AALBORG UNIVERSITY COPENHAGEN

MASTER THESIS
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PROCESS REPORT

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Master thesis

Process report

Title:
The potential of data in applied service design:
- A case study of how data can be used to empower citizens with type 2 diabetes

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Collaboration with an Organisation:
Sundhed.dk

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Abstract

In today's society, lifestyle diseases such as diabetes are becoming more and more common. Diabetes is the disease in Denmark that has the highest incidence rate, and the Danish healthcare system will therefore need a solution in order to overcome this challenge.

This thesis has investigated the potential of data in applied service design, through a case study of how data can be used to empower citizens with type 2 diabetes. This has been answered through the following problem statement

"How can a service system utilising quantified self data, empower citizens with type 2 diabetes, to take responsibility for their disease by supporting them in their decision making?"

The research conducted has involved the actors through interviews, co-creation, and workshops. Based on the research the service system contribution presented in this report, is a proposal to the challenges with diabetes.

The service solution has been developed and tested as an high fidelity prototype for people with type 2 diabetes, to better control and take more responsibility for their disease,

The study has included too few test participants, to conclude anything definitive, however it has shown clear tendencies. These tendencies show that data has a large potential in a service design context. It provides the possibility to create personalised services, which has been found as a rising demand from the users. Considering the case study, a service to support and empower citizens with type 2 diabetes, has shown to create value for the participants. Continuing the work are definitely worth the effort. Such a service would both be capable of supporting the users and gather valuable data for research purposes.

// ACKNOWLEDGEMENTS

To accomplish and complete this study we would like to thank some particular people.

Jakob Uffelmann and Line Langballe, contact persons from sundhed.dk for the provision of experts within the theme and the continues feedback, guidance, and ideas throughout thesis.

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Nicola Morelli, supervisor of the thesis, for inputs, guidance, and valuable feedback.

To all the people who participated in discovering and developing the service, for their personal inputs and opinions towards the service and for opening up for their personal stories.

Finally, a big thank you to everyone who have been a part of the thesis in one way or another: family, friends and colleagues.

// ABBREVATIONS

Longer expressions has in the report been abbreviated as acronyms. These are presented here for the reader to familiarise with, before starting to read the report. The abbriviated words will be presented in their original form followed by their acronym in the beginning of all sections throughout the report.

T2D: Type 2 diabetes

T1D: Type 1 diabetes

HCP: Healthcare Professionals

HCS: Healthcare System

GP: General Practitioner

DMP: Disease Management Programme

// READING GUIDE

The report is divided into six chapters following the design process model chronologically. The six chapters are introduction, discover, define, develop, deliver, and conclusion.

The first chapter is the **introduction** this introduces the reader to the overall theme, the problem field, and the methodological approach.

Discover is indicated by the colour green and marks the beginning of the thesis. This chapter will present the background research important to understand the context of the project. It will also present initial user research gathered through interviews and workshop.

Define is indicated by the colour red. It will align the framework for the further design process. In this chapter the actors involved, the target group, and the design constraints will be presented.

Develop is indicated by the colour blue and describes the development of the service. It will present the co-creation of the solution, iteration, prototyping, and testing. Furthermore, the suggested service system will be presented through visualisations and explanations of the system.

Deliver is indicated by the rosy colour and will present the deliverables to the collaborating partner.

The final part of the report, **the outro**, will present the future perspectives, reflections and conclusions in relations to the theoretical framework and service idea concluding on the problem statement.

// LEARNING GOALS

This section will describe the official study guide goals for the thesis.

Study guide goals

According to the study guide (The Technical Faculty of IT and Design The Study Board of Media Technology, 2012) the following qualifications should be obtained:

Knowledge:

- Must have knowledge about the possibilities to apply appropriate methodological approaches to specific study areas
- Must have knowledge about design theories and methods that focus on the design of advanced and complex product-service systems

Skills:

- Must be able to work independently, to identify major problem areas (analysis) and adequately address problems and opportunities (synthesis)
- Must demonstrate the capability of analysing, designing and representing innovative solutions
- Must demonstrate the ability to evaluate and address (synthesis) major organisational and business issues emerging in the design of a product-service system

Competencies:

- Must be able to master design and development work in situations that are complex, unpredictable and require new solutions (synthesis)
- Must be able to independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility (synthesis)
- Must have the capability to independently take responsibility for own professional development and specialisation (synthesis)

Personal goals

In addition to the study guide goals the group had the following goals for the thesis project:

- Work in collaboration with a company in order to apply service design methods and tools on a real world case
- Work with the service design approach in a healthcare project

// COLLABORATING PARTNERS

sundhed.dk

The study programme

Master programme: Service Systems Design
Service Systems Design is a master programme at Aalborg University Copenhagen. The programme teaches about planning and organisation of people, communication, infrastructures, interactions between different stakeholders in a service, mediums, user experience, and what a service provides to be able to improve its quality (Aalborg Universitet, 2017).

Company

Sundhed.dk
Sundhed.dk is a public organisation that works with digitalisation of the Danish healthcare system. They have developed several digital services to make health data transparent and accessible for the danish citizens and healthcare professionals.

The thesis group

Kristina Lenette Vittrup
Kristina holds a BSc degree in Industrial Design from Aalborg University.

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INTRODUCTION

Diabetes and other lifestyle diseases are becoming more and more common in today's society. How such diseases are treated is far from optimal. The regular procedures are a short rehabilitation programme, afterwards it is up to the patient to change their lifestyle. This kind of treatment has a large chance of losing the "weaker" people in society. People with less resources has a harder time changing habits, because they have other more important issues to worry about (Bjerregaard, M., 2016). In an article from DR (Danish Broadcasting Corporation) it is suggested that the treatment should be made more personalised adapting to the needs of individual people (ibid).

The cases of diabetes has the last ten years increased to the double. The registred number of people with diabetes in Denmark is 320.545 (in 2013) and is expected to increase to 600.000 in 2025 (Sivertsen, S. H., 2015). 80% of people with diabetes in Denmark has type 2 diabetes (T2D), while the last 20% has other kinds of diabetes (ibid).

According to the latest statistics from Sundhedsstyrelsen, diabetes is the disease that has the highest incidence rate and it is the fourth most cost-intensive disease proportionate to treatment and care in Denmark (Meulengracht, E. F. et al., 2015). Sundhed.dk are aware of the large load such diseases cause society and are therefore looking into making a service that can assist people with T2D, while collecting data for research. The hopes of such a system is that it can help improve research conditions in relation to T2D. At the same time it should help the people avoid being affected by sequelas, increasing life quality, and reducing societal costs in the process.

Since people with diabetes are constantly affected by their disease, a constant flow of data is created. This flow can include healthcare data, the people's own measurements, and quantified self data. The flow of data, especially quantified self data, has increased along with the increasing numbers of smart devices, which generate data from people's behavior, more data than previously possible (Birkavs, E., et al., 2016; Carson, S. et al.,2015). This large flow of data creates an opportunity for creating new supportive services for people. These services can act according to the users data, supporting them in their self-understanding and awareness of their condition and health.

When regulating T2D it is important to consider the triangulation between diet, exercise and treatment (e.g. medicine) (Dømgaard, M., 2015). Being aware of this triangulation could potentially help people with diabetes decide how to regulate their disease giving them more freedom of action.

One of the most important elements when treating diabetes is self care, which requires motivation and knowledge. Knowledge, the people have to get from the healthcare professionals or other sources when being diagnosed. The right knowledge can help empower the people to grow in their own realisation and insight, making them able to act according to it in their life (Bartholdy, J., 2003). Empowerment is the process and goal of giving power and strength to a group of people (ibid).

This diverse and expanding target group together with the complexity of regulating the disease, places many challenges that service designers might face in the future. The thesis group has agreed to collaborate with sundhed.dk to work towards building a service system that can help diabetes people deal with their condition by self managing their disease. This should be done through the gathering of quantified self data, empowerment and support.

The report

This process report outlines the design process of this thesis. The study programme is organised as a problem-based study. Therefore, the thesis group has formulated a problem statement, that will be presented in this chapter.

// PROBLEM FIELD

The introduction described briefly why there are such a large demand for developing a service, which will help people with diabetes manage their disease. This section will introduce the problem statement, which will form the foundation for the thesis.

In the previous section it was made clear that managing diabetes requires self care and knowledge about how to navigate the three main factors, exercise, diet, and treatment. It also highlighted that a secondary goal is to collect data to improve research potential, helping the health sector to better treat people with diabetes. Gathering data to improve treatment in healthcare makes sense since the danish healthcare system (HCS) is very focused on digitisation to better provide treatment for the users, especially towards users with a chronic disease (diabetes) or other long term diseases (Sundhedsdatastyrelsen, 2017).

This project aims towards creating a service system that can support and empower type 2 diabetes (T2D) people with their self care, while collecting data for research. The problem statement highlights the main factors needed to create such a system.

The problem statement highlights the use of collected data to support and empower citizens with T2D. A system answering this question would be able to manage the goal of both supporting the users with their disease and supplying the health sector with important data for research. The highlighted keywords fron the problem statement will be elaborated in the following:

Service system: The means to achieve the goal
Quantified self data: The ground pillar that are used to apply value in the service
Empower: A philosophy used to motivate the users of the service
Supporting: Guiding and helping the users to establish and achieve their goals

Citizens with type 2 diabetes: Defines the target group. An additional requirement connected to the target group is that they should be familiar with digital devices. This will be elaborated on in (Target group, p. 85)

Problem statement

*"How can a **service system** utilising **quantified self data**, **empower citizens with type 2 diabetes**, to take responsibility for their disease by **supporting** them in their decision making?"*

// PROCESS MANAGEMENT

A set of tools was selected to help manage the entire process of this thesis, in order to work structured throughout the process. This section will describe the chosen tools and the primary purpose of these.

Slack

Slack is a team communication tool that allows to create channels to discuss specific topics. Furthermore, slack is easy to integrate with other tools e.g. trello as explained below. *Slack* allows dynamic search based on channel or author making old conversations easy to localise (Slack, 2017)

Purpose
In this project slack was chosen to keep track of the written communication between group members. The option of structuring conversations in different channels (e.g. links-and-articles for easy sharing of relevant links) together with the easy localisation of old conversations was the primary reasons for using this software.

Trello

Trello is a collaborative online tool that allows teams to track and prioritise work in a flexible way. Trello works by creating boards. In these boards you create lists e.g. 'to do', 'doing', 'done' on each of these lists, cards with specific tasks are added. Trello syncs with slack allowing to post messages when a task is updated or moved in order to keep track of the progress of a project (Trello, 2017).

Purpose
For this thesis *Trello* was used to structure the writing assignments to keep a continuous overview of what is being done, by who, and where in the process the task is. A board was created for each chapter of the report e.g. \`Introduction\`, \`Discover\`, \`Define\`, etc. A digital solution was optimal because the group worked from different locations during a regular week.

Drive

Google Drive is a storage service. It is possible to store and share all types of documents as well as share folders with multiple documents. Furthermore, *Google Drive* allows to create and collaboratively edit documents online (Google, 2017, Google Drive).

Purpose
Collect and share all documents, photos, recordings, and articles in one common place. Furthermore, it allowed the group members to collaboratively edit documents and to make sure everyone had access to all files at any time.

Mendeley

A program for managing and structuring sources. With *Mendeley* it is possible to create shared folders allowing all members access to a database of all the sources used (Mendeley, 2017).

Purpose
The initial purpose of using *Mendeley* was to make sure all sources are formatted similarly and to allow the group members to access the sources used by one another.

Process timeline

The timeline displayed (Figure 1) is a visualisation of the actual process.

Purpose
The purpose of the timeline was to get an overview of all the processes the thesis group counted on going through to make sure that the project would be done by the expected deadline. This helped align expectations and plan the process.

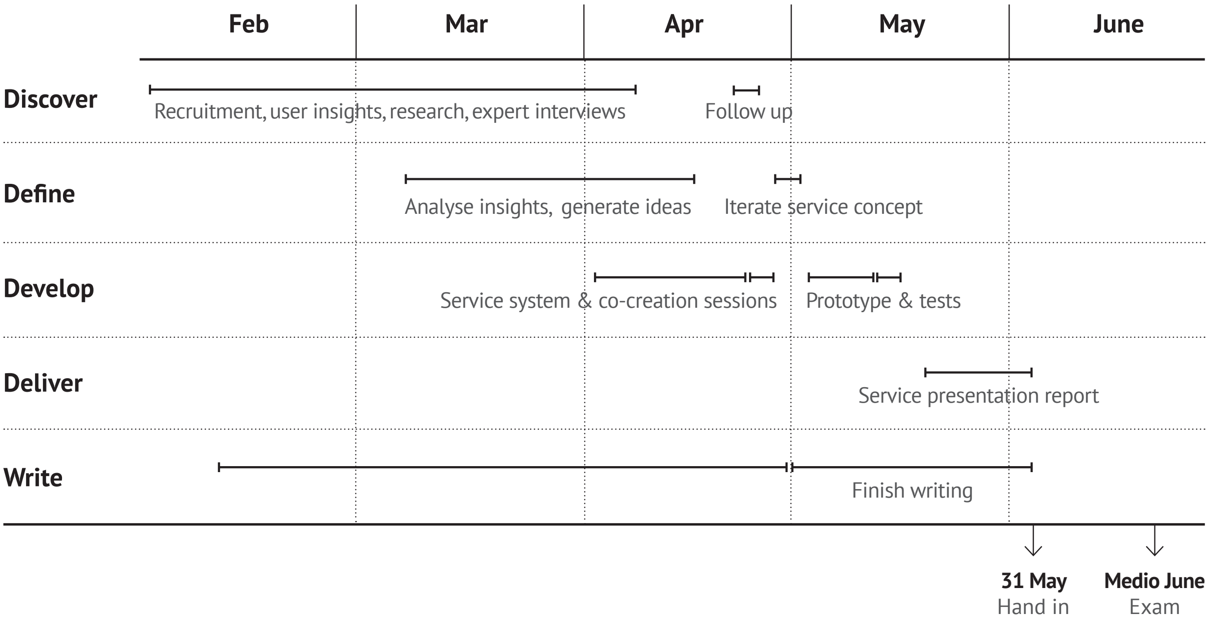


Figure 1 *- Process timeline*

// METHODOLOGICAL APPROACH

> *"As human beings, we continuously create things that help reshape the reality and essence of the world as we know it. When we create new things – technologies, organizations, processes, environments, ways of thinking or systems –we engage in design"*
>
> (Nelson, H. G., Stolterman, E., 2012)

> *"...the actual sequence of design thinking and decision making is not a simple linear process; and two, the problems addressed by designers do not, in actual practice, yield to any linear analysis and synthesis yet propose."*
>
> (Buchanan, R., 1992)

This following section will describe the different ways of thinking design, from the abstract mindset of design thinking to a more specific approach of designing.

Design thinking

With the vision of designing a better future and designing on the basis of the co-design approach, design thinking is an obvious approach for this thesis. Design thinking is a mindset, that provides a process for transforming challenges into possibilities and are simultaneously a human-centred, collaborative, optimistic, and experimental approach (Riverdale + IDEO, 2011).

The process of designing has to allow for continuous development, which means the process can not be followed as a linear design process nor can the defined goal of the project. The goal is to be open for ongoing improvements. The approach is boundlessly complex and diverse from process to process, which Buchanan describes in his article by:

Since the problem from sundhed.dk's perspective is given, the problem from the users perspective is to be investigated by the group themselves to understand the culture, meaning, value, and context of the diabetes people highlighting the right problems.
This operational approach paves the way of involving the user in the process, understanding their context. This is done by ideating, co-creating, and developing solutions throughout the process.

The group is aware of being as reflective and transparent in the process of decision making and problem solving as possible. This is both done by collaborating with the users and the interested parties in this inter deterministic design thinking methodology.

Design process model

The design process is the way to put design thinking in action. A design process model is a structured approach to generate and evolve ideas. To keep such a structure for the design process of a new service, the double diamond process model will be used (Design Council, 2005).

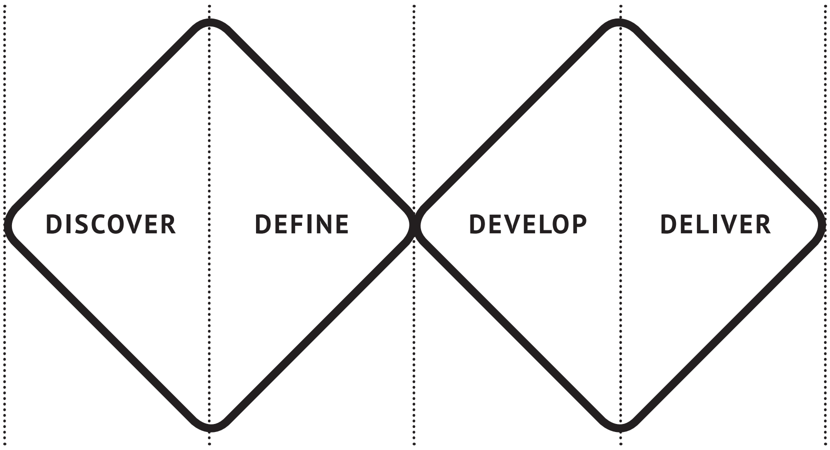


Figure 2 - *Design process model*

The methodological approach of design thinking is representing an iterative design process. The process model will help navigating the development by identifying the users' needs and incorporating these needs into a solution.

The double diamond consist of four phases; discover, define, develop, deliver, mapped in two convergent and two divergent stages (Figure 2). The convergent stages opens up for information, findings and ideas, that will be defined and refined throughout the divergent stages in the process (Design Council, 2007).

The group will experience how the process is changing and developing constantly through the process of the iterative, explorative and experimental design thinking mindset. The double diamond process model will help structure the process, to reach a common ground in the group and continuously reflecting upon the process and service.

Service design

The master programme in Service Systems Design works on the basis of the approach of service design. The book *This is Service Design Thinking* aims to give a proposition to a common language of service design (Stickdorn, M., Schneider, J., 2011). Service design can be defined in many different ways. Stickdorn, M. and Schneider, J. (2011) describes the discipline as:

> *"...an interdisciplinary approach that combines different methods and tools from various disciplines."*
>
> (Stickdorn, M., Schneider, J., 2011)

Moritz, S. (2005) explains it as:

> *"Service Design helps to innovate (create new) or improve (existing) services to make them more useful, usable, desirable for clients and efficient as well as effective for organisations. It is a new holistic, multi-disciplinary, integrative field."*
>
> (Moritz, S. 2005)

The approach of service design can be described on the basis of five principles illustrating service design thinking by Stickdorn, M., and Schneider, J. (2011). Following is a short description of the five principles:

User-centred
"The inherent intention of a service is to meet the customer's needs and, as a result, be used frequently and recommended heartily." (ibid)

The service should be experienced in the eyes of the customer or user. Services consist of interdisciplinary stakeholders with individual experiences and backgrounds. Understanding and using this is crucial for the success of a service (ibid).

Co-creation
Each stakeholder possesses different views and expectations towards a service. Therefore, it is important to include all interested stakeholders in the design process (ibid).
With co-creation the designers and stakeholders sets a common language through creativity (ibid),

allowing the user to actively participate in designing together with the designer.

Sequencing
A service consist of a sequence of service moments and is a dynamic process over time (ibid). It is important as a designer to keep the sequence in a pleasurable rhythm, that makes the frontstage and backstage work together and makes the backstage prepare for the frontstage processes (ibid).

Evidencing
Services are intangible, but by using evidences the service processes or touchpoints can become tangible. An evidence can be physical artefacts that can prolong the intangible service period and can result in increasing appreciation of the experience (ibid).

Holistic
A service consist of various stakeholders such as users, customers and providers, technological processes, various contexts, individual touchpoints, service moments and sequences that are incorporated into one bigger picture. Service design aims to create a holistic overview of the entire system build from these various elements or more (ibid).

These five principles creates an understanding of what service design consist of and can do. When designing services it should be with the users, but different approaches than the user-centred approach are applicable for the collaboration between the designer and the user.

Designing with users

As the service design approach is both multi-disciplinary and integrative, different approaches and methods exist within the service design discipline. To accommodate a service to its users needs it is important to involve them in the process. The usage of different design approaches changes the roles of the researcher, the designer and the user according to the chosen approach (Sanders, E. B.-N., Stappers, P. J. 2008).

The approaches to involve the users, customers and other experts has evolved through time, from observing to involving the users in the design of new services. This evolvement has both changed the involvement, but also the emerging design discipline such as service design affecting the roles of designers and users. The evolvement of design practices changes how we design, who designs, and what we design (Sanders, E. B.-N., Stappers, P. J., 2008).

The history of design practices goes back to where design was centred by design and designers imagined the users' needs. Later the users started participating more either by the designers representing the users or by the designer experiencing and observing the user (Moritz, S., 2005). Today the users are included in the design process by the approaches of user-centred design, participatory design, and/or co-design.

The three approaches
The three approaches differs from each other in the ways of involving the users and experts. The user-centred approach brings the user in a passive position, where the user is the subject of study who gives knowledge through research and interviews. The designers then uses this knowledge for creative thinking and idea development (ibid; Jørgensen, U., Lindegaard, H., Rosenqvist, T., 2011).
In the participatory approach the user is more involved by the designer asking questions and the user participating as tester. The designer is still designing based on insights, but the approach is different in co-design (Jørgensen, U., Lindegaard, H., Rosenqvist, T., 2011).
The co-design approach gives the user an active role in the design process, where they do not just inform the designer, but collaborate with the designer (ibid). As Jørgensen, Lindegaard and Rosenqvist (2011) explains,

> *"Doing co-design therefore means going the final step towards the user from observing the user (user-centred design), to engaging the user (participatory design), to collaborating with the user (co-design)."*
>
> (Jørgensen, U., Lindegaard, H., Rosenqvist, T., 2011)

The role of the user as co-designer can vary much depending on their creativity, expertise and passion. Sanders, E. B.-N., & Stappers, P. J. (2008) explains the role in co-designing by

> *"All people are creative but not all people become designers."*
>
> (Sanders, E. B.-N., Stappers, P. J., 2008)

They divide creativity into four levels of doing, adapting, making, and creating. People experience all the levels through their daily life in different situations.
The four creativity levels can be seen in the (Figure 3) and varies in the amount of interest and expertise. The position in the different levels also depends on the appropriate tools the designer offers to the users to express themselves (ibid).

To attain the discipline of service design, co-design has been the chosen approach for this project.

LEVEL	TYPE	MOTIVATED BY	PURPOSE	EXAMPLE
4	Creating	Inspiration	'express my creativity'	Dreaming up a new dish
3	Making	Asserting my ability or skill	'make with my own hands'	Cooking with a recipe
2	Adapting	Appropriation	'make things my own'	Embellishing a ready- made meal
1	Doing	Productivity	'getting something done'	Organizing my herbs and spices

Figure 3 - *Four levels of creativity*
(Sanders, E. B.-N., Stappers, P. J., 2008)

Service Design in Healthcare

The involvement of patients when redesigning healthcare processes are seen more and more frequently over the last years. The traditional view of the user being a passive recipient of the service has begun to change, by giving way for the user as an integrated part of the improvement process (Bate, P. and Robert, G., 2006).

Stiftelsen Svensk Industridesign has in 2013 initiated a study with the purpose to compile the knowledge about designing services within the focus of healthcare. The study evaluated the effects service design can expect to give by a broad investigation of development projects, academic research and other knowledge about the topic (Capire/HCM, 2013). The study shows a big potential of service design in

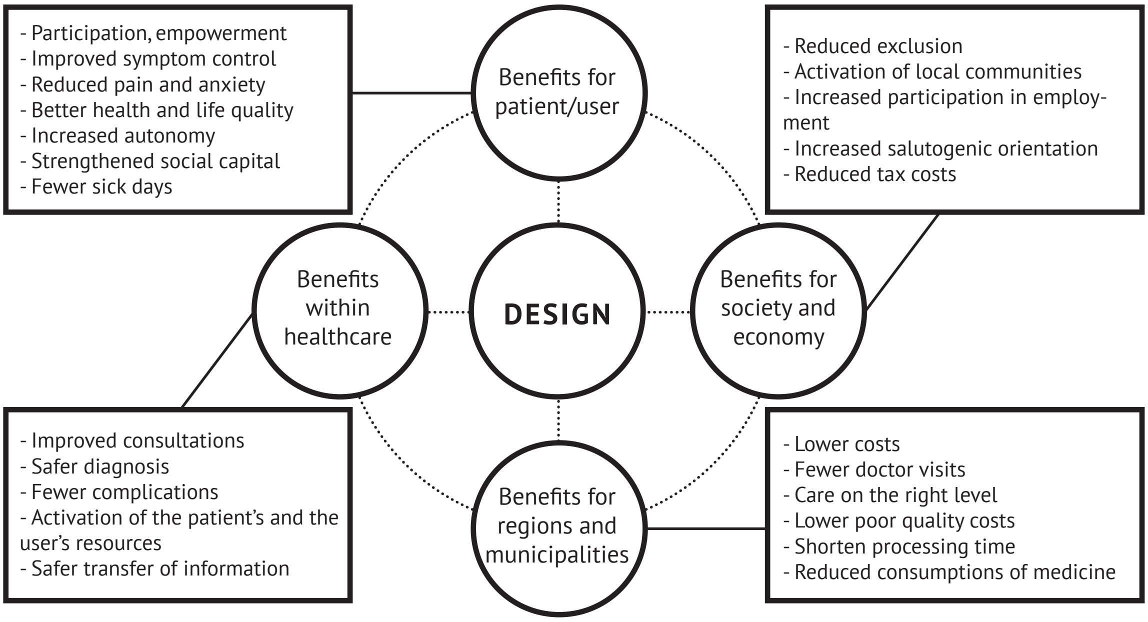


Figure 4 - *Example of direct and indirect gains, that can be achieved by patient- and user-centered design projects*
(Capire/HCM 2013) (trans.)

healthcare. The user-oriented services have shown to provide improvements in the resource expenditure and quality, but further studies are still required to confirm the theory. The gains is for example reduction in hospitalisation and specialised treatment, better medical results and higher quality in the personal care (ibid).

(Figure 4) by Capire/HCM (2013) describes the direct and indirect gains achieved by using user-oriented design approaches. The study suggest among other things that service design can offer:

- Increased empowerment and better health *for the patient*
- Better results and processes for *the healthcare professionals*
- Reduction in cost for *the healthcare system*
- More presence in *the societal environments*

When working around healthcare organisations in the public sector compared to other service organisations the way of working is different, which creates some challenges. The study describes two organisation principles. The healthcare organisations are working on the basis of different research and development areas, where different efforts are decided and replaced continuously on the basis of problems emerging based on needs (from competencies to needs). This is a producer-oriented approach, where the competences as medical research-based guidelines and disease management programmes manage the service development.
The other service organisations work on the basis of defining the users' needs and then organise the company most efficiently based on these needs (from needs to competencies). This is the consumer-oriented approach, which is used in service design (ibid). The producer-oriented approach also shows examples in the danish healthcare of discontented users, as in the newly implemented Sundhedsplatform in the Capital and Zealand regions of Denmark (Munksgaard, L. T., 2017).

In (Figure 5) the different ways of working are shown.

The study gives a glimpse of the effect service design can have when developing services in healthcare and which challenges that could emerge.

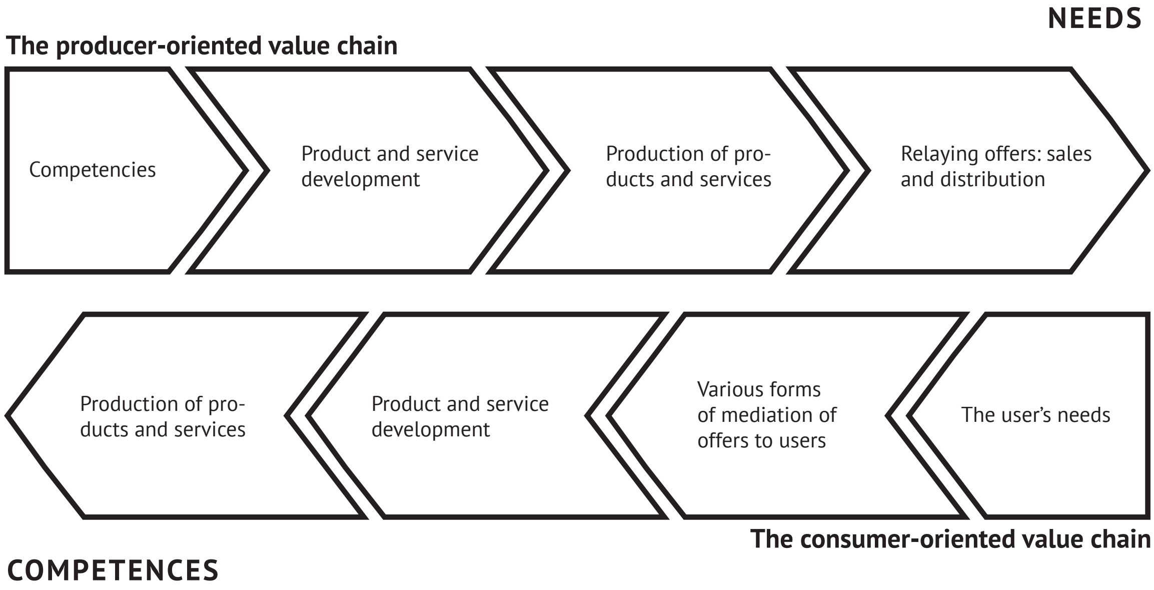


Figure 5 - *Two organisation principles: competencies that defines needs compared to needs that defines competencies (Capire/HCM 2013) (trans.)*

DISCOVER

The following chapter will present the wider perspectives of inspiration, ideas and knowledge towards identifying the right problem for the project. This chapter will touch on the overall healthcare system in Denmark, what diabetes is and its influence on the society as well as go deeper into the themes that emerge through the process.

// THE DANISH HEALTHCARE SYSTEM

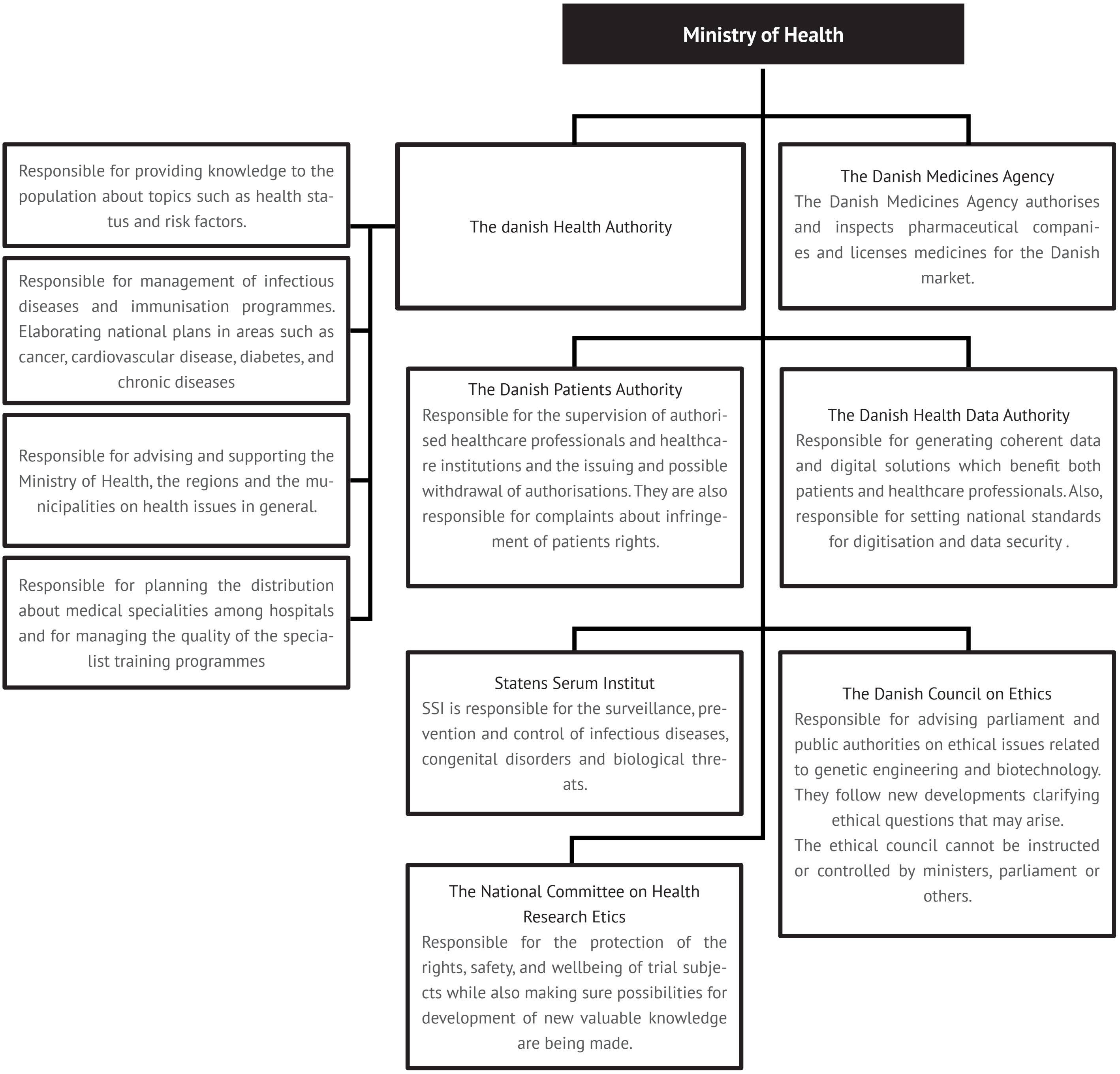
This section aims to provide a general understanding about the Danish healthcare system (HCS). It will look into the three administrative levels the system operates in and who is in control of them – the government (national level), the regions (regional level) and the municipalities (local level) – by highlighting each of their areas of responsibility (Ministry of Health, 2016).

The Ministry of Health

The department responsible for managing the HCS on a national level is the Ministry of Health. In the article *Healthcare in Denmark - an overview* published by the Ministry of Health, the overall responsibilities of the ministry are described in the citation.

> *“The Ministry of Health is responsible for establishing the overall framework for the provision of health and elderly care. This includes legislation on the organisation and provision of health and elderly care services, patients’ rights, healthcare professionals, hospitals, and pharmacies, medicinal products, vaccinations, maternity care and child healthcare.”*
>
> (Ministry of Health, 2016)

The responsibilities for the mentioned areas are divided into different underlying agencies, an organisational chart including the main responsibilities of each of these are shown on (Figure 6) (Ministry of Health, 2016).



Ministry of Health

The danish Health Authority

Responsible for providing knowledge to the population about topics such as health status and risk factors.

Responsible for management of infectious diseases and immunisation programmes. Elaborating national plans in areas such as cancer, cardiovascular disease, diabetes, and chronic diseases

Responsible for advising and supporting the Ministry of Health, the regions and the municipalities on health issues in general.

Responsible for planning the distribution about medical specialities among hospitals and for managing the quality of the specialist training programmes

The Danish Medicines Agency
The Danish Medicines Agency authorises and inspects pharmaceutical companies and licenses medicines for the Danish market.

The Danish Patients Authority
Responsible for the supervision of authorised healthcare professionals and healthcare institutions and the issuing and possible withdrawal of authorisations. They are also responsible for complaints about infringement of patients rights.

The Danish Health Data Authority
Responsible for generating coherent data and digital solutions which benefit both patients and healthcare professionals. Also, responsible for setting national standards for digitisation and data security .

Statens Serum Institut
SSI is responsible for the surveillance, prevention and control of infectious diseases, congenital disorders and biological threats.

The Danish Council on Ethics
Responsible for advising parliament and public authorities on ethical issues related to genetic engineering and biotechnology. They follow new developments clarifying ethical questions that may arise.
The ethical council cannot be instructed or controlled by ministers, parliament or others.

The National Committee on Health Research Etics
Responsible for the protection of the rights, safety, and wellbeing of trial subjects while also making sure possibilities for development of new valuable knowledge are being made.

Figure 6 - *Organisational chart of the Ministry of Health (Ministry of Health, 2016)*

Regions

The regional level is governed by five regions each composed of 41 members (Figure 7) (Ministry of Health, 2016).

The regions are responsible for hospital care, emergency care, psychiatry, and the health services provided by general practitioners and other specialists in private sector (Ministry of Health, 2016).

The services above can be managed and organized individually by the regions within the financial and national regulatory framework set by the ministry of health (Ministry of Health, 2016).

Municipalities

The local level are governed by the 98 municipalities (Ministry of Health, 2015).

The municipalities are responsible for a variety of social and health services. In the article by the health ministry the areas are described in the quote.

Financing

The healthcare in Denmark is greatly prioritised in the danish society. 84% of the general health care and other social services are financed by taxes, the

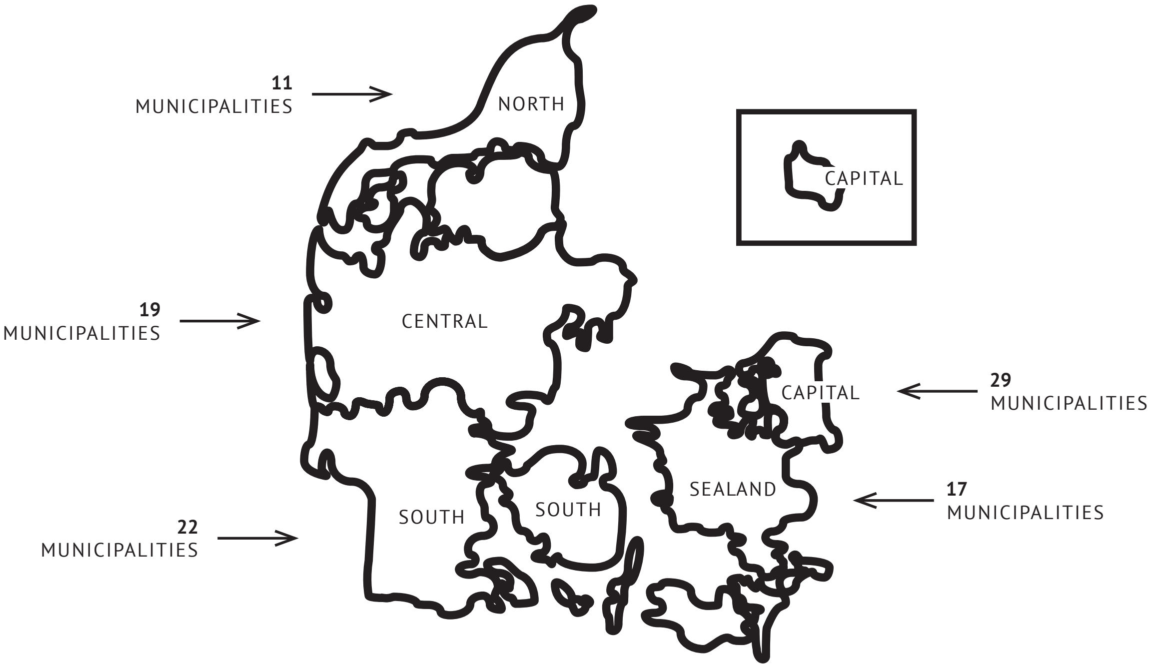


Figure 7 - Regions and municipalities in Denmark

> *"Local health and elderly care services {...include disease prevention and health promotion...}, rehabilitation outside hospital, home nursing, school health services, child dental treatment, child nursing, physiotherapy, alcohol and drug abuse treatment, home care services, nursing homes, and other services for elderly people. In addition, municipalities co-finance regional rehabilitation services and training facilities."*
> (Ministry of Health, 2016)

remaining 16% are primarily financed through patient co-payments. This means that 30% of the total public expenditure are used on healthcare (EUR 20.7 billion) (Ministry of Health, 2015).

Data in healthcare

The Danish HCS can be recognised by its extensively digitalised structure. Both the public hospitals and general practitioners systematically collect data on their patients, which are kept over long periods of time, allowing for large scale monitoring and analysis of data (Ministry of Health, 2015).

The following numbers provided by the report from the Danish Ministry of Health will show exactly how much the Danish healthcare is digitalised (Ministry of Health, 2015).

- All general practitioners (GP) keep electronic health records, and 98% exchange records electronically.
- GPs receive all laboratory test results from the hospitals electronically.
- 99% of all prescriptions are sent electronically to the pharmacies.
- 97% of all referrals to hospitals are made electronically.
- All referrals to medical specialists and psychologists are made electronically.

(Ministry of Health, 2015)

The numbers explains why the HCS is considered as one of the frontrunners within digital health technologies within the world (Ministry of Health, 2015). Furthermore, it explains why data is relevant when considering the treatment of a chronic disease, since this data can be correlated with the extensive healthcare data available.

A report by KPMG supports the consideration of the Danish HCS as frontrunners within digital health technology (KPMG International Cooperative, 2017). The report explains how transparency could be implemented better and how well transparency is implemented in global HCSs. The report evaluates on six different components, where Denmark manages to get the highest overall score, excelling in *finance*, *governance* and *personal healthcare data* (ibid). However, there is still room for improving the *communication of healthcare data*, the *patient experience* and the *quality of healthcare* (ibid).

// DIABETES

The collaboration with sundhed.dk means that the focus of this report will be on diabetes in Denmark. This section will look into the definition of diabetes, the different types of the disease and the numbers of the disease – national and worldwide.

What is diabetes?

Diabetes is a globally widespread chronic disease affecting more than 415 million people worldwide. Economically this means that 12% of global health expenditure are used in diabetes treatment (International diabetes federation, 2015).

Diabetes are devided into different types, common for all of them are that people who develop diabetes have inherited a genetic predisposition for the disease, which is being triggered by something in the surrounding environment (American Diabetes Association, 2017). Diabetes are caused by the pancreas fails to either produce insulin, enough insulin, or where the body fails to use the insulin it produces. Insulin is a hormone that lets glucose from the food we eat into the cells and converts it into energy. When this does not happen the glucose stays in the blood. An increased glucose level can seriously damage the body causing various sequelas (International Diabetes Federation, n.d., About diabetes; National Institute of Diabetes and Digestive and Kidney Diseases, 2017; Sundhedsstyrelsen, 2016).

Types of diabetes

Type 1

Type 1 diabetes (T1D) is primarily diagnosed among children and young adults, however it is also known to suddenly appear with elderly people. For T1D the body no longer produces insulin by itself, thus the affected person are in need of the necessary substance through injections (Wegener, A-M. K., 2014; American Diabetes Association, n.d.). This condition is usually caused by an autoimmune response, where the body's defence system attacks the cells which produces insulin (International diabetes federation, 2015). It is still unknown what triggers T1D and therefore there is still no cure or prevention for this type of the disease.

Type 2

Type 2 diabetes (T2D) can affect anyone, however it is often associated with overweight or obesity which can cause an increased insulin resistance. The carriers of this disease are affected by the body not being able to utilise the insulin it produces and/or by the body not producing enough insulin. The T2D can often be controlled through exercise and diet, but in many cases, additional treatment with oral drugs or insulin are needed (International diabetes federation, 2015).

Prediabetes

Prediabetes is a stage where the blood glucose levels are higher than normal but not high enough to be considered T2D. People with prediabetes, does if they do not change their lifestyle, risk to progress to T2D. However, progressing into T2D is not inevitable, assuming a healthy lifestyle by eating healthy and incorporating regular exercise can bring the blood glucose levels back to normal (MayoClinic, 2016, Prediabetes).

The sequelas

People with diabetes have an increased risk of developing various serious health problems caused by the disease - some of these are described below.

Cardiovascular disease

Patients with diabetes have a dramatically increased risk of experiencing various cardiovascular diseases. These include chest pain, heart attack, stroke and narrowing of arteries (Mayo Clinic, 2014, Diabetes Complications).

Nerve damage (neuropathy)

Increased blood glucose levels and blood pressure can cause damage to the nervous system. This can lead to digestive problems, erectile dysfunction and many other problems. Amongst the most commonly affected areas are extremities, in particular the feet. Nerve damage in these areas can lead to pain, tingling and loss of feeling. These injuries are known to go unnoticed, causing an infection which in some cases can result in amputation (International Diabetes Federation, n.d., Complications of diabetes).

Kidney damage (nephropathy)

Diabetes can damage the kidneys delicate filtering system that filter waste from your blood. Severe damage to this system can lead to kidney failure or irreversible end stage kidney disease that might require dialysis or kidney transplants (Mayo Clinic, 2014, Diabetes Complications).

Eye disease

Most people with diabetes will develop some form of eye disease, causing reduced vision or even blindness. Regular eye checks and managing the blood glucose levels and lipid levels close to normal are ways to avoid this (International Diabetes Federation, n.d., Complications of diabetes).

Diabetes in numbers, Denmark

(Figure 8) visualises the current situation in Denmark when talking about diabetes. The numbers are based on the latest updated numbers from the Danish health authority (Meulengracht, E. F. et al. 2015)

Why diabetes

The earlier sections describe diabetes and displays how common it is and how much it can affect the life of the people who are affected by it. It also explains how large an economical load diabetes is to the society. However, many cases of T2D can through a healthy lifestyle be kept under control limiting its medical sequelas on the patient as well as the economical load this patient has on society. This is why this thesis will aim towards finding a way of empowering diabetes people, helping them take responsibility and gain control of their disease, through the use of real world data. This should result in improvement of their life quality and reduce their impact on health expenditure.

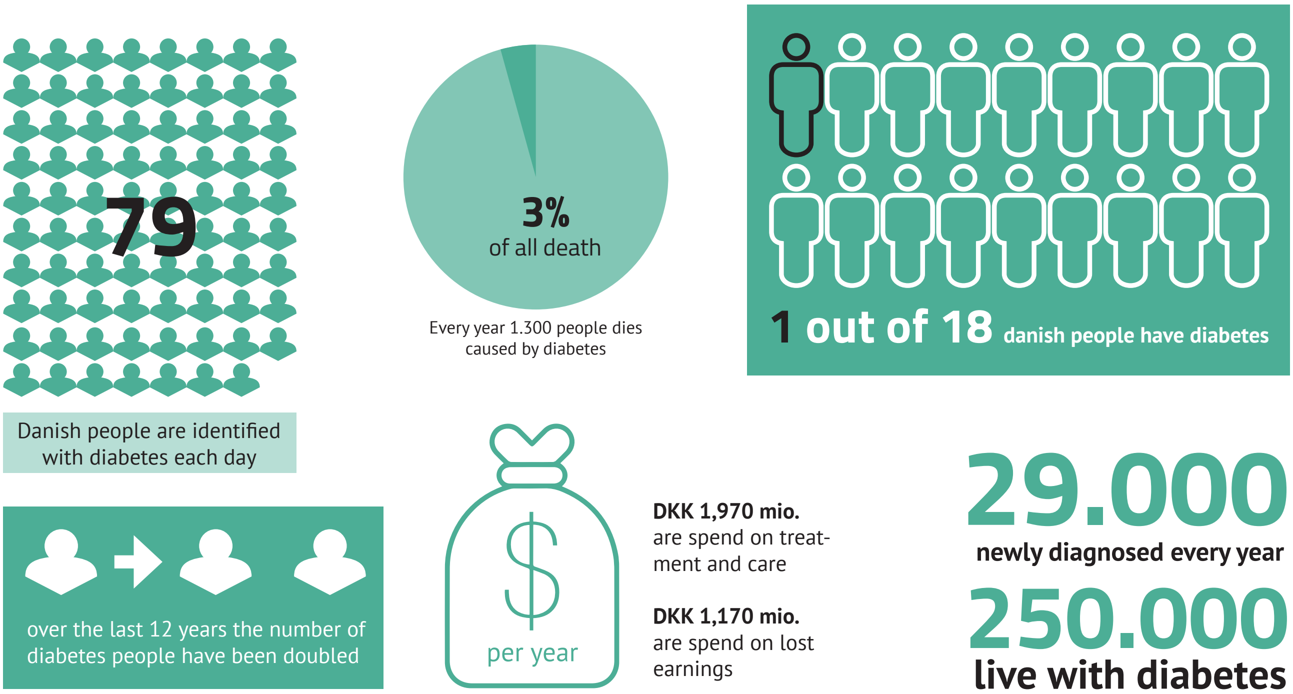


Figure 8 *- infographic about diabetes*
Based on information from (Meulengracht, E. F. et al., 2015; Sivertsen, S. H. 2015)

// PHYSIOLOGY BEHIND DIABETES

The previous section described the two primary types of diabetes and the basics of what diabetes is about. This section will look into the important physiological factors, which affects a people with diabetes and why these are important.

Blood glucoses

Blood glucose is measured in two different ways – regular blood glucose (plasma glucose) is measured in mmol/l and HbA1c (glycated hemoglobin) is measured in mmol/mol (DiabetesUdvalg Region Syddanmark, 2014).

HbA1c: Measuring the glycated hemoglobin reflects the average blood glucose throughout the last two to three months. This measurement is used to diagnose diabetes. If the blood glucose is measured to HbA1c ⩾ 48 mmol/mol on two seperate days, the diagnosis can be made (DiabetesUdvalg Region Syddanmark, 2014).

Blood glucose: A person with well regulated diabetes should have a blood glucose value between 4 - 7 mmol/l before a meal and 7 - 10 mmol/l 1½ - 2 hours after a meal (DiabetesUdvalg Region Syddanmark, 2014). For some people the HbA1c can not be used to set a diagnose, then the plasma glucose is used to make a diagnosis. The diagnosis can be made if a not fasting plasma blood glucose is above 11 mmol/l (DiabetesUdvalg Region Syddanmark, 2014).

Blood pressure

Diabetes damages the arteries making them targets for atherosclerosis, which is a coarctation of the arteries which can cause high blood preasure, increasing the risk of e.g. heart attacks and strokes (Beckerman, J., 2016). Therefore, monitoring the blood pressure as a diabetes person are important. A high blood pressure also increases the risk of other complications related to diabetes such as, diabetic eye disease, heart attacks, and kidney disease (Dansinger, M., 2017). The goal for many diabetes people's blood pressure are 130/80 mmHg (DiabetesUdvalg Region Syddanmark, 2014).

- The highest number is the systolic pressure, which is the pressure that occurs when the heart squeezes.
- The lowest number is the diastolic pressure, which is the lowest pressure in the arteries when the hearth relaxes between two heart beats.

(Dansinger, M., 2017)

Cholesterol

Diabetes is a known secondary cause of dyslipidemia, which is a condition that means the diabetes person has elevated cholesterol and/or triglycerides (a type of fat (lipid) found in the blood) or low high density lipoproteins (HDL) level, a "good/well behaved" cholesterol (Beckerman, J., 2016) (Goldberg, A. C., 2015). The consequence of this condition is increased risk of atherosclerosis (Goldberg, A. C., 2015). Because of the previous a diabetes person needs to monitor the cholesterol levels keeping the total cholesterol level below 4,5 mmol/l and the low density lipoproteins (LDL - the "bad" cholesterol (Beckerman, J., 2016)) level below 2,0 mmol/l. If the diabetes person has previously experienced cardiovascular disease the recommended levels are lower (DiabetesUdvalg Region Syddanmark, 2014).

As it can be seen people with diabetes has due to their condition some very important health requirements, which needs to be closely monitored. However, there are measures a diabetes person can take to make sure these values are kept within the required limits. The next section will look into the three main factors for the person to consider when regulating their own condition – these are exercise, diet, and medicine.

Treatment

The following factors - diet, exercise, and medicine - can be considered a triangulation that can be used to control a person with type 2 diabetes (T2D) condition (Figure 9). A good balance between these three can make a huge difference for the regulation of a person diagnosed with T2D.

Diet

Through food and drink a person gains energy in the form of fats, protein, carbohydrates, and alcohol. Since diabetes is strongly related to how the body processes its intake, especially carbohydrates, a good diet can strongly affect the wellbeing and potential sequelas for diabetes people.

To achieve a stable health, diabetes people are recommended to meet the following guidelines for their diet:

- Limit the intake of fat, especially saturated fat
- Eat wholemeal, lean meat, plenty fish (300g per day is recommended), plenty vegetables (300g per day is recommended), fruit (2 - 3 pieces a day)
- Consume ½ litre lean or sour milk products per day
- Reduce intake of sugar, salt and alcohol
- Follow a varied diet

(DiabetesUdvalg Region Syddanmark, 2014)

Other important things people with diabetes should consider in relation to diet are the number of meals you consume during a day. To keep a stable blood glucose level and avoid overeating it is recommended to plan many meals during a day e.g. 3 primary meals and 2 to 3 small meals in between (DiabetesUdvalg Region Syddanmark, 2014).
Another recommended change is a weight loss of initially 5-10%, because of a strong connection between blood glucose levels and weight. In many cases a weight loss of up to 20% of the initial weight of the person is required to normalise the blood glucose levels depending on the start weight of the person (DiabetesUdvalg Region Syddanmark, 2014).

Exercise

Exercise is an important factor in the treatment of diabetes because it has a positive influence on the following elements, both physical and psychological:

- Wellbeing
- Improved appetite regulation
- Helps on weight loss
- Reduce the risk of cardiovascular diseases and blood glucose levels
- Increase the insulin sensitivity of the cells
- Lower the blood pressure
- Gives a better lipid profile
- Reduces the amount of abdominal fat tissue

(DiabetesUdvalg Region Syddanmark, 2014)

To gain the potential benefits exercise has on diabetes people's condition, the following guidelines are recommended for adults between the age of 18 - 64 years:

- Be physically active at a medium to high intensity level each day. The activity should not be part of the regular everyday activities.
- The diabetes people should at least 3 times each week participate in physical activities of high intensity.

(DiabetesUdvalg Region Syddanmark, 2014)

Medicine

When diagnosed with diabetes the person can, as mentioned above, do a lot to reduce the complications of their own condition. However, most patients with diabetes will have to both follow the guidelines for exercise and diet as well as use pharmacological measures to control their condition. The primary purpose of medicine is similar to the two previous sections e.g.:

- Achieving the optimal levels of lipids, blood pressure, blood glucose and coagulation
- Increase the persons quality of life

(DiabetesUdvalg Region Syddanmark, 2014; Dansk Selskab for Almen Medicin, 2012)

These factors are all important and can help to regluate the severeness of diabetes. However, studies have shown that lifestyle interventions are more effective in reducing the complications of diabetes than medicine (Knowler, W. C., et al., 2006).

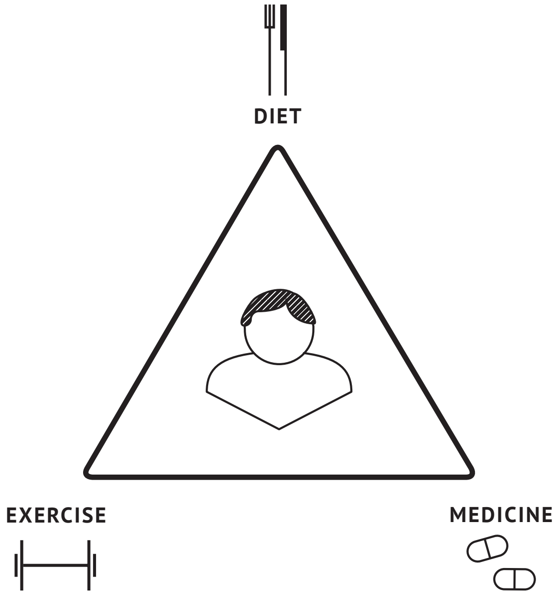


***Figure 9** - Triangulation of treatment*

Take outs

The above-mentioned factors – diet, exercise, and medicine – is as mentioned the three most important factors for a person with diabetes. From these three only the medicine can be controlled by the doctor. Diet and exercise is something the person with diabetes needs to self manage. This shows how important diabetes people's motivation and actions are. Therefore, a tool to help people manage these aspects could potentially be a life changing companion, if done right.

According to the above-mentioned values and notes, it can be concluded that a system that is focusing on helping a diabetes person manage their condition should be capable of the following, in order to guide them towards a better health:

- Help the person manage his blood glucose levels
- Help the person manage his blood pressure
- Help the person manage their cholesterol levels
- Help the person gain control of his diet
- Help the person exercise

The needs of the individual person can be very different depending on the severity of their condition, thus the system should guide the person based on the individual needs and not the general guidelines.

// THE COURSE OF DISEASE

The Danish Health Authority has formulated a generic model and a disease management programme (DMP) for chronic diseases. The latest versions is from 2012 (Sundhedsstyrelsen, 2012) and describes a generic model that the healthcare personnals (HCP) is advised to follow, when treating a person suffering from a chronic disease. A previous version from 2008 (Sundhedsstyrelsen, 2008) is describing a specific course of disease for diabetes people. The guidelines, the generic model, and the DMP will be described both in general and for people with diabetes.

The generic model

The purpose of the generic model is to give an overall framework and homogenous systematic classification of the content of the DMP. The generic model sets the standard for the treatment of chronic diseases across the country in order to align the HCS (Sundhedsstyrelsen, 2012).
The model for treatment of patients with chronic diseases is inspired by the american Chronic Care Model (Sundhedsstyrelsen, 2012). The Chronic Care Model takes point of departure in different focus areas that can be involved in the optimisation and systematisation of the contribution for people with chronic diseases (Figure 10) (ibid).
The generic model describes the different contributors who are important to improve the outcome of the treatment of chronic diseases; community, HCS, the patient, and the practitioners.

The generic model constitutes for the DMP a conceptual framework.

The DMP

The purpose of the DMP is to ensure a professional and organisational framework for the complex, long-term and intersectorial procedure by these four efforts from The Danish Health Authority (2012):

- High quality on the efforts
- Patient involvement
- Coherent course for the patient
- Appropriate use of resources

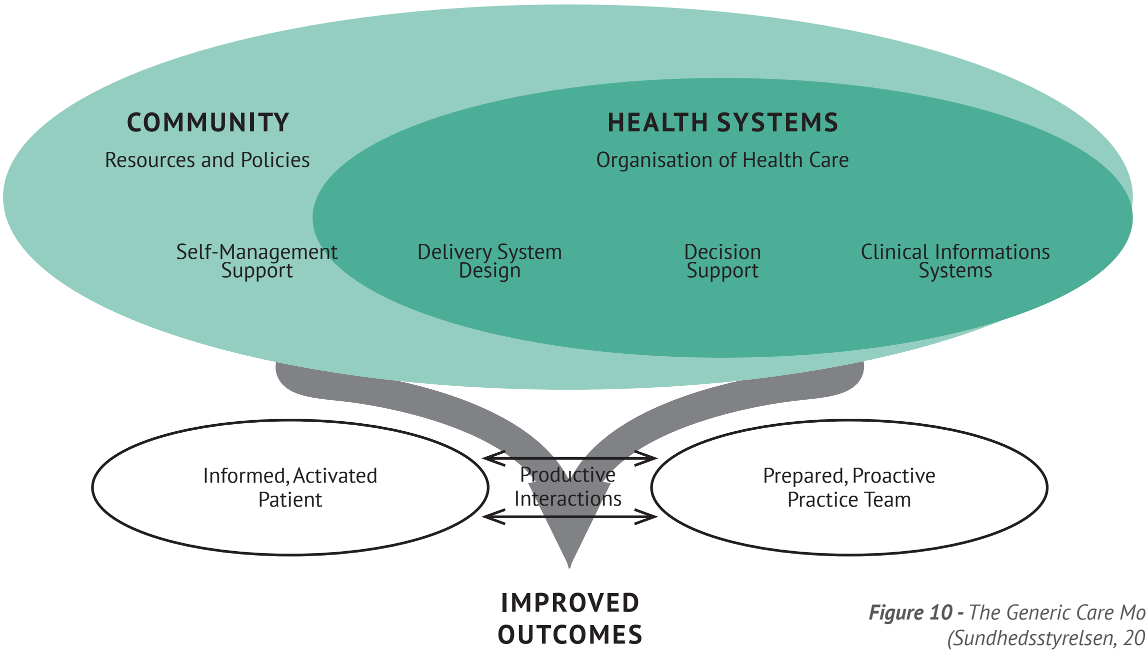


Figure 10 - *The Generic Care Model (Sundhedsstyrelsen, 2012)*

The programme is focusing on the healthcare system's (HCS) organisation and structure for groups of patients. This ensures an adjusted effort of high quality for the individual person with a specific chronic disease. The criteria for participating in a DMP is to have a chronic disease. A chronic disease is described by Sundhedsstyrelsen (2017) as:

> *"A disease is chronic, when it has a long-term course or it constantly returns."*
> (Sundhedsstyrelsen, 2017) (trans.)

The most important effort in the DMP for all chronic diseases is the support to self care. Self care indicates the abilities to maintain a healthy life, achieving a better quality of life, and taking co-responsibility in the treatment. This is supported by several consultations throughout the year with the necessary professionals accommodated the individual patient's needs. (Sundhedsstyrelsen, 2012, pp. 13)

The programme for diabetes patients

The programme for diabetes patients includes both type 1 and type 2 and were in 2008 (Sundhedsstyrelsen, 2008) exemplified according to the five general components from the DMP. The DMP is a broad description of the steps the professionals should follow when planning the procedures for a diabetes patient and the process of coordinating with other professionals.

The following are the relevant takeouts for this thesis, describing the evidence-based guidelines for diabetes.

The two to four arranged consultations per year involves (Sundhedsstyrelsen, 2008) (trans.):

- Control of risk factors: HbA1c, blood preasure, and weight. Check for microalbuminuria (indication of kidney injury (Engelbrecht, N., 2017)) furthermore control of urine sample.
- Discuss blood glucose measurements made at home, if any.
- Conversation with the patient about the experience of the everyday life with diabetes, including self care, psychosocial aspects and possible involvement of near relatives, network etc.
- Conversation with the patient about diet, exercise and smoking habits
- Conversation with the patient about the medical treatment and requirements for adjustment of the treatment and the individual goals of treatment.
- Identifying the needs for further patient education.
- Individual risk assessment and determination of individual goals of treatment.
- Determination/adjustment of an overall treatment plan in cooperation with the patient.

The annual consultation consist of the same elements as above and furthermore (Sundhedsstyrelsen, 2008) (trans.):

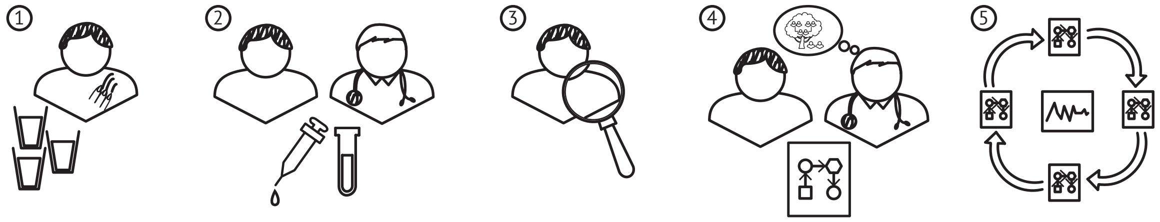
- Decision of eye screening: photo of retina and eyesight sharpness or eye examination by an eye specialist every second year.
- Foot examination. Assessment of potential need for further referral to chiropodist.
- Assessment of the symptoms of autonomous nerve damage, e.g. sexual dysfunction, stomach paralysis etc.
- Examination of diabetic kidney disease. Decision of potential further referral.
- Examination of cardiovascular disease. By the least suspicion an ordinary diagnosing is accomplished.
- Screening of cardiovascular risk factors moreover: fast or complete cholesterol, HDL- and LDL-cholesterol as well as triglycerides.
- Secure that the patient gets relevant subsidy (for example medication, test equipment, diet)
- Set-up goals of treatment.
- Determination of the plan of treatment.

As mentioned earlier, self care is one of the most important efforts in the process of living with a chronic disease especially in the case of T2D, since the condition is often affected by lifestyle.

The steps the patient goes through when getting diabetes will be described in the next section from the patient's point of view.

What happens when diagnosed with diabetes?

(Figure 11) will describe the procedure in general from the patient's viewpoint on the basis of Sundhedsstyrelsen (2008, pp. 46-47) and instructions from DSAM (2012).



Symptoms
Increased thirst, accidental weight loss, frequent large urinations, or recurring infections as genital yeast infection.

Diagnosis
By GP examining the patient's cardiovascular risk profile through a urine sample, blood pressure measurement and blood sample or in relation to other diseases or conditions.

Screening
Of complications to assess the need of other health professional benefits (dieticians, eye specialists, physical training, chiropodists and support to change lifestyle and self care).

Patient management programme
To give the patient knowledge and skills to act on the newly discovered disease on the basis of own goals and values. The relatives is incorporated in the programme.

Follow-up
On the patient's life situation, values and goals, which is distributed into two-four consultations during the year and one bigger annual consultation.

***Figure 11** - What happens when diagnosed with diabetes (Sundhedsstyrelsen, 2012)*

Reflection

The efforts described in the last pages are the national guidelines to the danish healthcare system. Each region or municipality in Denmark has also made their own DMP based on the national programme. The group has chosen not to explore these to design a national service.
The programmes and the guidelines have helped to give an overall overview of the procedures that a person with T2D should follow when diagnosed.

// INTERVIEWS W. TYPE 2 DIABETES PEOPLE

Three interviews with type 2 diabetes (T2D) people has been made to figure out, how they experienced the initial period of the disease. The interviews have also been used to figure out, which situations that have been good and which could be improved.

The purpose was to get an overview of the processes a diabetes person goes through when getting diagnosed and living with diabetes.

Participants: Three people with T2D
Duration: 30 min. per interview
Location: Every participant was sitting at home, while the group interviewed them over phone.
Method: In-depth semi-structured interview

Preparation

The interview method applied was an in-depth interview. This interview method is good for clarifying questions, exploring themes in depth, and are used when the interviewee is an expert within a certain theme (Bjørner, T., 2015).
The in-depth interview allows for a private setting, which can be important when working with a sensitive topic such as diabetes.
The participants were either family or friends, which made it more easy to empathise with them and created a relaxing atmosphere.
The interviews were organised as semi-structured interviews, a technique that allows the group to reorder and add questions during the interview (ibid).

Phone interviews, and photos from additional visit

Execution

Since the participants were living far away, the interviews were conducted over the phone. One of the interviews were deepened even more by a visit afterwards. The interviews were recorded and the findings were noted on a hand drawn timeline and in a document.

Findings

The interviews have revealed both individual and identical experiences among the participants. This has resulted in many findings. Some of them will be presented as individual findings, and some of them as general findings.

Interview w. Rasmus

- He stated that he has control of his disease by noticing his body's signals, but his blood glucose numbers has recently shown an increase anyhow.
- He was not reffered to any offers by his general practitioner (GP) when residing in Aalborg. After moving to Copenhagen he was referred to a chiropodist.
- He is about to start exercising, but was at the moment of the interview the only one of the three interviewed persons who was not doing any activities to ease the disease. He was only focusing on the diet.

Interview w. Jytte

- She do not want to be too dependent on activities in associations, because she wants her family to be her first priority. The only regular appointment is bowling one time per week. Besides this, she walks and bikes several times a week with her husband.
- She checks her blood pressure three times a day three days before the consultation and calculates the average of these measurements, because she is aware of *white coat hypertension* (a phenomenon that stresses the patient when being in a hospital setting, which gives unreliable results which results in a higher blood pressure (Celis, H., Fagard, R. H., 2004)).
- She is doing some activities, but not at a high level intensity of activity.

Interview w. Ella

- She has been well-regulated from the beginning and still is. She believes that she will never stop taking the medicine, and does not believe in the U-turn project (Ried-Larsen, M., et al, 2015)
- Ella is proactive in regards to exercising.
- She is doing activities at a high level of intensity several times a week.

Overall findings

The findings that have been identical for everyone are the following:

Everyone of the interviewees have taken contact themselves to other offers than the general practitioner, nurse, chiropodist and eye specialist, e.g. healthcare center, training programmes to ease their disease and to avoid impairment.

Everyone certainly has the motivation to lose weight, change their diet, and be active at different levels. Everyone has changed their diet to a diet with less carbohydrate.

No one was surprised by getting the diagnosis, but it seeemed to have been harder on Rasmus.

Reflections

The DMP is of course general, but the interviews showed that the programme is not always fully conducted in practice. The participants have not experienced any collaboration between their practitioners and have not received the offers and referrals they were in need of during their course of disease.

The three interviews has given insights into the journey of getting diabetes and living with the disease. This has helped the group to find an initial focus to use for workshops. The amount of participants has been too few to form a conclusion or a clear picture of the programme.
Two of the participants are from relatively small municipalities, which can mean that there are less alternative offers for the GP to provide. Rasmus moved to Copenhagen a year after his diagnosis, which lead to new practitioners and a municipality that have been more aware of supplying alternative offers like training.

Since the participants were all family or friends to the group members the empathy for the participants have might have been bigger, but this might also have made the participants more open to the group making them share more personal information. The interviews have been giving information in depth as desired.

// ABOUT SUNDHED.DK

> *"sundhed.dk is the joint public healthcare system online"*
> (sundhed.dk, 2016, Visioner og Mål) (trans.)

Sundhed.dk is both an organisation and a digital e-health portal. The portal was launched in 2003 and have since the start developed their portfolio of services that they offer to both healthcare professionals (HCP) and citizens. The overall goal of the portal is to empower the patients and citizens in their own treatment by making the healthcare system (HCS) more transparent and accessible (sundhed.dk, 2017, Visioner og mål). According to the 2016-2018 strategy for sundhed.dk, 65% of the danes know about, and use sundhed.dk (sundhed.dk, 2016, Strategi for sundhed.dk 2016-18). Furthermore, over the last five years, sundhed.dk has been the it-solution that most HCPs make use of. 51% of the HCPs know about, and use sundhed.dk (sundhed.dk, 2016, Strategi for sundhed.dk 2016-18).

Services

Sundhed.dk offers a wide range of services for both citizens and HCPs. Sundhed.dk facilitates around 80 different applications which collects data from 120 data sources. Data is being gathered from official healthcare institutions and sundhed.dk is the organisation that links all the content with IT solutions in order to provide access to this data for the affected actors (sundhed.dk, 2016, Strategi for sundhed.dk 2016-18).

Examples of the services offered by sundhed.dk is:
- *Medicinkortet*
- *e-jounal*
- *Patienthåndbogen*
- *Organdonation*

Several services targeted at HCPs are also offered through the portal e.g.
- *Lægehåndbogen*
- Information about general practice
- *e-journal*

Access

Sundhed.dk are handling sensitive health data and they have therefore developed solutions that makes it possible for each individual person to be in control of the accessibility and sharing of their data.
Every person has access to data about themselves, and each person can give permission for relatives to access his data. The HCPs who are in contact with a patient because of their treatment, can always access their data even without permission. However, the HCPs need to have a certificate in order to access the data of the patient. The system registers who has accessed each person's data, and the person can always inspect who have accessed their data (sundhed.dk, 2016, Adgang til sundhedsdata).

Structure of the organisation

Sundhed.dk is owned by by the Danish Regions (Danske Regioner), Ministry of Health and Elderly (Sundheds- og ældreministeriet), and the Local Government Denmark (KL). The organisation is managed by a board of directors consisting of people from the danish state, the regions, and the municipalities (sundhed.dk, 2017, Historien om sundhed.dk). Furthermore, sundhed.dk has a steering committee tasked with ensuring the right priorities of work and decisions, that sundhed.dk should follow (sundhed.dk, 2017, Parterne bag sundhed.dk). The company are divided into five different divisions each responsible for a part of the company (Figure 12).

Focus area

The danish citizens are sundhed.dk's primary target group, therefore there is a strong focus that sundhed.dk should provide overview, knowledge sharing, accessibility, and quick access to the citizen's healthcare data (sundhed.dk, 2016, Strategi for sundhed.

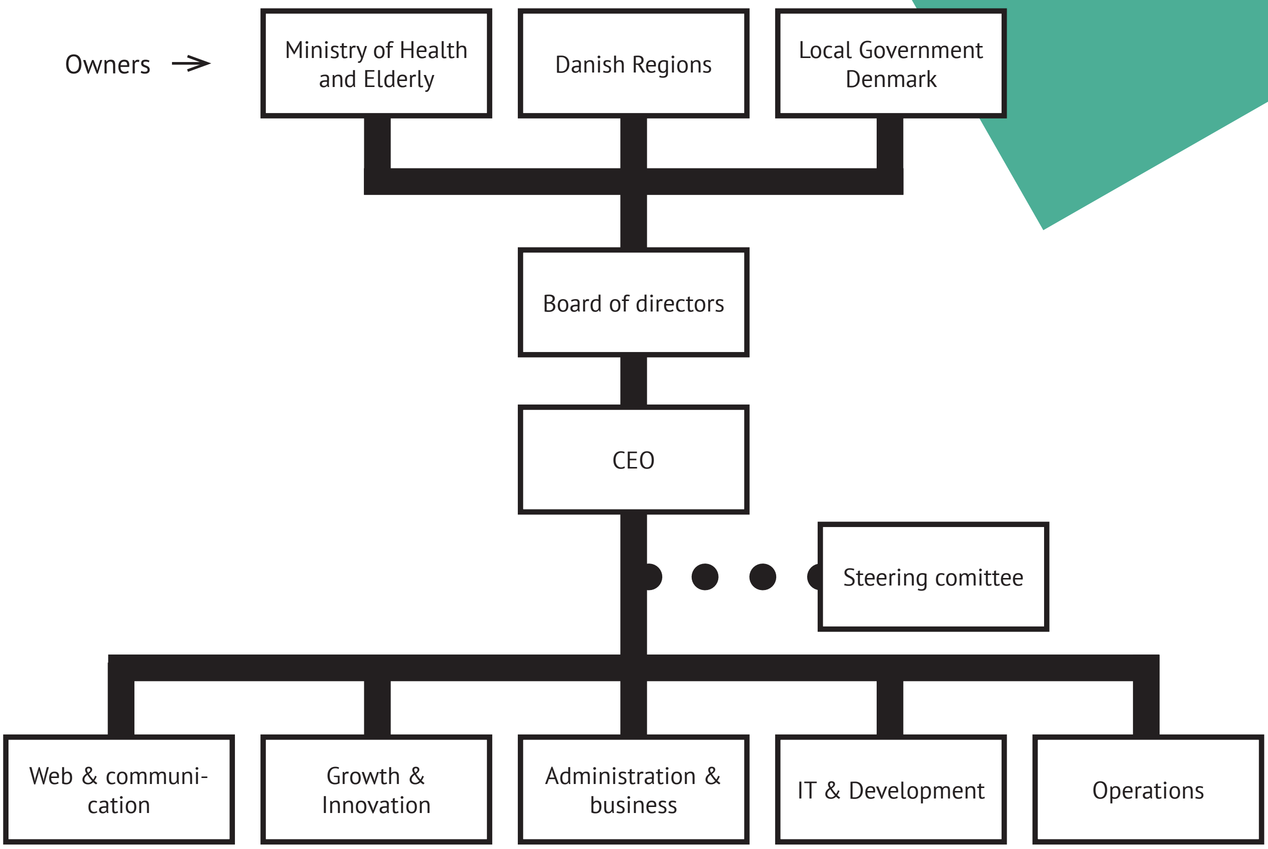


Figure 12 - *Organisational structure*
(Sundhed.dk, 2017, Til parter og leverandører)

dk 2016-18). The vision of sundhed.dk is based on a 2016-2018 strategy for the organisation. In this strategy, one of the goals is to make the patient an active part of the treatment:

> *"The goal is, that the citizen/patient becomes an equal part of the treatment and at the same time have their own resources strengthen, related to the specific illness treatment, including the possibility to share information"*
> (sundhed.dk, 2016, Strategi for sundhed.dk 2016-18) (trans.)

Sundhed.dk's general goal is to use all healthcare data that exists, to provide help to the danish citizens and improve the HCS. At the moment sundhed.dk is in a start-up phase with a couple of new projects, focusing on using healthcare data to develop new innovative systems that can help improve danish health by providing precise tools to specific groups of patients - one of them are people with type 2 diabetes (T2D).

// COLLABORATOR MEETING WITH SUNDHED.DK

To better understand what sundhed.dk does and how they are doing it, a collaborator meeting was arranged between the thesis group and the contact persons from sundhed.dk. It was decided that the thesis group should facilitate the meeting due to the fact that the group would be able to put the themes of interest on the agenda.

Participants: Jakob Uffelmann - director of innovation, Line Langballe - innovation consultant
Duration: 2 hours
Location: A meeting room at Sundhed.dk
Tools: A tool to map out the data sundhed.dk are using and a timeline to map the process of the diabetes project.

Preparation

The purpose of the meeting was to get more information about how sundhed.dk works with data in their organisation. Furthermore, the purpose is to gain insights towards how their process of working with the diabetes project has been so far and how they see the project evolve in the future. Besides, the group would tell about their plans for the thesis period, to share thoughts about which parts to focus on and what was thought to be manageable within the time period. All in all, this was a meeting to get as much knowledge from each other as possible to align expectations and get answers on important questions.

Process
The first tool developed for the meeting were a timeline where the people from sundhed.dk was able to map out the things that they have been working on related to the diabetes project before starting the collaboration and what they are planning to do in the future. At the same time, the group told about their overall goal for the project.

Data mapping
The second tool that was developed had the purpose of investigating what kind of data sundhed.dk are using in their systems. This was mapped out accord-

Meeting with the sundhed.dk

ing to what is coming into their systems and how it is being processed and used afterwards. A tool was designed where the left side of the paper would act as data coming into the system, and the right side of the paper would be used for the systems output. Each part was divided into three columns each one focussing on describing the data in depth.

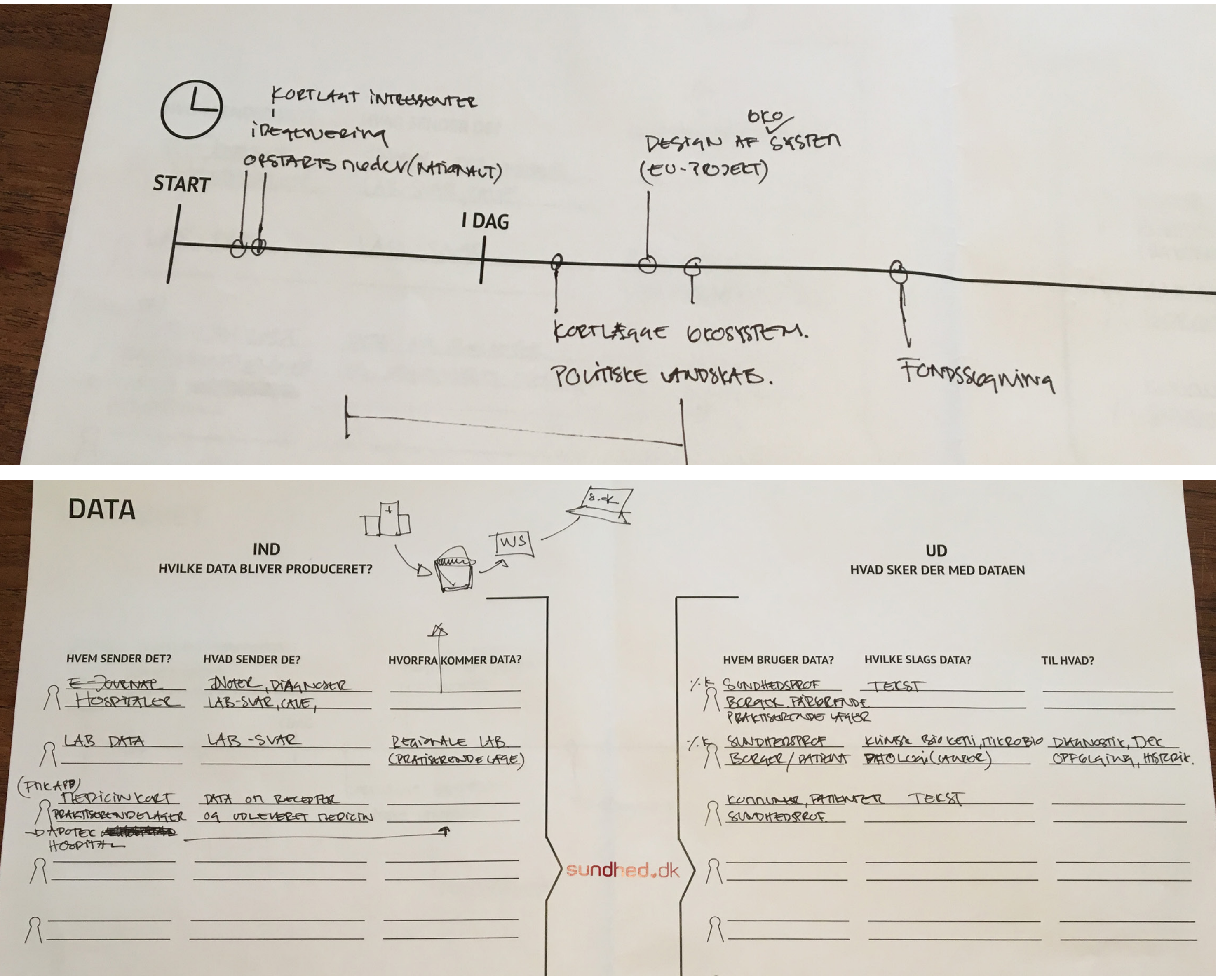
Execution

Since everyone present at the meeting had met before, in the process of getting the collaboration, the atmosphere was quite casual. The meeting started out with a small introduction explaining the goal of the meeting. This was followed by the thesis group showing their process timeline and explaining the plans for the rest of the thesis period creating a common ground and aligning expectations.

The data mapping tool were then introduced briefly, and the tool was handed to Jakob and Line. The role of the group was then to guide them in the process of filling out the tool. During this exercise, there was time to talk about and discuss some of the themes that arose.
When the data mapping exercise was done, it was time for the process exercise following the same procedure as for the data mapping exercise.

Findings

After the meeting, it was obvious that this project



DATA

IND
HVILKE DATA BLIVER PRODUCERET?

HVEM SENDER DET?	HVAD SENDER DE?	HVORFRA KOMMER DATA?
E-JOURNAL HOSPITALER	NOTER, DIAGNOSER LAB-SVAR, CAVE,	
LAB DATA	LAB-SVAR	REGIONALE LAB. (PRAKTISERENDE LÆGE)
(FMK APP) MEDICINKORT PRAKTISERENDE LÆGER APOTEK [illegible] HOSPITAL	DATA OM RECEPTER OG UDLEVERET MEDICIN	

UD
HVAD SKER DER MED DATAEN

HVEM BRUGER DATA?	HVILKE SLAGS DATA?	TIL HVAD?
Y.K SUNDHEDSPROF BORGER PÅRØRENDE PRAKTISERENDE LÆGER	TEKST	
Y.K SUNDHEDSPROF BORGER/PATIENT	KLINISK BIOKEMI, MIKROBIO PATOLOGI (CANCER)	DIAGNOSTIK, DEC OPFØLGNING, HISTORIK.
KOMMUNER, PATIENTER SUNDHEDSPROF.	TEKST	

Top: Process mapping tool. Buttom: data mapping tool is dealing with a large and complex system where rules and regulations plays a central part. Working with personal healthcare data is a serious venture, where security are taken very seriously - it is definitely something that should be taken into account when dealing with patients' personal data.

Data
Sundhed.dk have access to a lot of different data. However, there are three types of data, which are the most interesting and most used within the company's services.

1. **Patient records**
   - Sender: the hospitals
   - Contains: Notes, diagnosis, laboratory answers
2. **Lab data**
   - Sender: The laboratories
   - Contains: laboratory answers
3. **Medicine charts**
   - Sender: The hospitals, the pharmacies
   - Contains: Data about prescriptions (the type of medicine, data about the pharmacies handling of the medicine etc.)

An interesting aspect according to data is that there is a big difference between how the data that sundhed.dk gets, are structured when they recieve it. The patient records are mostly plain text coming directly from the doctors, whereas the medical charts has a specific number for the given type of medicine.

Process
The process of the diabetes project is in its early phases meaning that it can go in different directions. What sundhed.dk has done so far is to map possible stakeholders of the project and conduct start-up meetings.
Points still left to do includes:

- Getting funding for the project
- Conducting pilot projects
- Mapping out the ecosystem of the project

This thesis project are one of the pilot projects, which will be used as a initial research for the rest of the project - depending on the outcome.

// HEALTH DATA TECHNOLOGY

In the end of February the thesis group attended an event in Malmø called *Medea Talks*. The event consisted of a keynote with the title: *Where is "the human" in digital health technology* (MedeaTV, n.d.). The keynote speaker was Kirsten Ostherr from Rice University, Professor of english and Master in Public Health. The thesis group attended the event to gain knowledge about the current discussions within health data technology, emerging technologies, and to gain insights into tendencies on an international scale.

After the talk, the group mapped out the themes that seemed interesting to research according to the project (Figure 13). The map has afterwards served as a guide to remember, which aspects of technology could be applied in the project.

The following section will mention the themes from the talk that the group found most interesting related to the project.

The evolution of the health industry

Medicine is increasingly being digitised, this makes personalisation an interesting theme. Over the past years, many services have tried to revolutionise the health industry. Services such as *Doctor On Demand* (Doctor On Demand, 2017), and video call services with doctors, has appeared. However, even though the industry gets digitised, the demand for personal interaction is still there, it can be seen in how the new services advertise. Most of the advertisements have a focus on the human in the service. An interesting aspect is to look at how personalisation can be applied to the digital services in the health industry.

The health industry is pushed forward by big data, algorithms, and mobile technology. It provides the possibility of greater scalability, and efficiency in the industry.

> *"The grand challenge for humanists: to provide the methods, analytical tools and insights needed to guide the use of emerging health data technologies for the public good"*
> Kirsten Ostherr (MedeaTV, n.d.)

Mobile connectivity

People are connected almost all the time. When using apps and web services, people produce tons of data and leave digital footprints everywhere. An example is the story of the retail company *Target* that predicted a high school girl's pregnancy before her and her family knew about it due to advanced data-mining and analysis of consumption patterns (Hill, K., 2012).

Quantified self

Is a movement where people use mobile apps and wearables to measure themselves in order to decode problems that the medical professionals have failed to solve (Birkavs, E., et. al., 2016). This is just a example of how people can reclaim the empowerment of their own care by using the technology that already exist on the market. The growth of *Fitbit* and wearables makes quantified self much more efficient and accessible (Data, p. 40).

Concerns about technology

When technology is evolving, concerns and ethical questions will follow. Concerns need to be taken into consideration when working with technology in order to avoid undesirable situations.

Privacy is an theme that are very interesting and important to look into especially within the field of healthcare. When patient data and personal measurements are digital, the privacy of people's data need to be taken serious.

Data ownership - who own peoples' personal data? Should it be governmental, private organisations, or the person himself? Who is capable of handling this large amount of sensitive data?

Bridging the gap between people and technology
When technology now and in the future replace many of the processes healthcare professionals are used to offer, who will bridge the gap that are in the interaction between human and computer.

These are just some of the concerns that follow the evolution of technology. Some of the themes will be discussed in this report, others just serve as inspiration to reflection of the role of digital healthcare technology.

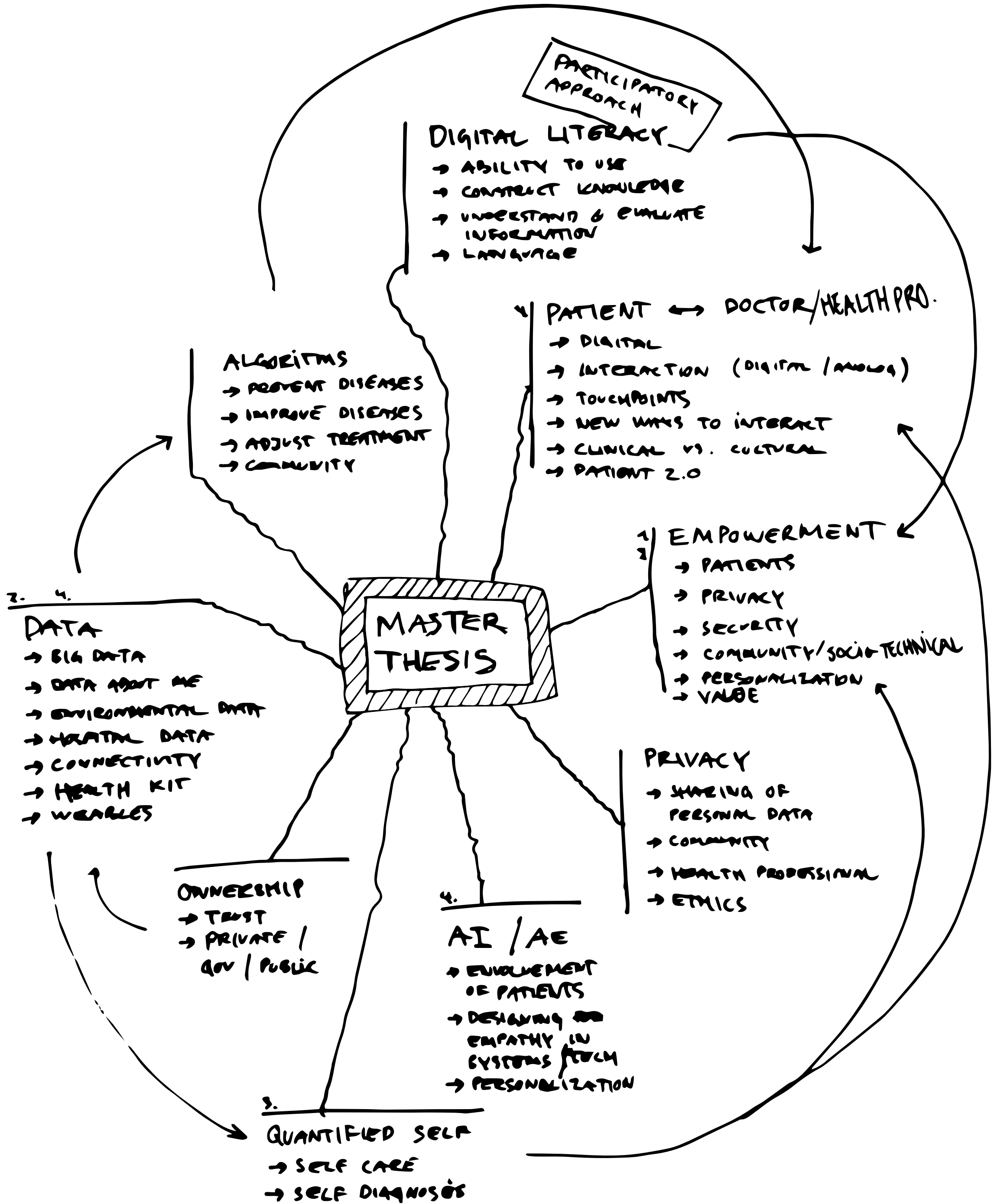


Figure 13 - Mapping of healt data technology themes

// DATA

Data can potentially change healthcare as we know it, helping to predict, understand, and improve upon various diseases (Holzinger, A., et al., 2016) (Kruse, C. S., et al., 2016). One of the reasons for the huge potential of data is:

> *"Healthcare organizations cannot improve what they cannot measure. The best way for organizations to ensure their long-term success is by leveraging data [...] "*
>
> (IBM, 2013)

This section will look into data, and why it is more relevant than ever. It will consider terms such as big data and open data and how these are relevant for the healthcare industry.

One of the reasons why data is more relevant than ever is that more people than ever are constantly connected through mobile devices. Considering this statement, a study of the Danish population supports the claim, showing that in Denmark 81% of the population has a smartphone (ICT Data and Statistics Division, 2015) and in 2014, 85% of all Danish citizens used the internet on a daily basis (Wijas-Jensen, J., 2014). Based on these numbers it can be expected that most of the diabetes people will have access to smart devices and the internet. Therefore, it can be safely assumed that a large part of these people are comfortable with digital devices, thus working with digital devices and data collection is possible.

Data types

This part will explain the larger concepts such as open data and big data and consider how these are relevant for the healthcare industry. It will be followed by a more precise description of how this is relevant in regards to this thesis and diabetes people in general.

Open data

In the *Dictionary of Human Geography* by Castree, N., et al., (2016) the following short definition of open data is provided:

> *"The data that is freely available to everyone to use, analyse, display, and distribute for any purpose."*
>
> (Castree, N., Kitchin, R., Rogers, A., 2016)

However, this definition is just the tip of the iceberg, *Open Knowledge international* Open Knowledge International (n.d.) goes into much more detail about the definition of open data. They list the three main elements to consider according to open data:

1. **Availability and access:** the data must be available as a whole and at no more than a reasonable reproduction cost, preferably by downloading over the internet. The data must also be available in a convenient and modifiable form.
2. **Re-use and Redistribution:** the data must be provided under terms that permit re-use and redistribution including the intermixing with other datasets.
3. **Universal Participation:** everyone must be able to use, re-use and redistribute - there should be no discrimination against fields of endeavour or against persons or groups. For example, 'non-commercial' restrictions that would prevent 'commercial' use, or restrictions of use for certain purposes (e.g. only in education), are not allowed.

(Open Knowledge International, n.d.)

Considering the description of open data, it becomes clearer that working with open data within the medical industry poses some major challenges in context with privacy (Holzinger, A., et al., 2016).

Much data gathered when working with private people and their health will be personally sensitive information, meaning that open distribution and redistribution of said data will be difficult (Holzinger, A., et al., 2016). This will be a challenge when considering the distribution of the data collected within the future service system. Furthermore, it will be a challenge when considering the data accessible as input in the service system, since data which is not open will be much less accessible.

This means that this description of the requirements of open data will be used as a reference point when considering the data used in and created by the future service.

Open data in healthcare

When considering open data in healthcare, there are some major challenges to be overcome in order to get the maximum benefit out of it. Since open data is supposed to be freely available and accessible, opening up data in the health sector would mean allowing people access to private peoples personal information. In the article *Who Owns the Data? Open Data for Healthcare,* Holzinger, A., et al., (2016) the authors discuss the issues and benefits of open data in healthcare. They highlight that the potential benefits of opening up big data sets in the healthcare sector is enormous, e.g. better understanding of specific diseases and improvements to the care of long term conditions (Holzinger, A., et al., 2016). However, to gain these benefits there are some major challenges and potential negative consequences, when considering the individual privacy and data security that needs to be overcome (Holzinger, A., et al., 2016). Even though, these challenges will be hard to overcome the article sees the benefit of overcoming these to outweigh the challenges:

> *"As transparent access to Big Data is the key challenge for healthcare research on clinical and population research datasets, policymakers, and scientific and business communities should embrace the underlying challenges of a political and legal nature. Finding novel approaches to satisfy business interests and actively engage the public are essential for opening avenues to a balanced equilibrium."*
>
> (Holzinger, A., et al., 2016)

Thus generating data that can be distributed openly to healthcare facilities could potentially help making significant positive changes to how diseases are treated contributing largely towards the treatment of diseases such as diabetes.

Big data

In the article *A formal definition of Big Data based on its essential features* the authors explore current definitions of the term in order to propose a thorough definition of big data. Their resulting definition is:

> *"Big Data is the Information asset characterised by such a High Volume, Velocity and Variety to require specific Technology and Analytical Methods for its transformation into Value."*
>
> (De Mauro, A., Greco, M., Grimaldi, M., 2016)

To get a better understanding of what exactly this definition means it will be deconstructed a bit.

"Information asset characterised by, high volume, velocity and variety" (De Mauro, A., Greco, M., Grimaldi, M., 2016). This part talks about the characteristics of big data.

- High volume is about the scale or quantity of data
- Velocity is about the speed and analysis of real time or near real time data
- Variety is about the different forms of data from disparate data sources

(Kruse, C. S., Goswamy, R., Raval, Y., Marawi, S., 2016).

"Technology and analytical methods" (De Mauro, A., Greco, M., Grimaldi, M., 2016). This section is describing what is needed to make use of the information in order to create an outcome based on the data.

"Transforming it into value" (De Mauro, A., Greco, M., Grimaldi, M., 2016) is about the outcome, which is about transforming this data into valuable insights that might create economic and societal benefits.

Considering the above-mentioned – if the data gathered through the service would be used as big data it should be considered according to the characteristics of big data, volume, variety and velocity. Furthermore, the data should be collected in a way to make it simple to analyse, meaning it should be collected in a uniform way that allows users of the data to apply different technology and analytical methods. If the data gathered has these two elements the individual data users will through their analysis be able to gain value from the data collected.

Big data in healthcare
As with open data in healthcare, the opportunities by using big data in healthcare are many. However, there are also some challenges that needs to be overcome to enable the opportunities to be utilised to their full extent. This section will shortly describe some of the challenges and some of the opportunities of using big data in healthcare.

Challenges

According to the article *Challenges and Opportunities of Big Data in Healthcare: A Systematic Review* (Kruse, C. S., Goswamy, R., Raval, Y., Marawi, S., 2016), the authors are reviewing various literature locating the main similarities between their stated challenges and opportunities with big data. Some of the main challenges are as following:

- **Data structure and standardisation issues:** The data stored in electronic health records, are generally unstructured. This means, it does not share well within and across different organisations (Kruse, C. S., et al., 2016). To make the data usable as big data it needs to be made more uniform allowing better analysis of the data.
- **Security issues:** As with open data, big data in healthcare faces considerable privacy issues. Healthcare data are very sensitive and often confidential, this means allowing people access to big data would include opening up for private data, making it highly vulnerable (ibid).

Opportunities

If the challenges above are overcome, there are some major opportunities with using big data in healthcare. The following are the most relevant for this thesis described in *Challenges and Opportunities of Big Data in Health Care: A Systematic Review* by Kruse, C. S., et al., (2016).

- **Improve quality of care:** Big data has the potential of improving quality and efficiency of care by predicting outcomes by using current or historical data to provide proof of benefit, potentially changing industry wide standards of care for the better (ibid).
- **Managing population health:** Big data analysis enable a finer level of separation of populations than what has ever been previously achieved. This mean it can help manage the overall health of a population both globally and locally as well as the specific individual health (ibid).
- **Early detection of diseases:** Potentially big data can help detect diseases in its early stages, this helps with improving treatments and secure higher patient outcomes. Along with early detection big data can also help prevent a wide range of deadly diseases (ibid).

The challenges above in relation with both big and open data means that there are some general elements that needs to be strongly considered when working with the data of users. One element is privacy, this is a major concern no matter how you work with people's private data, thus it is important that the privacy of the users are considered and taken into account when designing the service. Another important element when working with data is the format of the data. The format needs to be considered focusing on keeping the data uniform and usable for analysis.
However, even though there is plenty of challenges concerning the data of private persons and data in healthcare, the potential benefits are many and can potentially change the healthcare industry for the better, securing the best possible treatment for all patients.

Based on the definitions of data, one can think of data as the only resource that becomes worth more, proportional to its use. Explaining that data will only be made more meaningful if people are allowed to use it.

Quantified self

> *"Quantified self refers to engagement in the self-tracking of any kind of biological, physical, behavioral, or environmental information, either as individuals or in groups, with the aim to improve self-sensing, self-awareness, and human performance within the digital health industry"*
>
> (Shin, D.-H., Biocca, F. 2016)

The previous sections explained the large usefulness of data in the healthcare sector. The above definition of quantified self explains how it is related to the gathering of data about the individuals or groups. Since chronic diseases like diabetes is constantly affecting the person's life, there is a constant flow of data that can be very helpful in improving the condition. This constant flow of data are being made more accessible through the increasing number of smart devices such as smartphones, smart watches, etc. (Birkavs, E., et al., 2016; Carson, S. et al.,2015). These devices mean that most people in developing countries are constantly generating data about their behaviour. This can enable easier gathering of specific data than previously possible.

The movement of quantified self is one of the main reasons why a service enabling people to generate data through their everyday activities is possible. This makes the potential of such a service extremely big.

// PRIVACY

The following chapter will elaborate more on privacy, which was touched upon in the previous section. Throughout this section, various states of personal data will be described and how these states are relevant when working with privacy and furthermore examine how to work with citizens' personal data in a secure and safe way.

Personal data

In order for data to be declared personal, the data must contain information which can lead to identification of an individual person. Whether it is a name, a civil registration number, or non-personal data that when combined with other data or information can lead to identification of the person (Erhvervsstyrelsen, 2017).

There are two levels of personal data - standard personal data and sensitive personal data.
Personal data are sensitive when the data include information such as religious beliefs, political orientation, racial origin, mental or physical health, or sexual life (information Commissioner's Office, 2017). A organisation working with sensitive personal data must meet certain demands in order, to legally, be allowed to work with that kind of data. The demands refers the treatment of the data e.g. storage, usage, and transmission (Erhvervsstyrelsen, 2017) (information Commissioner's Office, 2017).

Privacy law

Today, all danish organisations and companies handling personal data are subject to the danish privacy law. However, due to the fast paced development of technology and the digital landscape, the European Commision has made the EU Data Protection Reform. This reform will apply to all European countries by 25th of May 2018 (European Commission, n.d.).
The new regulation will give the citizens' in EU more control of their own personal data and how that data are being treated by the companies. The companies will have to meet new rules regarding how they treat personal information and can receive a heavy fine if these rules not are met (Grønbæk, M. V. H., 2016). All in all, the new privacy law sets a new standard for how personal data is being treated by the companies. A new standard that will suit the fast growing digital world and avocate for the privacy of the user's data.

Pseudonymisation and anonymity

Even though personal data are very restricted, multiple technologies makes it possible to work with the datasets, which otherwise would be concealed.

Anonymity is about removing people's identity from a given dataset and thereby making it impossible to identify who the dataset belongs to (Datatilsynet, 2016). Anonymity is useful for e.g. research purposes because the identity behind the dataset not are needed in order to analyse patterns in the dataset.

Pseudonymisation is referring to the process of replacing one or more parameters that makes it possible to identify a given individual with pseudonyms (a piece of code). This process makes the dataset anonymous for people who look at the dataset. At the same time, the personal information about the person who belongs to the dataset can be retrieved if you have access to the pseudonyms. Pseudonymisation is useful in order to be able to perform follow-up on a given research result (Datatilsynet, 2016). When working with pseudonymisation it is important that the given dataset and the pseudonymised information are stored separately to make sure that the anonymisation of the dataset is sustained.

NemID

NemID is a login solution for private and public self-service solutions. The solution consists of a username, a password, and a physical keycard. This makes it a safe solution because all three elements are needed in order to access the information, that is being secured by the solution (NemID, 2017).

When using NemID, the civil registration number, address, and name of the given person are stored and related to the login information (Finans, 2010). NemID can therefore be used to approve a given person's identity online.

Reflection

Privacy according to personal data is very important, and should be taken very seriously. At the moment the rules and regulations are sparse, but because of the new EU Data Protection Reform, more emphasis are put on the theme of citizens' privacy online. When working with healthcare data it is especially important to treat the data carefully since it is sensitive personal data that are being processed. If the data generated by a future service are going to be used for research purposes, anonymisation and pseudonymisation are important processes to use.

// INTERVIEW W. VIBEKE ZOFFMANN

This next sections will explain about the expert interviews that were conducted during the discover phase.
An interview was planned with Vibeke Zoffmann in order to deepen the thesis groups' knowledge about the theme *empowerment*. She is doing research within the field, and has a lot of knowledge applying empowerment into the lives of people with diabetes.

The purpose of the interview was to get more into depth with empowerment and to investigate how the method works and if some parts of their method principles could be applied in this process working with empowerment of diabetes people.

Participants: Vibeke Zoffmann - Head of Research Unit for Women's and Children's Health at Rigshospitalet
Duration: 1 hour
Location: Juliane Marie Centeret
Method: Semi-structured interview

Preparation

As stated in the problem statement, a focus for this master thesis is to work with empowerment of people with type 2 diabetes (T2D). Research of the term was done in the beginning of the thesis in order to establish a fundamental understanding of empowerment (Introduction, p. 9). Some articles were found, and by studying these articles, the group started to get a glimpse of what the theme was covering. Vibeke Zoffmann is researching empowerment of patients in relation to healthcare professionals (HCP). Furthermore, Zoffmann, V. et al. (2015) has developed the method Guided Self Determination (GSD) with the purpose of overcoming the obstacles that the HCP are facing working with empowerment, in the treatment of people with diabetes. The method were originally developed for type 1 diabetes people, but in the article *Translating person-centered care into practice,* Zoffmann et al. (2015) argues that the method can be used for other chronic diseases as well.
Before the meeting, a semi-structured interview guide was developed to form the foundation for what the interview should cover. The overall structure should be loose, providing room for talking about other relevant themes (Bjørner, T., 2015).

Execution

The interview took place in the office of Vibeke at *Juliane Marie Centeret*. It all started with a short introduction to the participants followed by a presentation of what the project groups thesis was about. Afterwards Vibeke was asked to introduce herself. This created a feeling of knowing a bit about each other before the interview started.
The interview were recorded to make sure that it could be heard again (the recording can be found in Appendix 9). It had the advantage that the group could focus their attention on the interview and conversation.

Vibeke Zoffmann during the interview

Analysis

The interview was analysed just after the execution of the interview. In the beginning the talk was about the elements from the interview that made the biggest impression. This was followed by playing back the recording from the interview while noting down topics and important citations on post-it notes.

These post-it notes were placed on a matrix board to give a better overview of the interview. The horisontal axis was labeled *relations*, meaning all the relations that the patients have in regards to their disease. The vertical axis was labeled *conditions* meaning the stages of the disease (e.g. well regulated, not well regulated) and the state of motivation towards the disease. When the analysis started, it was not known how every element from the interview would fit into the categories, but the idea was that new elements and categories could be added or existing could be subtracted during the process, if necessary.

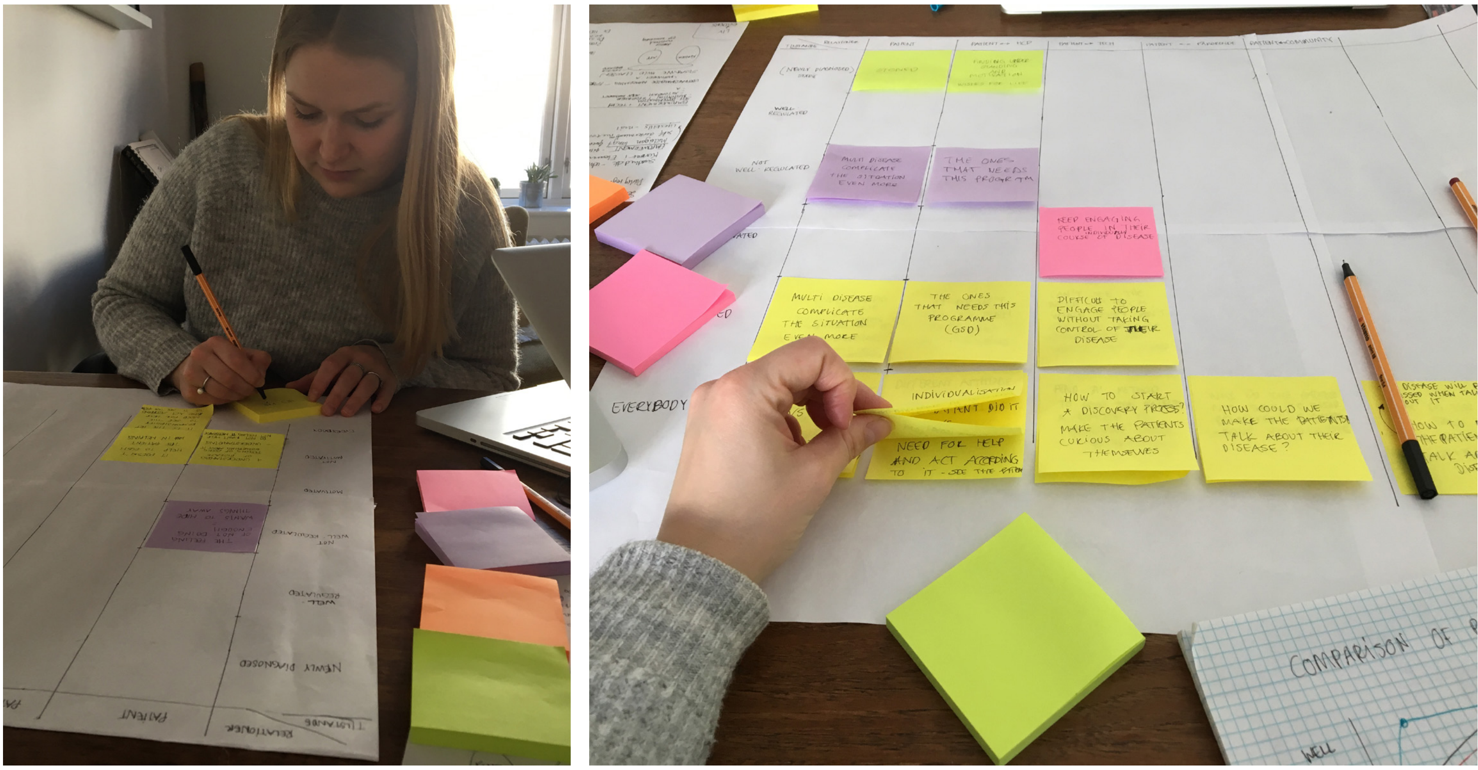
Findings

The matrix-board analysis made a good overview of what had been talked about during the interview. It was found that the two conditions (regulation and motivation) are interesting to examine further. Diabetes people will always have some kind of regulation according to their disease, whether they are not well regulated ranging to being well regulated. At the same time they will have some degree of motivation ranging from not motivated to very motivated. These two factors are not necessarily depending on each other, but it was found interesting as a way of analysing the state of the individual person.

About empowerment

> *"Empowerment is very much a philosophy - but hard to implement. They [the HCP] really want to do something about it, but nothing seems to be happening."*
>
> Vibeke Zoffmann (trans.)

In this citation, Vibeke refers to HCPs in general. Empowerment is at the moment a well-known term and a lot of HCPs want to work with it in their practice. However, due to many different interests at the hospitals, it can be hard for them to implement it in their daily routines.



Matrix board analysis of interview

The reason for using empowerment

> *"The kind of decision-making that are used as treatment for diseases does not work at chronic diseases - only on the acute diseases. The fact that the patient just expose a problem for the HCP, and the HCP then find a solution to that problem."*
> Vibeke Zoffmann (trans.)

This is where empowerment becomes very interesting. A chronic disease will be there for the rest of the person's life, and currently no medication can cure it. Therefore there need to be a shift in the decision-making process, which the HCPs are used to. The HCPs do not need to find a final solution for the disease, the patient need to find the solution that fits into their personal life - then the solution will last longer. The challenge is, if the HCPs will have the courage to let the patients choose by themselves, only by guiding them towards the right decision.

Guided self-determination

When talking about the method GSD, Vibeke described that the method consists of three different aspects:

- The philosophy: Empowerment
- The method: Self-determination
- The goal: Life-skills

> *"We support the patient in the process of growing wiser towards what it is that I want to change, and to establish their own goals"*
> Vibeke Zoffmann (trans.)

The philosophy, method, and goal describes in a very good way how to empower patients. The method that is used to empower patients is self-determination. As described in the citation above, it is about supporting the patient in the process of finding their own goals. They do not have to find it themselves, but in a close collaboration with the HCPs. Through self-determination and empowerment the patients will gain essential life-skills that should support them in their life of living with a chronic disease.

Three types of motivation

During the interview about empowerment, Vibeke made it clear that motivation is closely connected to empowerment. However, there exists several different types of motivational factors:

- Motivation based on **autonomy** (what you think is good for you)
- Motivation **based on control** (you do what you are told to/should do)
- **Half-hearted amotivation** (you don't really believe it, so the execution is half-hearted)

> *"The best kind of motivation is being autonomous, then you believe in what you do, and what you should do"*
> Vibeke Zoffmann (trans.)

Releasing knowledge

Releasing knowledge can be achieved when working with empowerment. In the process of working with the GSD method, Zoffmann et al. (2015) observed that the patients discovered new areas of themselves, that they did not know how to talk about beforehand.

A patient said:

> *"I haven't been able to tell it before, because I did not know about it"*
> Patient in conversation with Vibeke Zoffmann (trans.)

It leads to new knowledge for the professionals when the patient discover new parts of themselves. Then the patients are able to tell about elements of their disease that they were not aware of before, thus elements they have never told anyone about. Elements that the professionals did know nothing about even with patients they have seen for a long time. When these new parts of people's life appears, it affects their whole community.
In some cases, the families, friends, and colleagues have not been told about a person's disease, but when the patient gain knowledge, it is easier for them to tell their relatives about the disease because they now know how to explain it.
Releasing knowledge is therefore an important aspect of the process of living with diabetes, and is an

aspect that should be aimed for when working with patient empowerment.

General comments from the interview
Vibeke was told about the thesis plan of making an digital service to help people with T2D, take more control of their disease. She was explained that empowerment should be an important factor for the underlying method. This opened up for some of her do's and don'ts, when working with empowerment through digital tools, based on her experiences.

> *"If you, in your app, requests people to do something specific, then it is an external request - and it has a negative effect on people's motivaiton."*
> Vibeke Zoffmann (trans.)

> *"If you can help the patients to start a process of discovery, then you have the possibility of making people curious on their blood glucose etc."*
> Vibeke Zoffmann (trans.)

Take outs

The interview with Vibeke gave a better understanding of how empowerment can be used when working with people with diabetes. At the same time it was a great insight into the GSD-method and how some of the elements can be used to incorporate empowerment in this thesis project.
The comments about don'ts in technology will be elaborated in (System co-creation, p. 91), in order to use it when developing the system together with the users.
Based on the interview, and all the findings it have been chosen to investigate some of the themes more, since it can be important to the project. The themes and how they will be used in the project will be described in (Elaboration on findings, p. 55).

// INTERVIEW W. NIELS BOYE

Sundhed.dk shared the contact to Niels Boye for the group to arrange an interview going in depth with the doctor's point of view. The interview should clear out the project purpose with sundhed.dk giving insights into, which data that have shown important to the diabetes people's conditions.

The purpose of the meeting was to get the HCPs point of view in regards to which kind of data they need from the diabetes people, for improving the treatment of diabetes. Additionally the meeting should give a better understanding of the project.

Participants: Niels Boye - Physician, specialist in Internal Medicine, Endocrinology and Health Informatics
Duration: 1 hour
Location: Café at Østerbro
Method: Semi-structured interview

Preparation

Working around the approach of service design, it is to important to create a holistic service involving the different actors interested in the service. This made it important to get a doctor's point of view to the service.
The preparation before the interview was to figure out which data, that could be interesting for the doctors in the treatment of diabetes people. Research about which kinds of data this could be, have been done through *the initial interviews* (crossref.) and through the *physiology behind diabetes* (crossref.).

Before the meeting with Niels, he sent a confidential project description about the diabetes project with sundhed.dk. The description helped guide the interview in the right direction. A semi-structured interview guide together with an exercise was developed to help explaining the importance of data.

Execution

The interview took place in a café at Østerbro. Firstly, a short introduction of the group and the project was given, whereupon Niels was asked to introduce himself and what he works with. It helped the participants of the meeting to empathise, and created a shared understanding of each others background.

The interview was recorded for the group to be more permitted to the interview (the recording can be found in Appendix 10). Furthermore, the interview were documented by photos and by a few notes taken throughout the interview.

Analysis

During the interview Niels was explaining the business model for the project by drawing it. This drawing was afterwards discussed by the group to talk about the details and to understand the business model of the whole eco-system. The interview was not analysed further, but the themes discussed and the drawing was used as findings. The findings important for the further process will be presented in the following section.

Findings

The drawing of the business model
Niels compartmentalised the drawing in three overall classifications surrounding the citizen; the healthcare system (HCS), the quantified self and the supermarkets and commodity data.

The project's purpose from Niels' perspective
The purpose of the diabetes project is to make a hybrid service model between the HCSs data, the quantifiable data and commodity data. In this service model there should be a algorithmic filtration that puts the data into a context of the user, where the data is directed to the user.
They desire to make a sacred alignment between the citizen and the HCS about sharing health data. The HCS can use the data anonymously for scientific work and development, and the citizen can use it in their personal context. The user should of course

own the data by giving the other instances access to the data.
Niels sees the system as developed by sundhed.dk, in order to be able to keep other interested corporations out of it, to have control of the data and to maintain the privacy of the data.
The citizen should have the possibility of choosing who to share data with, or if they want to share it. The HCS will still share their healthcare data with the citizen no matter what. This database will also make it possible to easier make statistics about the population on the data gathered.

As a person with diabtes you have to take many decisions every day, where data-driven algorithmic support could help. It could give a more flexible life, but it requires a balance between the quantifiable self and the things that are ingested.

Diabetes is chosen for the project, because it is a good example of how the citizens should control their disease themselves, which is the case for many chronic diseases.

> *"Everyone should take care of themselves, but I think they should have some help."*
> Niels Boye (trans.)

It is not possible to make sure the whole population will be able to use this new system, but it should be seen as a supplement to the treatment as it appears in the HCS right now. It should be a service model that is parallel and complementary to the HCS. Therefore the model should be made outside the HCS, but for the HCS.

Reliable measurements
The citizen is responsible for their own quantified self measurements. In Niels' opinion, the HCS do not care about the reliability of the data the individual citizen produces. The citizens are responsible of their own data, while the HCS is responsible for the healthcare data.
If the citizens are cheating with their measurements before a consultation, it is their own problem. The HCPs can only react on the numbers they get and give advices on the basis of that. The citizen is responsible for their own health in most cases, the HCPs is only advising on the conditions and treatment. In telemedicine the HCPs are responsible of the data, because they are the ones who collects the data and not the patient. This is the reason why this project is not focusing on telemedicine.

> *"You should give the control to the patient. You should also give the responsibility to the patient!"*
> Niels Boye (trans.)

The stakes in the drawing

The service to be created will be part of a larger eco-system described by Niels (Figure 14). The section in the drawing that this thesis are focusing on is the section that is surrounding the citizen. This is closely connected to the larger system therefore the key parts of the system will be explained to understand the project.

Citizen's Eco-system

The citizen's database
The citizen has its own database, the flow of data to and from this and who can access it are controlled by the citizen.

Quantifiable self
The citizen's quantified self data consists of all the data the citizen care about gathering. A lot of this data is already being produced and could be valuable to the HCS, however it is not shared with them. The goal with the project is to enable the citizens to create their own eco-system of quantified data, combined with commodity data, and healthcare data. The citizen's eco-system should then be shared with the healthcare's eco-system for research purposes.

Healthcare eco-system

Central bank
The central bank is the primary database of the healthcare system, where the data from the HCS and the data from the citizen is kept (if the citizen has allowed it). The data from HCS is already paid by the citizen by taxes and is stored by sundhed.dk. In this bank the data can be shared, partly anonymous and partly personal.

Bank director - broker and banker of data
The bank director controls the data stored in the

central bank. He is the only one who can translate the anonymous data, supplied from the citizens, to personal data. To ensure the data is being treated securely, a strict democratic process together with the Securities and Exchange Commission will be made.

Securities and Exchange Commission
The securities and exchange commission acts together with the bank director as an external commission, tasked with securing the privacy of the citizens data.

Doctor
The citizen's doctor can access data from the citizen's eco-system if allowed.

Customer of the data
Customers of datasets could e.g. be the pharmaceutical companies, that uses data for scientific work.

Commodity data (Supermarket and stores)
The citizen's commodity data covers data provided by e.g. supermarkets and stores. They can provide knowledge about the citizen's consumption to the citizen's eco-system. Their interest could, on the other hand, be to gain insights about their users of their stores through data from the citizen's eco-system.

This system shows how the citizens can benefit from the larger system and how the larger system can benefit from the citizens. It also depicts that the citizen are kept in control of their own system, deciding who can access their data and who can not.

Economy in the system and ownership
- *The citizen* will use the tools they have and want to. They will not pay anything for the system other than the taxes.
- *The society* will pay what they always have for the analogue system in the new system.
- *The supermarket* will pay the same for the digital system as they pay for the analogue variation.
- The cost for the system and project will be paid through funding.
- *The owner* of the system is the society.
- *The Securities and Exchange Commission* will be the authority managing the system. There is already some possibilities for who should take on this role, for example 'Regionernes kvalitets institut' - the danish regions, that already works with data.

Sundhed.dk's task is to demonstrate this complicated system, making the fundations understand the advantages of the system, what the system could look like, and maybe act as the provider of the service.

The exercise

On the basis of the different data described in the exercise, Niels agreed that all kinds of data presented was important for the system. There are three aspects of the data for the HCPs – the health aspect, guidance of the citizen (the data you need to have to give the patient advices), and the new knowledge (the attempt to use data to generate new knowledge).
The data presented for Niels are in the interest of the citizen while the doctor is interested to a limited extend of giving guidance to the patient about how to manage the disease.

Niels feedback to the types of data:
- **Exercise and diet** is important for the patient's own regulation of his disease. It is only relevant for the patient and not for the doctor.
- **Blood glucose** is important for both the doctor and the patient.
- **Medication** is important for both the doctor and the patient.
- **Blood pressure** is a central part of the examination at the doctor. The blood pressure can tell a lot about the health of the patient. The blood pressure measured at home by the patient is very valuable, because of the *white coat hypertension*.
- **Sleep** is important for the balance of the mind.
- **Weight** is also important. When a patient increases in weight, it is a sign that the insulin level is too high. For example the patient's gets hungry all the time, because the blood glucose decreases all the time.
- **Mood** is important for the patient.
- **Pictures of physical condition** is important for the patient, to follow the process of the complications or react of the conditions.

Responsibility

Since the doctor is only seeing the people with diabetes on average four times a year, the diabetes people has to take responsibility of their own disease the rest of the time.

The doctor's task is to detect and treat complications to diabetes. In this structure of a new digital system the data produced by the citizens is for the benefit of themselves, and for the doctor to support the patient better. The data measured by the citizen

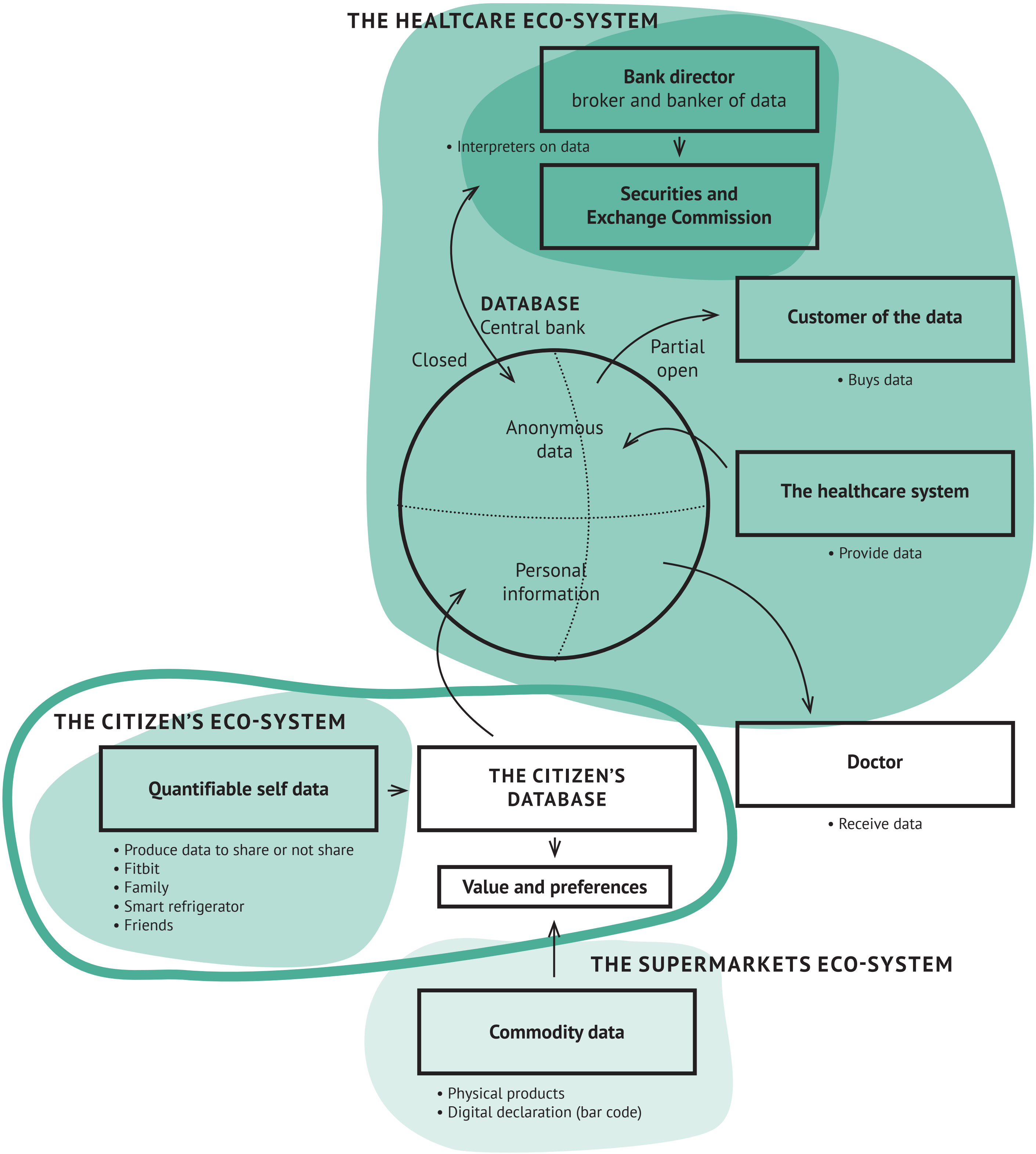


Figure 14 - *The eco-system of the overall diabetes project*

is not for the benefit of the HCPs.
Niels was asked about, if this new system should be able to discover fluctuations and then contact the HCP but this would make the HCS responsible of the citizens data, which is unwanted. Instead the citizens could be informed about their situation to be able to react according to it.
When citizens are insecure about their current situation they should have the opportunity to share their data from the system with the HCPs. Niels told that the HCPs are actually not committed to and responsible for answering the citizens about their data.

> *"There should be a clear distribution of the responsibility. The doctors can not shift their responsibility to the patient, and the patients can not shift their responsibility to the doctor."*
> Niels Boye (trans.)

> *"There are many [citizens] that would like to place the responsibility on the healthcare system."*
> Niels Boye (trans.)

Patient vs. citizen

It was discussed how diabetes people are being treated in the HCS. The HCS treats people as either citizen or as patient. However, people can be both at the same time depending on their responsibility and drive towards the disease. It is important to understand that the person is a patient in some parts of their disease and a citizen in other parts of the disease. The diabetes person should therefore not be seen as a patient because they receive a diagnosis. (Figure 15) illustrates the different stages a diabetes person can be in when living with diabetes.

This system that is about to be developed should be a help in the diabetes person's everyday life to accomplish the things that he should already accomplish. By sharing this person's data, the HCS and the person would be able to form advantages of that.

Take outs

Based on the interview and all the findings it was chosen to investigate the following themes more, since it can be important for the project. The themes and how they will be used in the project will be described in the following section.

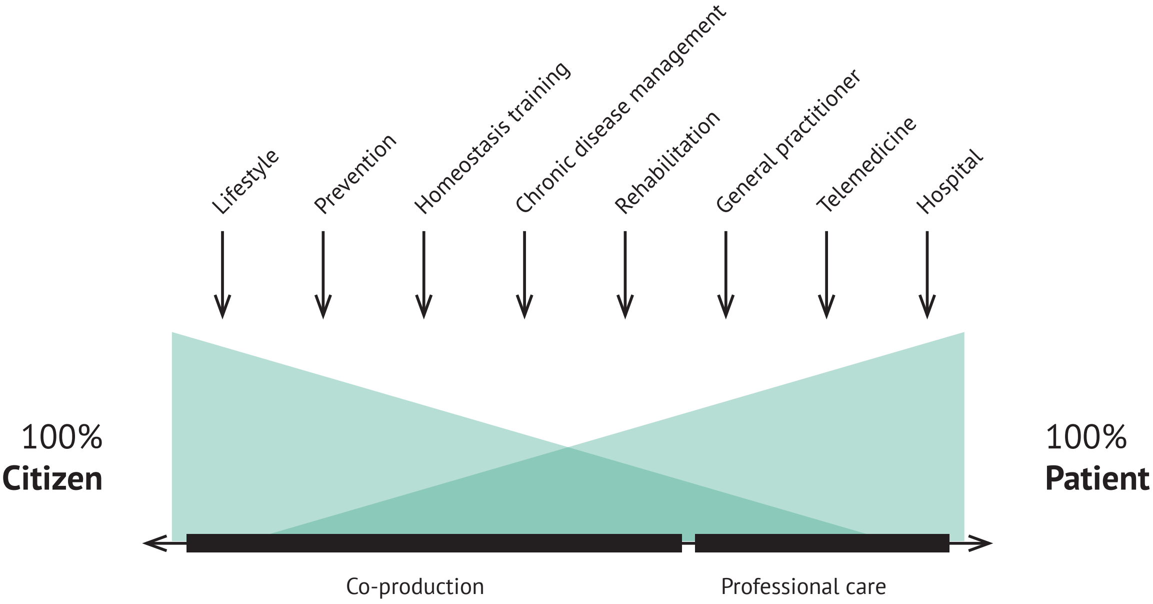


Figure 15 *- About The Digital Health Continuum*
(Jylling, E., n.d.)

// ELABORATION ON FINDINGS

The following section will elaborate on the important themes found through the expert interviews.

Empowerment

Zoffmann, V., et al. (2015) describes the method "Guided self-determination" (GSD) as having the goal and supportive process as:

> *"GSD utilizes a seven-stage process to develop illness-related life skills: establishing a mutual people-provider relationship with clear boundaries; self-exploration; self-understanding; shared decision making; action; and feedback from action."*
>
> (Zoffmann, V., et al., 2016)

GSD provides tools to discover and help people express their personal priorities and difficulties related to the disease. Through these discoveries, they can take an active part in the process of change by clarifying their needs and values in collaboration with the healthcare professionals (HCP) (ibid).

Rappaport (1987) (as cited in Feste, C., Anderson, R.M., 1995) describes empowerment as a:

> *"process by which people gain mastery over their lives."*

To successfully manage a chronic disease it is required for people to set personal and health-oriented goals and to make a decisions about how to achieve these goals. Feste, C. and Anderson, R.M. (1995) argues that this requirement can be achieved through provided health education focussed on a combination of skills, heightened self-awareness concerning the patient's values, and knowledge to achieve the desired goals.

Motivation in relation to empowerment
To empower diabetes people in their process of change, motivation is important to keep in mind.
Motivation is closely connected to empowerment and will therefore be used to deepen the understanding of the theme.
Below is a definitions of motivation:

> *"Motivation in psychology is a collective term for explanations of what causes the mental and physical activity of human. (trans.)"*
>
> (Katzenelson, B., Redaktionen, 2017).

The motivational explanations can refer to interests, needs, purposes, expectations, operations or/and desires (Katzenelson, B. and Redaktionen, 2017).

Firlik, K.S. (2011) describes in an article, how to successfully motivate people with disease self-management and how mobile technology can help motivate. She argues that disease management is a team sport, where the patient has the biggest responsibility. As described by both Firlik, Vibeke, and Niels, the patients are in need of solutions to motivate them in managing their disease.

Patient vs. HCP relationship

For patients to achieve their goals and outline their values and needs, health education are needed. The traditional compliance approach to healthcare prepares and persuades patients to act according to the HCPs recommandations. The traditional approach reduces the patient's freedom of choice and autonomy. When having a chronic disease such as diabetes, there are many lifestyle and metabolic parameters that are essential to make decisions about.

This requires people to take self-care and to manage their own health (Feste, C., Anderson, R.M., 1995). The diabetes people need to be aware of their own health conditions to be able to reflect upon it and figure out what works and what does not.
Empowerment should be facilitated by the HCP, but it is mostly accomplished by the patient. The role of the HCP is to support the strengthening of the patient's empowerment by appropriate actions and follow-ups to support the psychological, spiritual and social aspects of the patient's life (ibid).
In the relationship between the HCP and the patient, the HCP often priorities the disease-over-life, while the patient tries to separate the disease and their life (Zoffmann, V., Kirkevold, M., 2005).

Zoffmann, V. and Kirkevold, M. (2005) describes in their study, conflicts within each actor and between the diabetes people and HCP in the process of treatment. The study showed that the understanding and communication of the disease is not alike between the diabetes people and HCPs in the traditional compliance approach – they do not meet each other. The connection between life and disease is not clear enough for the individuals which creates conflicts. The HCP is not enough aware of the patient's life and the patient is not enough aware about their disease to take responsibility and react to the signals. (Figure 16) explains the conflicts that arise. Some of the same conflicts have been noticed in the thesis through interviews and workshops.

Responsibility or response ability

The terms are described in the paper by Thille, P. H., & Russell, G. M. (2010) as:

Responsibility is:

> *"... something a physician could "give" or "transfer" to patients, or that patients needed to "take.""*
>
> Dr Stevens (as cited in Thille, P. H., & Russell, G. M., 2010)

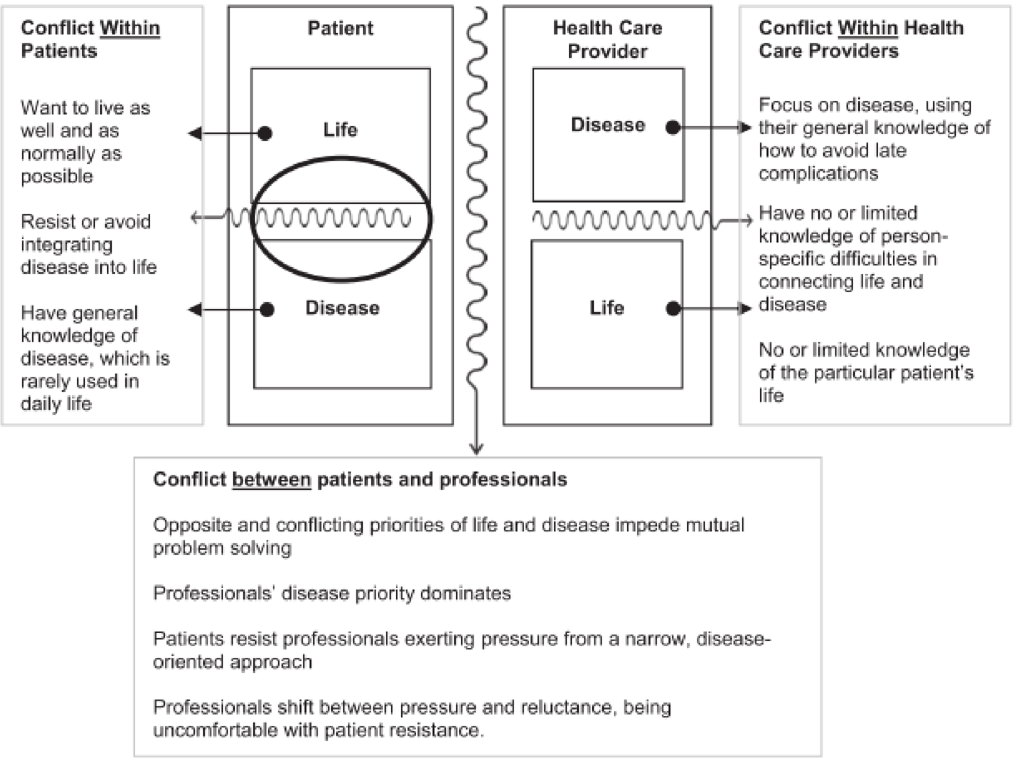


Figure 16 *- Life-Versus-Disease Conflicts*
(Zoffmann, V., Kirkevold, M., 2005)

Reponse-ability:

> *"...effective care as involving active partnership of physician and patient, implying a need to foster the ability of both practitioners and patients to respond to complex challenges as they arose."*
>
> Thille, P. H. and Russell, G. M. (2010)

Responsibility can therefore be described as the citizens responsibility towards themselves and the disease.

Response-ability can on the other hand be described as the citizen's and HCPs ability to react on the disease and conditions.

If the diabetes people have these competencies and get help from technology, they would maybe be able to live a better and easier life with a chronic disease. Some of the knowledge the citizens are in need of to improve their response-ability is something they produce themselves - the quantifiable self data. By producing the data the citizens can take responsibility for themselves.

Algorithm based treatment and precision medicine

The quantifiable self data, data from the healthcare systems (HCS), and the commodity data can be used to create precision-based medicine in the future.

The process of investigating and analyzing diseases has gone through a big change over time. From being symptom-based - meaning a treatment based on symptoms. Becomming pattern-based - treatments are given based on certain allignments of patterns. To algorithm-based, which are interesting for this project.

Through peoples data treated by algorithms, the treatment and care of diseases like diabetes can be more individualised, precise and efficient and even prevent diseases in the long term. The treatment is not only based on intuitive actions and long term evidence-based research as it is now, but also on the citizen's own data to give appropriate treatment accommodated to the individual (Wilckens, T., 2014). (Figure 17) by Wilckens, T. (2014) shows how data usage and actions has changed, and how it might change. A report from *Tænketanken Mandag Morgen* also uses the model to explain how the digital transformation will change the Danish society in the field of health and what the Danish society should be aware of when changing to precision medicine in the future (Tænketanken Mandag Morgen, 2017).

	YESTERDAY	TODAY	TOMORROW
DATA	Symptom-based	Pattern-based	Algorithm-based
ACTIONS	Intuition medicine	Evidence-based medicine	Precision medicine

Figure 17 - *Paradigm Shift in healthcare (Wilckens, T., 2014)*

Reflection

A direct implementation of the method GSD as a communication tool will be difficult. The way of reaching people on their terms and including them in the process of taking decisions towards their disease could be useful in the further development of the application. Motivation is important to remember, when working with empowerment. The motivations of using tools in people's everyday life will be researched through a workshop in the next section. The actual motivation of the future service is hard to determine within the limited time span.

The expectations between the HCS and the diabetes people are not aligned, this creates conflicts. Improving the communication and relationship between these two could be interesting for future work.

By making a system to better control the disease, people with diabetes could become more responsible for their own disease and result in a more personalised treatment. By using algorithms in the treatment, it could hopefully give people with diabetes the ability to react on the signs that appears.

// MOTIVATION WORKSHOP

The motivation workshop was conducted in the end of March as a part of the midterm seminar at Aalborg University Copenhagen. The workshop started with a presentation of the thesis' purpose. Afterwards an exercise were planned to get an understanding of the participants use of tools in their everyday life.

The purpose of the workshop was to learn about the reasons and values that makes a user frequently use a tool or application.

Participants: Supervisors and students from the Service Systems Design programme
Duration: 30 min.
Location: Aalborg University Copenhagen
Materials: Table to map out the analog or digital tools and their values.

Preparation

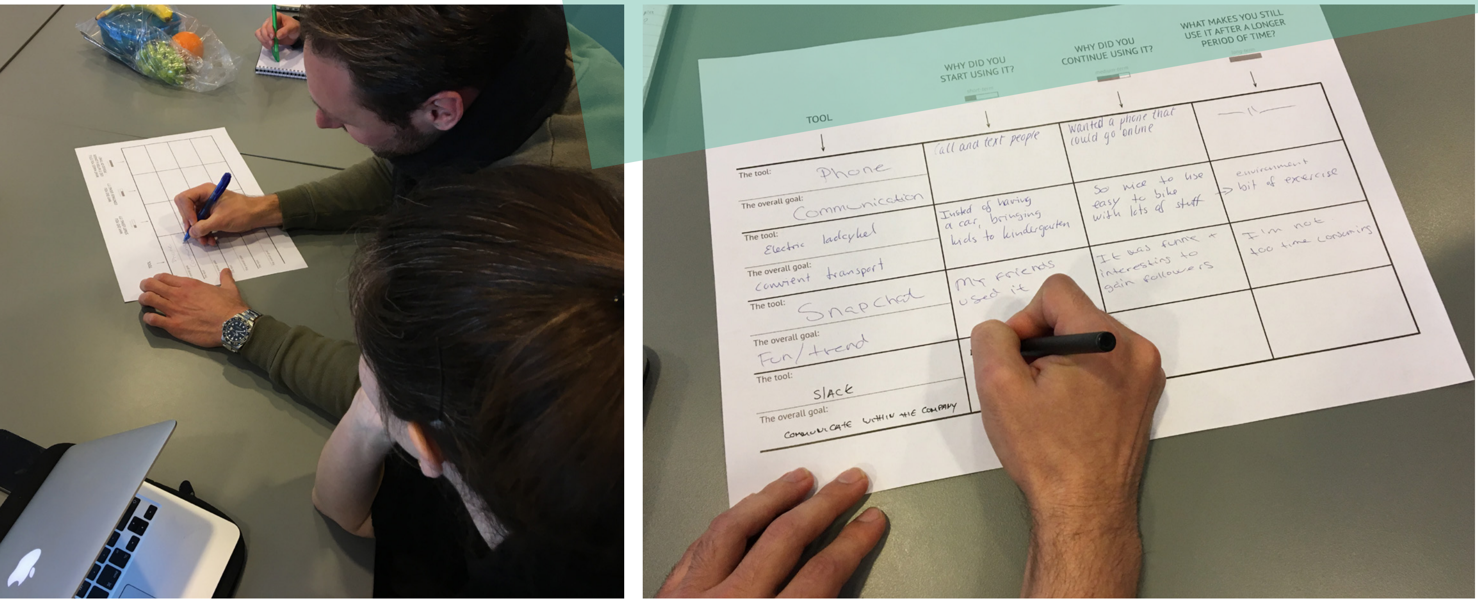
The product of this service will be a tool for type 2 diabetes (T2D) people. The time span of using applications can vary a lot, therefore it was interesting to investigate what makes people start using a analog or digital tool and what makes them continue using it.

The tool used for the workshop was a table divided into four columns and four rows. In the first column the participant filled in the name of the tool and the goal which made them start using it. The three other columns should help the participants describe the motivation from start using the tool until now – the continuous use.

Execution

The estimated time for the workshop was 15 minutes. The workshop participants were divided into four random groups and were given the exercise tool. The groups filled in the exercise by letting everyone choose a tool they are using in their everyday life. The choice of tools were very open, since the most important part was to find a tool that they

Presentation during the motivation workshop



TOOL	WHY DID YOU START USING IT?	WHY DID YOU CONTINUE USING IT?	WHAT MAKES YOU STILL USE IT AFTER A LONGER PERIOD OF TIME?
The tool: Phone The overall goal: Communication	Call and text people	Wanted a phone that could go online	—"—
The tool: Electric ladcykel The overall goal: convient transport	Insted of having a car, bringing kids to kindergarten	So nice to use easy to bike with lots of stuff	→ environment bit of exercise
The tool: Snapchat The overall goal: Fun/trend	My friends used it	It was funne + interesting to gain followers	I'm not too time consuming
The tool: Slack The overall goal: COMMUNICATE WITHIN THE COMPANY			

The workshop participants during the exercise

have used for an extended period of time.

After filling out the tool, the participants were told about the purpose of the exercise.

One of the reasons why this workshop was about finding the value of using tools, was to understand what motivates users.

Since empowerment is closely connected to motivation, the workshop was also made with the purpose to have the participants map out what motivated them when they started using some of their favorite tools and what made them keep using it. These purposes for the workshop should give inspiration in ways of motivating and empower the users in using the future service.

Analysis

To analyse the exercises, the values and descriptions was identified. The method used to analyse the workshop was the data analysing method, *Meaning Condensation*, by Kvale, S. and Brinkmann, S. (2009) (as cited in Bjørner, T., 2015). The method abridge the meanings expressed by the participants into shorter formulations or rephrasing into few words (ibid). The values from the participants in the workshop were classified to find patterns. These patterns were condensed into few words as categories (Figure 18). Some of the tools described were belonging to more than one category.

The words linking the values will be used as inspiration for the further development of the service.

Findings

The findings from this workshop gave an overview of the people's reasons to start using and continue using a tool. The values can be used further in the process to be aware of, what values are important for the users of the future service to motivate them to use it. Many of the tools that the users continued using shared patterns from all the participants.

Since sundhed.dk and the partners of the project from sundhed.dk are mostly interested in the data they get from the users of a future service. The focus for the upcoming workshops and interviews should therefore be about data.

START USING A TOOL

VALUE	THE SOURCE TO THE VALUE
Novelty	Twitter, Snapchat
Practicality	Bike, communication, carrier cycle, Google Drive, smartphone
Community	Whats app, Slack, laptop, smartphone, Instagram
Forced habit / necessity	Toothbrush, Slack, laptop
Fun / entertainment	Snapchat, Instagram
Economy	Bike to save money on public transportation, carrier cycle

USING A TOOL FOR A LONGER PERIOD OF TIME

VALUE	THE SOURCE TO THE VALUE
Environmental	Bike
Usability	Bike, Instagram, Spotify
Practicalities	Carrier cycle, bike, smartphone
Necessity	Communication to work, smartphone (contains everything), computer/ laptop ("basic need in Denmark")
Habit	Bike, Whats app, Instagram, toothbrush
Economy	Whats app, bike
Community	Whats app, smartphone
Continued novelty (unique, updated content)	Twitter, Instagram, Spotify
Adaptable	Smartphone, Google Drive
Communication	Whats app, smartphone
Flexibility	Bike, smartphone
Addiction	Spotify (to move everything from one program to another is too time-consuming, takes too much effort)

Figure 18 *- Findings from the value exercise*

// ANALYSIS OF EXISTING SERVICES

The following text will provide an overview of existing services on the market, that are targeted diabetes people. It will serve as a research and analysis of the state-of-the-art services within this field to give a better understanding of the market that this project are aiming for.

Mapping of the services

In order to get an overview of the different services and their areas of interest, a map (Figure 19) were made where the services could be showcased. The map are divided into four main categories that each have a central role in diabetes people's life (exercise, diet, planning, and medical). The map is created with some of the categories overlapping, because some of the services are focussing on more than one aspect of the disease.

Elaboration of services

In the following texts some of the services will be explained quickly to give a bit more detail about the given service. The services that are explained were chosen based on what the thesis group found most relevant to elaborate further.

BlueStar
A medical application for people with diabetes. It offers several functionalities, and is therefore one of the apps on the market that has the broadest perspective on the disease. The functionalities include a diary to track meals and carbs, personalised insights that are based on the diabetes people's own numbers, helping them manage their blood glucose. It also includes sync of fitness trackers, a chat function to get help from experts, and the possibility to share numbers with doctors (WellDoc Inc., 2017).

My diabetes record (Min Diabetesjournal)
A analog record that the diabetes people can use to get an overview of the yearly visits at the different doctors and at the same time use it as a place to keep all the results and notes. The record is printed with the number of visits that are recommended, and the possibility to note down dates and results.
The record also offers a section for writing down personal goals and agreements made with the doctor (Diabetesforeningen, 2010, Min Diabetesjournal).

Other relevant services

A range of tools has not been mapped since they are not directly aimed towards diabetes people. However, some of them are worth mentioning since they deliver relevant information that can be useful for people with diabetes. At the same time, it is services that will have a relevance for this project, the following section will therefore be used as a elaboration of these services.

HealthKit
Healthkit is a platform developed by Apple. It is designed to make it easier for people to learn about their health and start reaching goals to improve their health. Healthkit does also collect data from third-party apps to make it easier for people to get the full overview of their own health (Apple Inc., 2017).

Google Fit
Google Fit are similar to HealthKit. Through Google Fit, the users can set goals for their fitness and monitor the progress they are making. It has the functionality of connecting third-party apps as well which makes it suitable for getting a broad overview of all the activity and health related measurements that are being tracked (Google, n.d.)

Reflection

A lot of different services does exist on the market both in Denmark, but especially at the international scene. In order to prioritise, only a few of the services has been explained in the text. More state-of-the-art analysis could be done in order to give a more exact picture of the landscape.

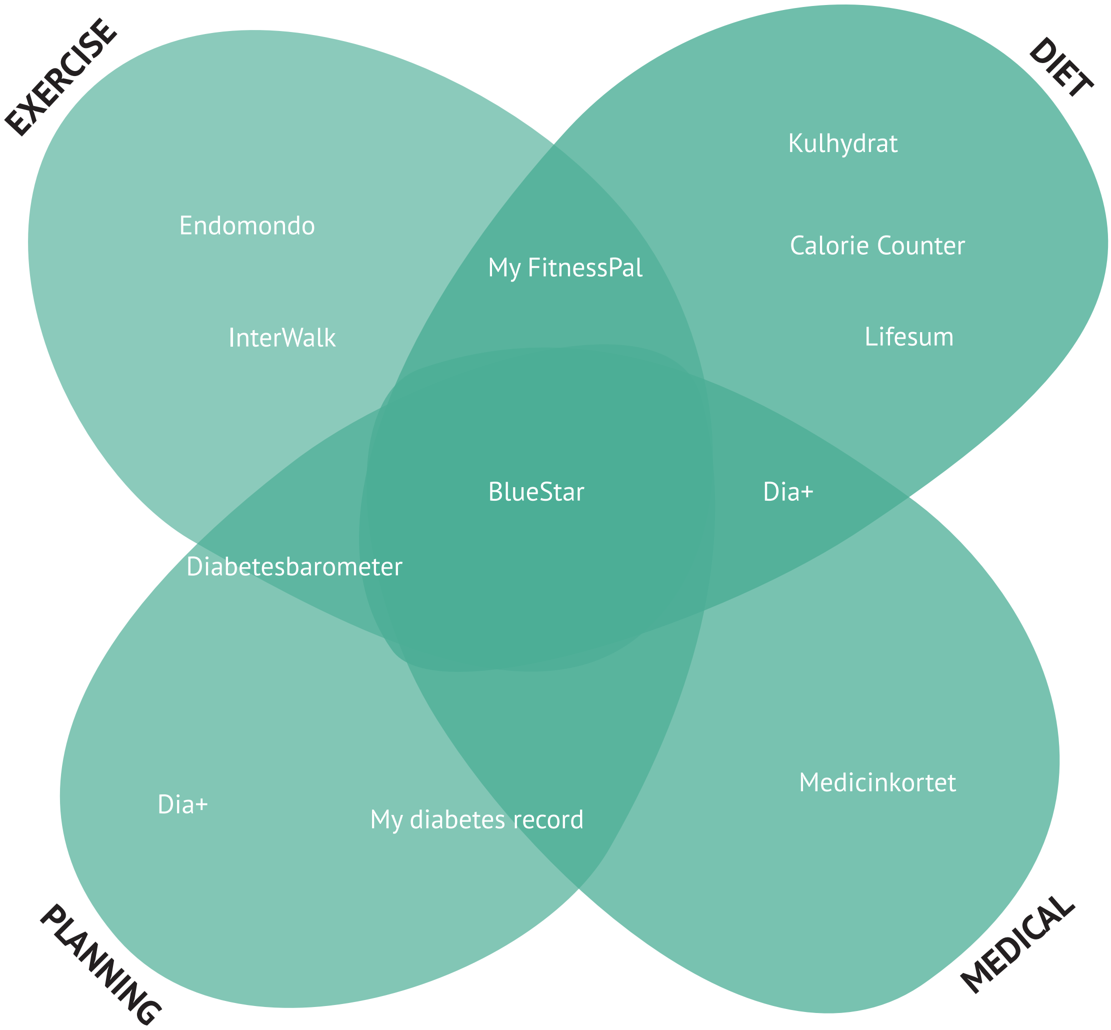


Figure 19 *- Mapping of existing services*

// WEARABLES

Wearable technology is an emerging type of products that allows the user to track a lot of different data about themselves throughout their daily activities. Because of the potential this offers when speaking about data tracking and because of its growth, it is relevant to consider for the thesis.

Owning and using wearable technology, such as *Fitbit*, smartwatches, and others are becoming more and more regular, and prospects shows that it will keep increasing (Marr, B., 2016). Currently the user penetration of wearable technology (excluding smartwatches) is 2,6% worldwide and is expected to raise to 5% in 2021 (Statista Market Forecast, 2017), showing that it is a well known type of device to carry. The total amount of shipped wearable devices was 50 million in 2015 and is expected to raise to 125 million devices in 2019. This shows a huge growth in people using wearable technology (Marr, B., 2016).

Wearable devices makes it possible to track a lot of different physiologic information about the user, which for example is: steps, distance traveled, active minutes, sleep time, sleep quality, and heart rate (Silbert, S., 2017).

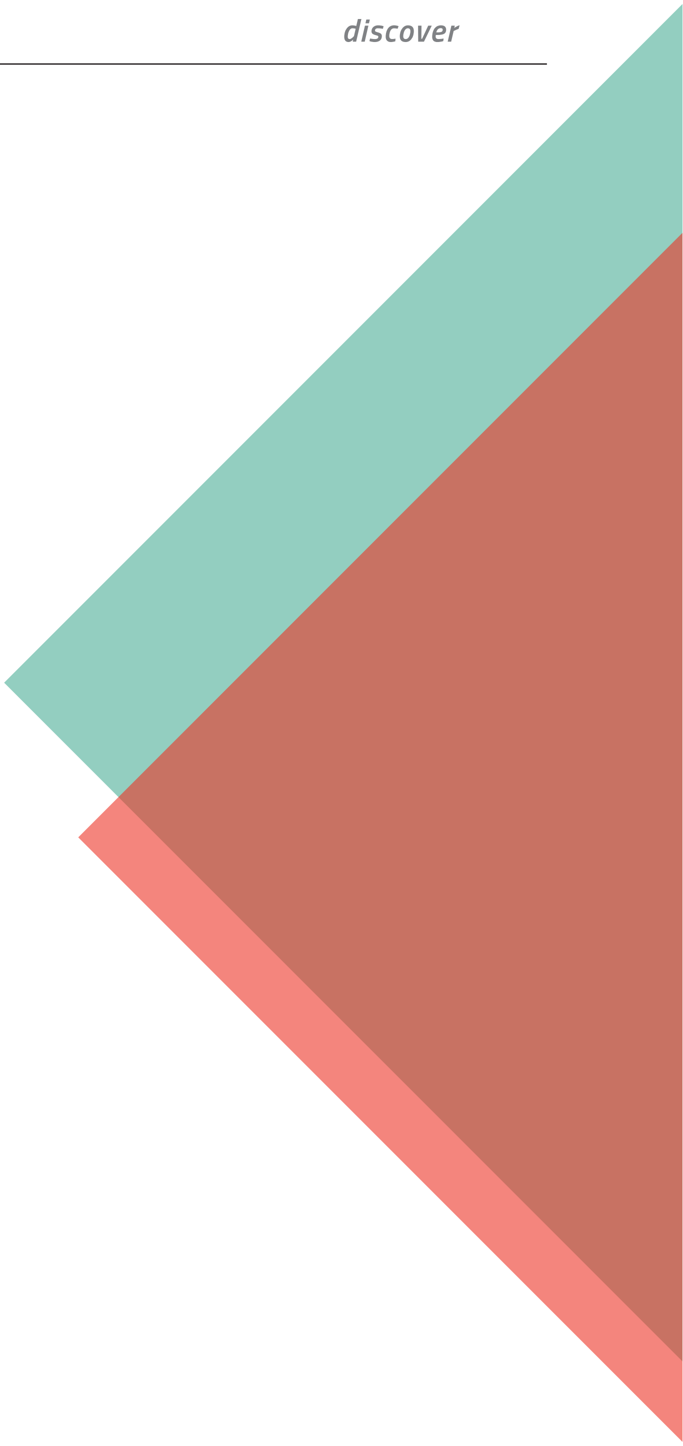
Some devices are actually made for specific target groups e.g. diabetes people. Currently there exists wearable pair of socks, which are made to prevent diabetic foot ulcers (Siren Care, 2016). Rumors has it, that Apple are working on a wearable that are able to measure blood glucose continuously (Becker, R., 2017).

Reflection

A service aiming to collect data, could potentially benefit greatly from users using wearable technology. However, it is not just a chance of collecting more data. If the users provide more data to such a system, it would be able to give more precise feedback and assist the users in managing their diabetes.

// TRANSITION

This chapter has established the background research for the project. Through the next chapter, the project will converge in order to define the constraints for a future service system.



DEFINE

The following chapter will synthesise the directions, findings, needs and ideas from the discover phase, including some of the early findings from the develop phase (cross Ref: develop). This will setup constraints of the further service development and present the stakeholders and target group thought to be involved in the service system. The chapter will also include a workshop to define the opinions towards data and two service concepts towards gathering data.

// ACTORS AND STAKEHOLDERS

The actors and stakeholders surrounding the people with type 2 diabetes (T2D) is visualised and categorised in a stakeholder map centered around the user. The stakeholders in the map are all involved with the user indirectly or directly. The actors in the map are limited to be described as the stakeholders, that can be directly in contact with the user during their disease (Figure 20).

A stakeholder map is a visualisation of the stakeholders involved in a service or with a particular group of people to define and analyse the interplay between the different actors and stakeholders in the particular relations. The map can have many formats (Stickdorn, M., Schneider, J., 2011).

This is not a stakeholder map of the service contribution, but of the overall landscape surrounding the diabetes person.

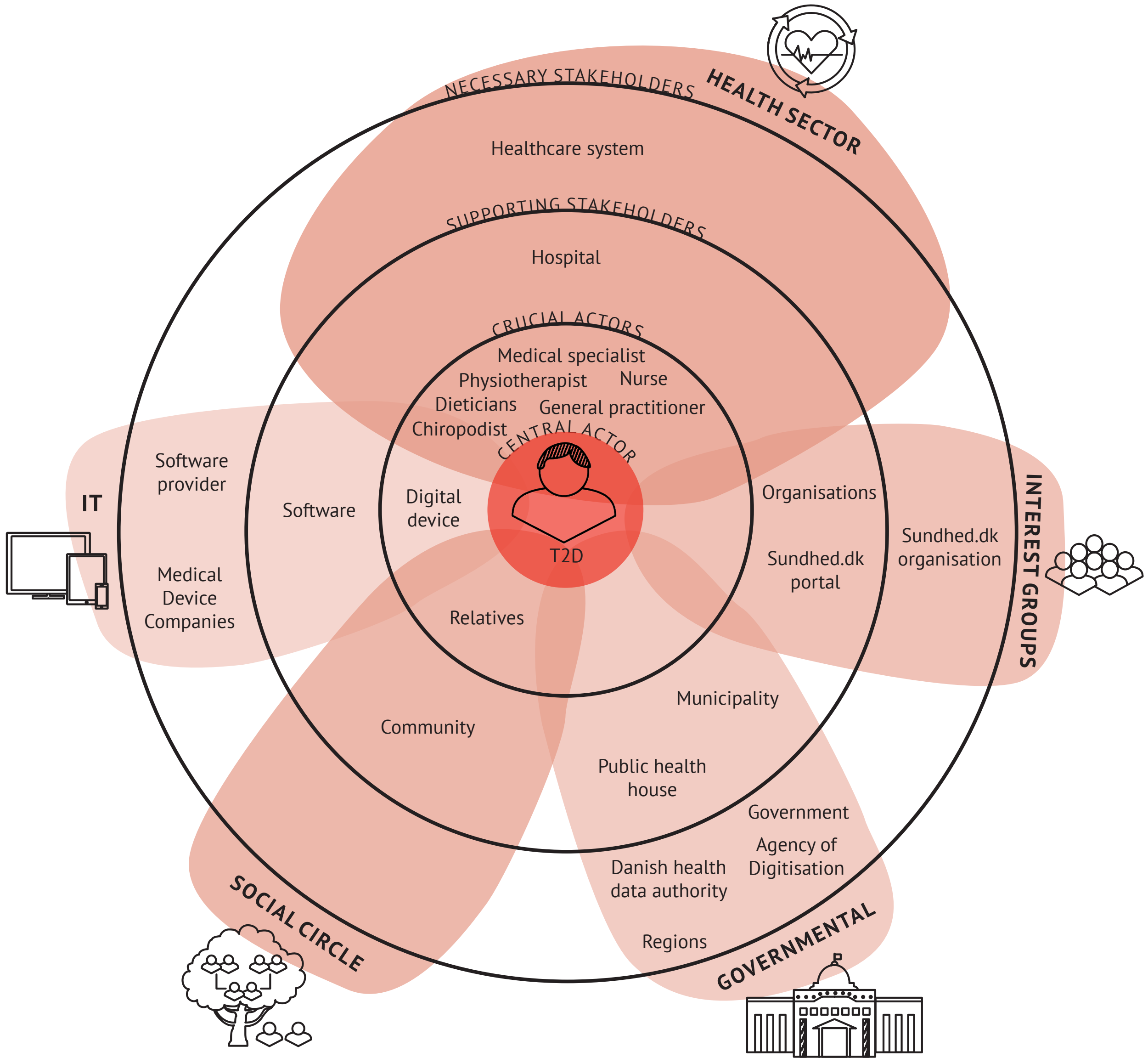


Figure 20 - *Stakeholder map*

- **The first circle** from inside is the *central actor*, in this case the person with T2D, which the other stakeholders are placed in relation to.
- **The second circle** is the *crucial actors*, who are either treating or in close relation to the person.
- **The third circle** is the *supporting stakeholders* who supports diabetes person in his disease.
- **The fourth circle** is the *necessary stakeholders*. They are the ones who own and maintain the systems around the diabetes person.

The actors and stakeholders will be described in the following texts.

Central actor
People with 2 diabetes are in contact with many stakeholders in regards to their disease. These stakeholders are categorised into five overall categories:

Health sector

In the health sector the stakeholders are the ones, who are concerned with the health issues related to the person with T2D.

General practitioner
The general practitioner (GP) is often the actor who diagnose the disease and the one, who takes care of the following consultations. The GP manages the less critical cases, where as the hospital takes care of the more critical cases, that requires additional resources from healthcare professionals (HCP).
The GP refers the person with T2D to the necessary medical specialist.

Medical specialist
The specialists consist of the doctors associated to the hospital and in some cases GPs with specialities. These kind of doctors are eye specialists and endocrinologists with different specialities, who take part in the treatment of people with diabetes.

Nurse
The nurse takes care of the tests at the regular consultations two to four times a year. The nurse can be in contact with the patient both at the GP, if the severity of the disease is mild and at the hospital for worse cases.
The nurse runs the tests, while the doctor pass on the answers from the tests to the patient.

Physiotherapist
The physiotherapist can help the people with diabetes increase their physical activity level and advise about the right kind of exercise. The physiotherapist can be found in both a private practice, at the hospital for rehabilitation or can be a part of the health houses, which offers different kinds of exercises and follow-ups (Ritzau, 2015).

Dietician
A dietician helps people with T2D to better regulate their disease by eating healthy and thereby increase life quality. A dietician is not offered to every people with T2D, but only the more critical cases where the progress ceases (DiabetesUdvalg Region Syddanmark, 2014).

Chiropodist
One of the complications associated with diabetes is complications to the feet (Physiology behind diabetes, p. 25). Therefore it is important to render self-care and to be controlled by the chiropodist at least once a year.

Hospital
The hospital is supported by the regions and is in most cases the location for the more critical cases of T2D. It is also a place for some people with T2D to perform all tests in the same day, both by the doctor, the chiropodist, and the eye specialist.

Healthcare system
The healthcare system is manage by the Ministry of Health, that sets the overall framework for the provision of health. The healthcare system provides a variety of services (Danish Health Authority and The Danish Cancer Society, 2016). There can be read more about the healthcare system (HCS) in (The danish healthcare system, p. 19).

Interest groups

The interest groups are the ones who desires to inform the patient about the disease and the possibilities of living better as a person with diabetes, for example subsidy to treatments, medicine and social activities.

Organisations
Different organisations are focusing on supporting and standing up for people with diabetes, as for example the Danish Diabetes Association (DDA).

Sundhed.dk portal
The portal makes it possible to find valuable information about the disease and each person's data from the HCS online e.g. medicine.

Sundhed.dk organisation
Sundhed.dk aims at making the HCS more transparent for the citizens by offering services (About sundhed.dk, p. 33). The organisation are the ones maintaining the sundhed.dk portal.

Social circle

The social circle is the personal relations who are connected to the person with diabetes.

Relatives
The relatives are both the nearest family, spouse, children and siblings, but also friends and co-workers who takes part in the courses of the disease or are in contact with the person's everyday life.

Community
The communities are groups where people with diabetes can receive and provide help to each other. It can both be groups that are arranged by the municipality, organisations like DDA or health centres with special offers for people with diabetes. It can also be social media groups.

Governmental

Government
The government determine the overall framework and economy in Denmark, this includes what is at the municipalities and regions disposal. The government usually work around tasks that has an association nationwide (Ligetil, 2013).

Agency for Digitisation
The Agency of Digitisation is digitising the public sector in Denmark to make the public sector more efficient and to strengthen the productivity and growth in the public sector (Digitaliseringsstyrelsen, 2016). The agency is among others the owner of NemID as described previously (Privacy, p. 44).

Danish Health Data Authority
The Danish Health Data Authority is described in the earlier chapter about (The danish healthcare system, p. 19). They convert the health political goals to concrete solutions to promote a healthier Denmark.

Regions
The regions most important task are to manage the HCS, hospitals, and psychiatry. At the same time they run and create regional development and performance (Ligetil, 2013).

Public health houses
A health house is offered by the municipalities, that gathers several health offers under the same roof, giving the citizens easier access to these. It also creates a better collaboration between the HCPs, such as GPs, nurses, and physiotherapists (Ritzau, 2015). The DDA does also have different offers and activities in the health houses.

Municipality
The municipality takes care of the tasks directed the citizens, which among others consist of the citizens' health.

IT

The group of IT is the different technologies and softwares that support the diabetes people in their disease and the providers of these services.

Digital devices
Digital devices is used to get access to the different softwares that could be helpful for the people with diabetes to keep track of their disease or to find information about the disease. The devices is also the access to see the health data that sundhed.dk provides.

Software
Different kinds of software are developed to support people with T2D in their life with the disease. Some of them were described in (Analysis of existing services, p. 62).

Software provider
The software provider are the ones who own the specific program and are in charge of developing the programs further if necessary.

Medical device companies
Medical device companies are manufacturers of medical devices as measuring instruments to measure the blood pressure or blood glucose, which are necessary for some diabetes people.

The above-mentioned stakeholders has in the stakeholders map been put in relation to the people with diabetes and are the ones who have been considered relevant.

// THE CURRENT SYSTEM

In this chapter the current system around diabetes will be defined. It will go into detail with how the system and journey was defined, and explain elements of the blueprint that was developed to give a better overview of the system.

Defining the current system

The blueprint of the current system (Figure 21) is based on findings from the interviews that was made with people with diabetes (Interviews w. type 2, p. 31) in order to define the journey of the people with diabetes and on research performed on the course of the disease (The course of disease, p. 28) to put the journey in context with the healthcare system (HCS).

The journey in the blueprint

The journey consists of three main parts explaining what happens:

- Before the diagnosis
- While identifying the disease
- In a persons life with diabetes

Consultations

A person are in average attending two different consultations in the process of getting diagnosed with diabetes. The first consultation is a visit at the person's general practitioner (GP) to check up on the symptoms the person has identified. This will normally lead to several tests and a second consultation where the person will receive feedback on the various tests.

After getting the diagnose, the person is visiting several doctors multiple times a year (The course of disease, p. 28). This is a recurring process since diabetes is a chronic disease.

Pain points

Four pain points are placed on the blueprint. Each of these pain points does represent a point where something is identified to be a pain for the person with diabetes. The pain points were all identified in the process of conducting the initial interviews (Interviews w. type 2, p. 31).

Touchpoints

Touchpoints are used to explain an interaction that a person has with a service (Stickdorn, M Schneider, J., 2011). In this case the touchpoints are used to provide an overview of the interactions that the people with diabetes has with the HCS and with other relevant services. Each touchpoint are divided into a device, a channel, and an activity. These three elements are used to clarify each touchpoint.

Reflection

The blueprint serve as a great tool for providing an overview of large complex journeys and systems with various stakeholders and touchpoints.

The blueprint does not represent every individual person with diabetes and should be read as a general overview of the process of being diagnosed with diabetes and living with the disease.

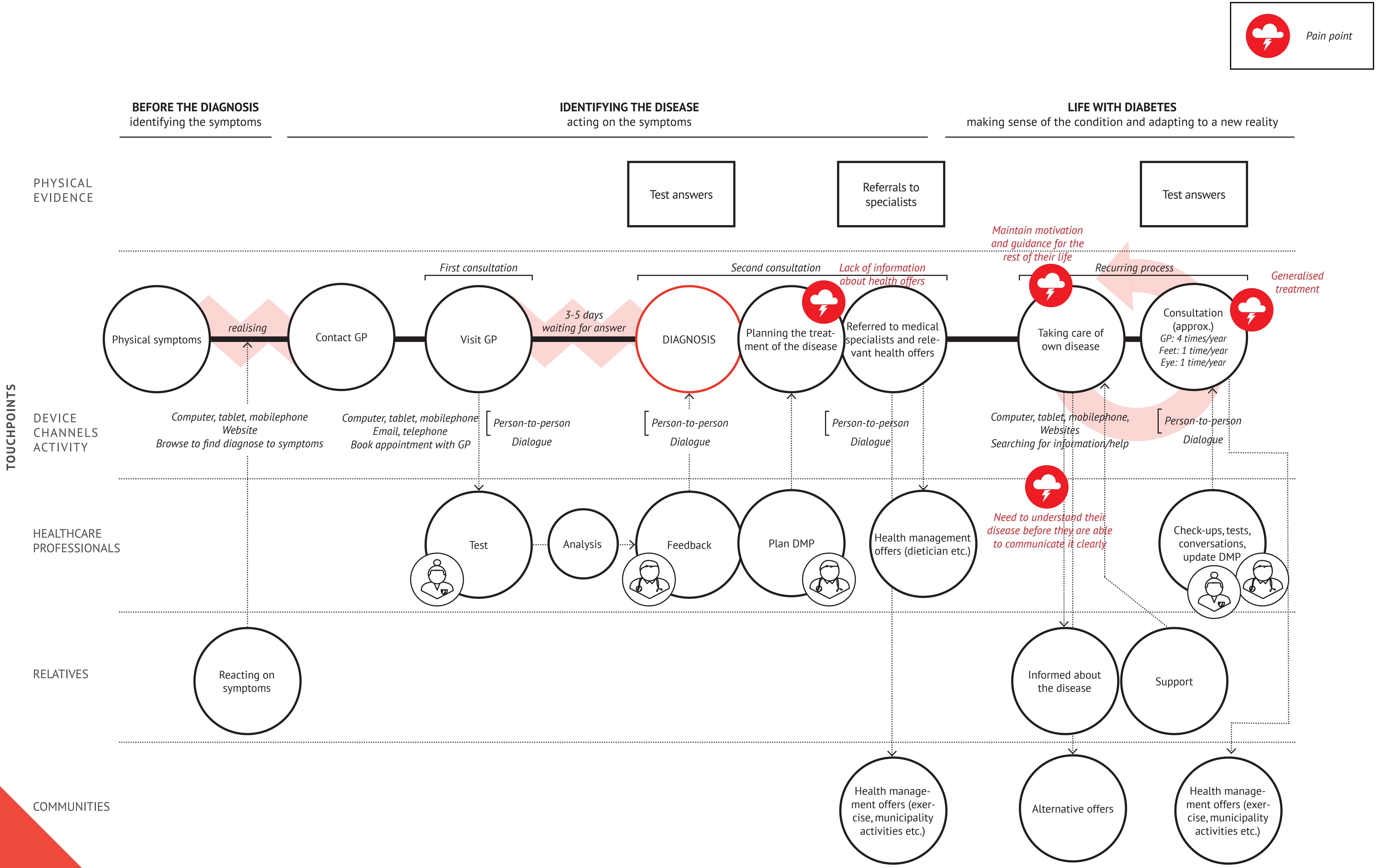


Figure 21 *- Blueprint of the current system*

// WORKSHOP ABOUT DATA

Data is a big part of the project description, why it is obvious to make a workshop in order to figure out what kind of data people produce. This includes which data they already produce and what data they could be interested in producing. Data is produced by everyone and the attitude towards data can be similar for people with and without a chronic disease. Therefore, the participants invited to this workshop were people in general.

The purpose of the workshop can be split into three parts, firstly was the need to understand which data the participants produce and use in their everyday life. Secondly was the interest towards which requirements the participants would set for a system made to collect data from their everyday life. Lastly was about their feelings towards sharing data and the willingness to share data with external parties. To help the participants be creative when answering the second goal of the workshop the exercises was planned and arranged with the purpose to help the participants to progress from the first to the fourth level of Sanders, E. B.-N. and Stappers, P. J. (2008) four creativity levels (Methodological approach, p. 13).

Participants: Friends
Duration: 1,5 hour
Location: Aalborg University Copenhagen
Method: Co-creation workshop

Preparation

Data is produced by everyone all the time, but the way of using and producing it can be different and so can the attitude towards sharing it. For this workshop users who produce and use personal data was gathered.

Since the project works with type 2 diabetes (T2D) the obvious target group for this workshop would be people with diabetes. However, the recruitment of people with diabetes has caused problems, therefore the target group for this workshop was broadened.
The final users gathered for the workshop was based on convenience sampling (Bjørner, T., 2015). This means the participants were gathered from the thesis group's own social circles.

The workshop consisted of five different exercises each made to answer individual questions relevant to the problem statement of this thesis. The five exercises for the workshop were:

- Data in my everyday life
- Values for you
- Values in the system
- Goal and content
- The solution

The approach and tools for this workshop was fixed until a certain point, however some flexibility was kept to make room for modifications dependent on the progress of the workshop. The same was the case for the time planned for each individual exercise.

Execution

The workshop took place at Aalborg university Copenhagen, where the participants were invited to participate from 19:00 - 20:30. Snacks and refreshments was provided.
Initially the participants had a brief introduction to what they were going to be doing, however very little information about the project was given, to keep the participants as objective as possible during the exercises. Afterwards the participants were split into two different groups; one with four and one with three participants. The groups was premade by the project team based on the knowledge of the individual participants background, this was to help create a more diverse discussion about the exercises. On each of the groups table a recording device was placed, which captured the entire discussion for later analysis.

Data in my everyday life - the first exercise
The purpose of this exercise was for the participants to map out data in their everyday life. Each partici-

pant got a paper, where they had to note the activities they perform during an average week and which analog or digital tools they use when performing these activities. Even though the assignment was individual the participants was allowed to discuss amongst themselves and use ideas from the others papers.

Values for you - the second exercise
During this exercise the participants were working together to choose some of the tools they noted in the previous exercise. For each of the chosen tools they had to note down the value it provides.

Values in the system - the third exercise
The goal of this exercise was to have the participants use the values from the previous exercise to choose values they would find important in a new system. However, in the actual workshop the participants started to discuss actual systems and services. This was actually what the participants was supposed to progress towards and start doing in the next exercise, therefore it was decided to encourage this turn of events and have them start thinking in terms of a new system.

Goal and content - the fourth exercise
The original purpose of this exercise was for the participants to decide on a goal for a system and then specify the content of a system made to fulfill this goal. Due to the previous exercise the purpose was changed a bit, instead of deciding on a goal they had to choose a system from the previous exercise and elaborate on the content of such a system.

The solution - the fifth exercise
The turn of events in the third and fourth exercise, meant that the participants had already developed a solution. Therefore, the time allocated for this exercise was used to extend the previous exercise al-

Top: The two groups during an exercise. Bottom: Energizer during the workshop lowing the participants to go into depth with their idea.

Focus group about data sharing
To finish up the day all the participants and the project group were gathered in one focus group. The theme of the focus group discussion was data sharing and how the individuals feel about sharing data. It also revolved around what is required for the participants to feel safe sharing data through applications.

Analysis

The goal of this section was to draw out patterns from the insights and concepts developed. This was done by analysing the data collected from the workshop through traditional coding. Traditional coding works within four steps:

- **Step 1**, organising: Prepare the data for analysis.
- **Step 2**, recognising: Evaluating all the data several times.
- **Step 3**, coding: Organise, cluster and/or label the data according to similarities, categories and subcategories.
- **Step 4**, interpretation: Analyse the coded data, which interpretations can be derived from the assembled data.

(Bjørner, T., 2015)

The workshop was analysed in three parts. Firstly the section will look at what was learned about the participants use of data in their everyday life and which value this data brings to them. Secondly it will look at the two last exercises and see what was learned from the systems they developed. Lastly, the focus group will be analysed to explain what has been learned about the participants view on sharing data.

Analysis of first and second exercise

To summarize what was learned from the two exercises, the (Figure 22) was created. It collects all the information from the first two exercises and depicts, which tool they use during which activity and which value using this tool brings them. Because the primary theme of this thesis is about collecting data, the focus of the scheme is on digital tools or tools that could be made digital.

Based on (Figure 22) the project group got a good understanding of which tools people use in their everyday life. It showed that in many parts of people's everyday activities some kind of digital device are involved. With this knowledge it is safe to say that collecting data during people's everyday activities is definitely possible. However, it can also be seen that the different digital devices are used to

ACTIVITY	TOOL	VALUE
Morning routine	Clock, music, Spotify, radio, news, SoMe, television,	Multitasking in the morning, updates about the world, entertainment
Transportation (bike, train)	Digital 'pendlerkort', GPS, Google Maps, Rejseplanen, Mobilbillet	Biking: free exercise, transportation, health, good conscience, time for myself
Shopping	Tilbudsavis, Tænk, shopping list	Digital catalogue: easy and simple to shop
Updates	SoMe, messages, mails, news, calendar	Keep in contact with people, planning the day,
Exercise	Fitness app	Well-being, health, social, competition
Shopping	Recipes inspiration, debit card, digital/analogue shopping list	
Entertainment	Playstation, computer, Netflix, HBO, games, browsing, Youtube	Relax
Inspiration	Browsing, Pinterest, Instagram	Creative input
Medication	Medicin.dk	
Cooking	Browsing, recipes	Pleasure, health, socializing, hobby

Figure 22 *- Activities, tools and values from the participants everyday life*

create value. This means that a service to collect data from everyday activities also needs to provide value, for the user to be likely to collect data.

Analysis of third and fourth exercise

The purpose was to get insights into which requirements potential users would have to a system if they were the designers. The result of exercise three and four ended up in two very different concepts from each of the two workshop groups. Therefore, they were analysed individually followed by a short summation of what can be learned when looking on both.

Group 1
In this part of the workshop, the participants had to define potential systems that would create value for the group members. The following systems was defined by the group:

- Logbook for relatives, reminding users about lacking contact to relatives
- Reading of news, loud reading of top ten news customised for the user
- News system, giving a wider view of the world around the user
- App, ordering what I need in the fridge, including discount offers
- Health tracking app, Collecting data for the doctor

Based on their ideas, the group was asked to choose one or a combination of their ideas to look more specific into. This group decided to continue working with the *news system*.

Goal: To expand the user's horizon and provide a more varied image of the world around them.

Based on their suggested system, they listed main points that their system should contain and not contain. From these points, the thesis group has extracted some do's and don'ts to use in the further process.

Do's:
- Information/content provided should be based on the users preferences to avoid insignificant content.
- If new content, not completely connected to the users defined interests are displayed, a system for the user to rate this content should make it possible to show the level of interest.

Don'ts:
- Uniform content should be avoided, the system should provide varied content.
- Push notifications, should be avoided or at least kept to a bare minimum
- Irrelevant content should be left out e.g. commercials

Group 2
Group two also generated potential ideas, which can be seen in the following:

- Wireless blood glucose measurement, ongoing guidance about remaining insulin and carbohydrate intake.
- Measuring the need for medicine
- Sleep tracking, telling the user how much sleep they need differentiating based on the day of the month
- Traffic notifications, integrated part of the phone combined with daily doings e.g. calendar and shopping. For example, if there is a queue (in the supermarket) the user gets redirected to optimise the order in which the tasks should be performed

As before this groups was also asked to choose an idea to keep on working with, in this case they decided to combine different ideas into a main topic which they would continue working with. In this case the group chose to continue their work with a system for *public health*.

Goal: Improvement of the public health

Based on their idea and their listed requirements, the thesis group extracted some do's and don'ts:

Do's:
- The system should provide a gateway for the healthcare professionals to learn from the information
- An explicit choice for the user to decide which data can be shared and which cannot
- Guidance so the user can make healthy choices, and the potential consequences and benefits of the choices the user makes
- Ongoing feedback about the user's health
- Security in case the application falls into the wrong hands
- Direct connection to emergency response in case of life threatening situations
- Integration and information about social activities and/or offers in the nearby areas

Don’ts

- Pathologisation, it should not make the user feel sick and bad about their condition. Positive encouragement
- The user should not feel under surveillance
- The service should not display the user’s personal sensitive information, unless requested or allowed by the user

Analysis of the focus group

During this focus group the goal was to gain insights into people’s thoughts about sharing their data. This section will consider the discussion and highlight the problem areas of data sharing which was brought up.

Commercialising user data
One of the participants mentioned it as an potential issue that the companies who gather data earns money on selling the data to other organisations. This point of view got recognition from the other participants. Considering this, one issue could be the feeling that the data tracked is the user’s data, thus it is the user’s right to decide what happens with it. If the service provider makes money on passing along the data the user feels powerless and has no choice but to stand idly by.

Mental wellbeing
How tracking could affect mental wellbeing was another point of discussion. When tracking physical data the person is also making himself aware of his own physical condition. This would mean being constantly aware of how much you e.g. exercise and eat. For example, if the person starts slacking off he would be reminded. When the person is going through such a period he might feel bad that he are not performing as expected. If it continues he might start feeling mentally bad.

Relevance of data
When creating a system it should provide relevant data based on the user’s activity, minimizing the amount of irrelevant data provided.

The right motivation
The participants mentioned a statement often used as motivation: *if you live healthy, you live longer.* However, based on the people from the workshop, life is not just about healthy living so this is not necessarily the right motivation for everyone.
From this focus group some of the things learned are the following:

- The users should have control over their data and what is done with it
- The system needs to provided relevant and personalised data for the users
- Positive encouragement is important, the system should avoid pointing fingers and only focus on the things the users do wrong
- The system should not decide how the users would like to live, it should allow the user to decide and help them achieve their goals

As it can be seen above a large focus should be on customisation, the system should not try to decide how users should live and force them to follow some strict guidelines. Instead it should allow for the users to decide and empower them in their decisions.

Reflections

This section will provide a short reflection about the workshop, how it went, what could have been changed and how this might affected the final result.

As mentioned in the execution of the workshop some ongoing changes were made while performing the workshop. The primary reason for these changes was that the participants progressed more quickly to the fourth level of the *four levels of creativity*, than anticipated (Sanders, E. B.-N., Stappers, P. J., 2008). Because of this the project group had to be creative and modify their explanations a bit. A potential bias with doing this is that the two individual groups might have had slightly different explanations of how to progress between the exercises. Considering this, the results from the individual groups might not be completely comparable, but since the goal was to have the groups create individual concepts with individual requirements to serve as inspiration, this is not considered a large issue. Since the people participating in the workshop were friends, they might have known about the project before participating. This could have affected the choice of the concepts, to better fit the overall theme for the thesis.
This development might however mean that the project team could have made some initial changes to the workshop which would allow the participants to become even more creative. Such a thing might have been possible, but making such changes could also have meant that the participants would feel too pushed and made it hard for them to get to the fourth level of creativity. All together this development shows that predicting how a workshop turns out, is a challenging task. In this specific case adaptability seems to have provided useful results for

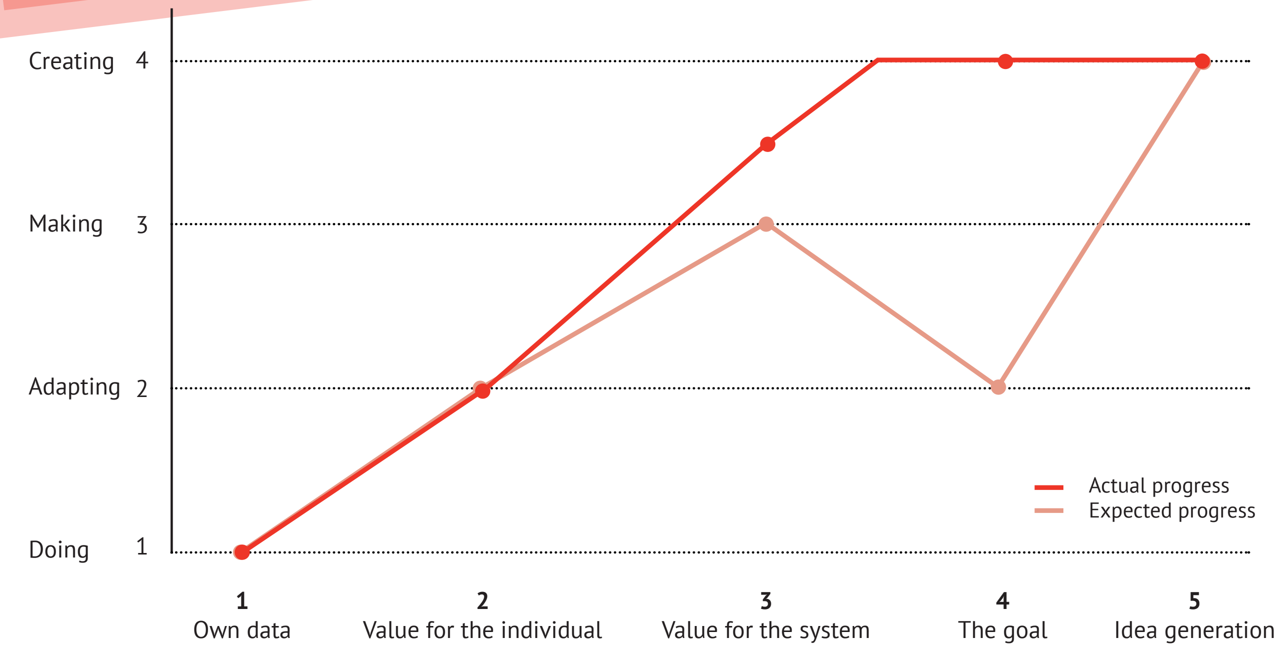


Figure 23 - *Actual and expected progress of the participants' creativity levels*

further work.
(Figure 23) shows how the participants were expected to progress through the creativity levels based on exercises compared to what actually happened.

Another important thing to consider from this workshop is the entire concept of tracking and the question about how much tracking is healthy? This question opens up for reflections about when and if tracking can start influencing users mentally and what would make this influence negative or positive. As mentioned by the participants in the focus group constantly being reminded about one's inadequacies, such as: "I've just missed my training, two days in a row" or "I have been eating too many calories according to my diet" can be very tough. However, not being reminded can in some cases be unhealthy, if there is an important reasoning behind the diet or training. Therefore, it is important to find a way to encourage and reminding the users without blaming them, if they fail to follow a plan.

Findings

This section will gather the combined findings from the analysis, listed as requirements for the future service.
What the system should and should not contain:
- The system should be build to provide value for the users
- Allow healthcare professionals to learn from the system
- Clear choice about which data is shared and which data is displayed
- Empowering user specific, and preference-based guidance and feedback
- Focus on positive encouragement - not a slap on the wrists
- High level of security
- Location based information about activities and offers
- Ongoing rating-based adjustment of system content
- The system should only use user requested reminders and in application notifications
- No commercials should be used in the system
- It should give the users control of their data
- Relevant and personalised data is important
- Allow the users to set their own goals

The workshop showed that people generally use digital devices regularly throughout their day, thus tracking data can be expected to be possible.

// DEFINE SESSIONS

During the discover and define phases of the thesis many different workshops and interviews has been performed to understand the problem field and the users. Getting a full overview of what exactly has been learned and which information was recurring throughout these sessions can be complex. Therefore, a workshop amongst the project group was planned to get an understanding of the material collected.

The purpose of this session was to evaluate the individual interviews and workshops and the content created about these. The reasoning was to make sure everything of relevance were going to be included in the development of the system.

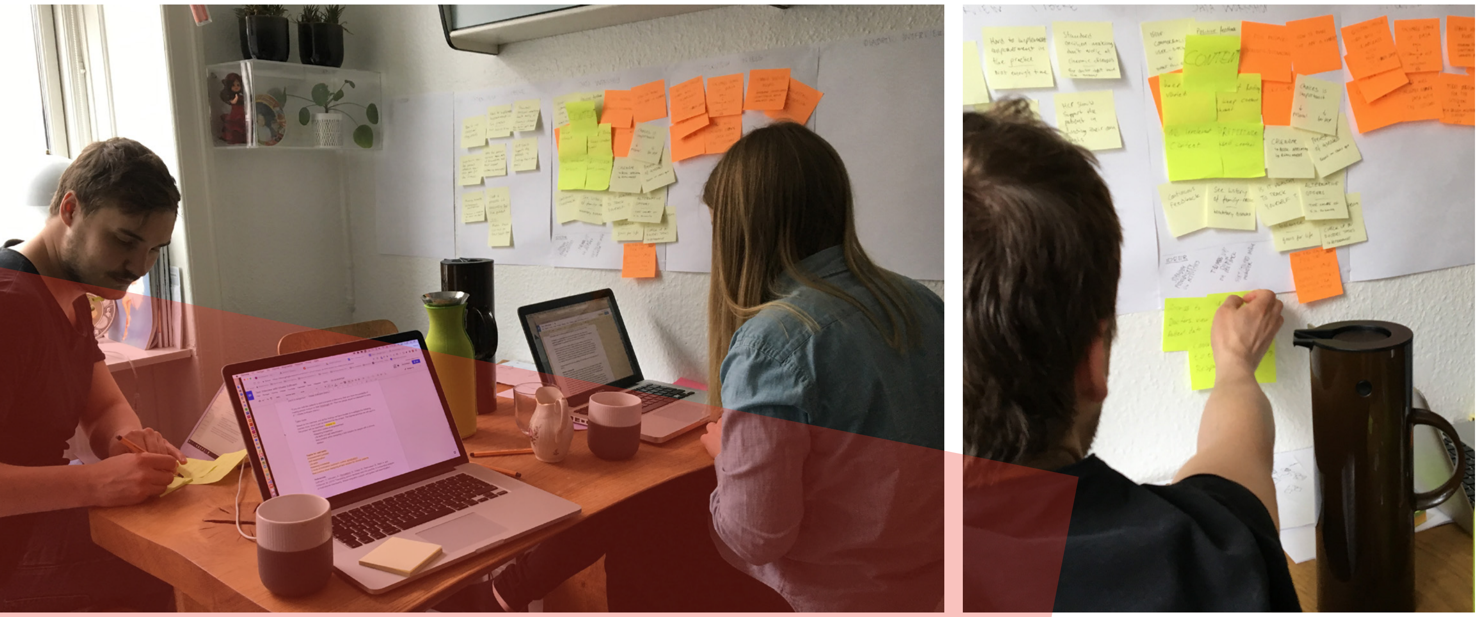
Participants: Thesis group
Duration: 2 hours
Location: Private apartment
Method: Mapping and clustering

Preparation

Most of the information which was going to be used in this workshop had already been analysed and elaborated upon in different texts. However, some parts of the workshops and interviews still missed the initial analysis before it would be relevant to include in the define session. Therefore, the first part of preparation was to split out all the content which still needed to undergo some work.

Execution

The execution of the session was carried out by making a piece of A3 paper for each of the workshops and interviews. Following, the group members made notes for each workshop or interview on post-its adding them to the right paper. This was done in two steps, firstly the group went over the data workshop together since it was not fully worked through and each member had been listening to different parts of the workshop. Secondly the remaining workshops and interviews was split out between the group members.



Mapping out the findings form the research

ACTIVITY	PURPOSE	LEARNINGS
Interviews with type 2 diabetes people (Interviews w. type 2 diabetes persons, p. 31)	Understand the people's journey throughout their course of their disease	Insights into the daily life with type 2 diabetes Most people do not track information about their disease People lack information in the pre-period of their disease Diabetes requires a lot self care to treat the disease Limited information about offers available for diabetes people There is little to no collaboration between healthcare professionals They may feel in control but the physiological measurements show differently
Interview with Vibeke Zoffmann (Interview w. Vibeke Zoffmann, p. 46)	Get more into depth with topic of empowerment and to figure out how her method works and how we could use her method principles for our project.	Chronic patients need to actively decide on which physiological values they want to aim towards Don't's in technology include: Use of notifications, and other invasive elements
Interview with Niels Boye (Interview w. Niels Boye, p. 50)	Get into depth of the doctor's point of view of relevant data types for improving the treatment of diabetes people	Understanding and mapping out the ecosystem the service is supposed to be part of Understanding responsibility between the healthcare professional and the patient Business model of the project from sundhed.dk
Attending Medea talk: "Where is "the Human" in Digital Health Technology?" with Kirsten Ostherr (Health data technology, p. 38)	Gathering inspiration around digital health technology and current trends and tendencies.	Insight into many interesting concepts (quantified self, digitizing of the health industry, artificial empathy) Interesting thoughts (what are the ethical problems of increasing health technology? e.g. privacy) Data ownership (who owns the citizens data?)
Motivation workshop (Motivation workshop, p. 59)	Understanding what makes users start using devices/apps/items and what makes them continue using them.	Gaining insights into why the users use objects/service/system Start using a object/system/service: Curiosity, fulfilling a practical need, necessity Continue using a object/system/service: Necessity, habits, uniqueness
Data workshop (Workshop about data, p. 72)	Gain an understanding of what people already use in terms of tools to control their everyday life. Co-create solutions that solve some of the issues they find relevant.	Updated content and ongoing feedback is important A user need the ability to customise, choosing what to include and what not to include The worst thing a system can do is to make users feel guilty Should not contain: all irrelevant content, e.g. commercials, push notifications

Figure 24 - *Overview of learnings from the interviews and workshops*

Analysis

The information on each of the post-its were presented for the rest of the group. This offered a chance for the remaining group members to give inputs if something was missing.

Patterns was extracted by going over each of the workshops and interviews one by one.

Take outs

The analysis served as a way of getting a overview of all the interviews and workshops. In (Figure 24) this overview can be seen explaining each activity’s puspose and learnings.

Each of the workshops and interviews has their own sections referenced in (Figure 24). Each of these are more elaborated in the individual sections. The accumulated requirements based on all the previous research can be read in (Design requirements, p. 97).

// SERVICE EVALUATION

To evaluate on the different needs associated with the different functionalities in the service system a matrix has been created (Figure 25). The service evaluation is subjective and are considered by the thesis group as a summarise and a extraction of both the findings from the discover phase, but also the findings from the system co-creation (System co-creation, p. 91). The needs to the service are deduced from the different interviews and workshops throughout the process with both people with type 2 diabetes (T2D), experts, and people in general. The needs included in the matrix are needs from the diabetes people and their needs towards the healthcare system (HCS). The functionalities included in the service system have also been deduced and developed simultaneously with the needs.

The needs and functionalities have been considered in relation to their fulfilment of each other, on the basis of four parameters; direct fulfilment, indirect fulfilment, future fulfilment and no fulfilment. Underneath the fulfilment, that does not have a clear argumentation in itself has a small note with an argumentation. The parameters have been assigned a value to evaluate the overall fulfilment of a need or a functionality to see, which are the ones most fulfilled by the service.

The value of the parameters has been distributed in this way:

- Direct fulfilment gets 2 points
- Indirect fulfilment gets 1 point
- No fulfilment gets 0 point
- Future fulfilment gets 0 points

The direct fulfilments get the highest score, since it is the only one that actually meets the functionalities and needs. The following values decrease according to the extend of fulfilment of the needs functionalities.

The matrix gives an overview of the most relevant and important functionalities the diabetes people have enquired about.

Fulfilment of needs and functionalities

To illustrate the total fulfilment of the needs and functionalities, two graphs have been made (Figure 26), which will be explained in the following text.

Needs

- The need that are most fulfilled by the service is the need of an individual and customised tool to control and keep track of their disease.
- The secondly most fulfilled need is to have a place to gather all the existing and relevant health data from existing systems like *sundhed.dk, medicinkortet,* and *Min Sundhedsplatform*. This creates the option of getting an overview of both quantifiable self and other types of data related to their disease.
- The needs rated highest after the previous needs are the possibility:
    - to gather the numbers and notes from the general practitioner
    - to get inspiration and guidance about diet, exercise, and communities based on their profile,
    - to get guidance after receiving their diagnosis about health offers
    - to have an better overview of all their measurements.

Functionalities

- The functionality that is rated most fulfilled in the matrix is the gathering point for all their relevant data.
- The second highest rated functionality is a place to keep track of their disease
- The functionalities rated best, after the two previously mentioned functionalities are:
    - support in the decision-making and measurements consulted by Vibeke,
    - the service should be adjustable from user to user
    - should help the user to plan their consultations easier

The only need that is not fulfilled in the matrix is the need of better collaboration between healthcare professionals.

EVALUATION FACTORS

● Direct fulfilment 2
○ Indirect fulfilment 1
No fulfilment 0
☼ Future fulfilment 0

THE FUNCTIONALITIES

	THE DIABETES PEOPLE											HEALTHCARE SYSTEM					
	Get an overview of consultations	Get an overview of measurements	Guidance after receiving diagnosis about disease	Guidance after receiving diagnosis about health offers	A helping hand to communicate the disease to relatives	A individualised and costomised tool	A place to gather all existing and relevant health data from existing systems	Gather measurements and notes from GP	Get inspiration and guidance about diet, exercise and communities related to diabetes	Better guidance from HCP	Better collaboration between HCP	Make the citizen take control of their own disease	More cost-efficient treatment	To figure out what citizens do next to the consultations, to improve advices in their treatment	To find correlations in healthcare data	To get more data to research about diabetes to exterminate the disease	**TOTAL**
Personal goal		●			○	●	●	●				○				○	11
Notes		Relation between goal and measurements				The user can choose what to measure	Data can help to choose goal	Data can help to choose goal				First step of empowerment				Shows what the citizens want their value to be	
Adjustable for each user	●	●		●	○	●	●	●	●								15
Notes	Able to choose how often	Able to choose how often			The possibility to show condition to relative	Add and deselect choices	Add and deselect choices	Add and deselect choices	Add and deselect choices								
Inspiration in the app				●	○	●			●								9
Notes					Find things to do together, cases and stories	Based on individual interest											
Keeping track of the disease	●	●			○	●	●	●		☼		○	○	●	●	●	19
Notes						User choose what to track, app can remind	The more measurement, the better overview	The more measurement, the better overview		Measurements could be used by HCP to improve advices		Could help the citizen to take control	The data could help users to act on swings		Long term possibility		
Ownership of own data						○	○	○				○					4
Notes						Can help to take ownership	Can choose to use the data or not	Can choose to use the data or not				Give the responsibility to the diabetics					
Gathering point for all relevant data	●	●		●	●	●	●	●	●	☼		○	○		●	●	22
Notes	Creates overview of all data	Creates overview of all data		Also a relevant data type	Show all data and overviews to underpin case	Possibility to choose what to gather	Relevant data	Relevant data	Relevant data	The overview of data could help to infer from context		Help to make overview to take control	Creates potential for changes in cost		Possibility to create correlations in data	Possibility to gather datasets	
Help to find communities and societies				●	○	●			●	○		●					10
Notes				Concrete offers	Communities could give advices to communicate disease	Add and deselect choices						Self-care					
Short cut to contacts related to the disease			●	○		●	●			●			○				10
Notes			Easier to contact HCP	HCP could help to suggest offers		Personal contacts to HCP are coded in	Gather contacts through NemID			Easier contact, easier to get advices			Avoid consultation - not if hypochondriac				
Easier planning	●	●		○		●	●	●				●					13
Notes				Easy to find in the app		Template to a wide range of users	See all reminders, schedules in one place	See all reminders, schedules in one place				Diabetic takes control of their own schedule					
Advices based on interest				●	○	●			●	○		○					9
Notes				Advice to health offers based on interest	Give advices to explain the disease				User can choose itself	Evidence-based advices		Unsure if the user will act on the advices					
Support in the decision-making and measurements		●	●			○	●	●	●			●	○		●		16
Notes		Gives overview to help take the decision	Gives information to support decision			Individualisation helpd to support right	Measurement and overview helps to support	Always available and notes of what to do	Personalised help/advices to support decision			Supports, but gives the control to the citizen	Could be, if citizen act on their own		Correlations can find patterns to support		
Choice of sharing data with HCP and scientific work						○								● (if user share)	● (if user share)	● (if user share)	7
Notes						The users choice of sharing								Daily patterns of measurements	Scientists can analyse the data	Possibility to have data for scientific work	
TOTAL	8	12	6	12	8	21	15	13	12	4		11	4	4	8	6	

Figure 25 - Service evaluation matrix

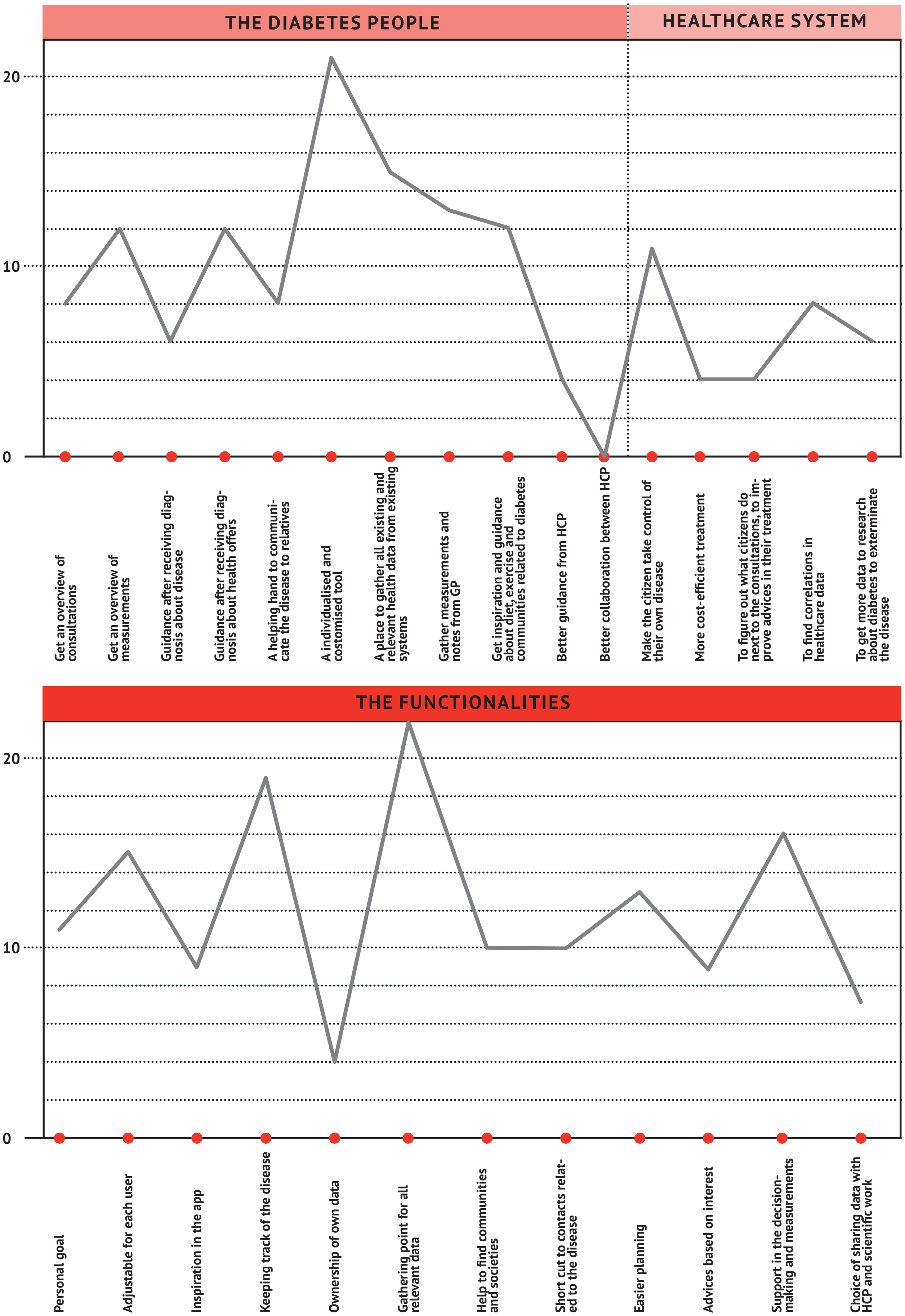


Figure 26 - *Fulfilment of needs and functionalities*

Reflection

The needs and functionalities with the best evaluation are the most prioritised factors in the service system. If each of the functionalities will be implemented as desired and used as desired it can be presumed to cover the needs of the people with diabetes and the healthcare system.

// TARGET GROUP

Initially the purpose handed to the group from sundhed.dk was to look into a service that can help gather data from people with type 2 diabetes (T2D), this is also the target denoted in the problem statement. This made the group aim towards making a service for the general and wide target group of all people with T2D. Through the discover phase, the research made with diabetes people has shown that this might be too wide an objective. The purpose of gathering data from people with diabetes quickly lead to the realisation that the system, which would be made was going to be digital. This decision made the group aware that people with diabetes who had no to very low technical knowledge was out of range as actual users of a digital system. Therefore, the target group was narrowed down to:

People with T2D who are familiar with digital devices.

The learnings, which has been gathered from diabetes people with no to very limited technical knowledge, has shown great value. This group of people can still be used to gain an understanding of the disease and to highlight the pain points that need a solution.

Familiar with digital devices

Based on the definition of the target group, *familiar with digital devices* means that the people with T2D has some degree of experience with digital devices e.g. smartphones. The diabetes people should be capable of at least navigating to an application, opening it up, and inputting values into editable fields. This being said, having a low familiarity with digital devices sets another requirement related to the motivation of the user. A user with low familiarity would require a high motivation to use the system, because it would require a high effort to fully understand and use the system. Users who are either proficient or above in using digital devices will be able to use the system without effort thus it sets less of a requirement to their motivation.

// PERSONAS

Based on the project group's encounters and experiences with different people with type 2 diabetes (T2D), experts, and research performed has been used to create the following personas. A persona is used to represent a character that shares the interests of a particular group. As such a persona offers a way to shift the focus from abstract demographics towards the real needs of a user group, when designing e.g. a service (Stickdorn, M Schneider, J., 2011).

To decide the different personas, a quattro stagioni was developed on the basis of the two parameters used in the interview with Vibeke – regulation and motivation (Figure 27). The quattro stagioni is a scenario approach to define scenarios on the basis of two to three dimensions with high uncertainty or impact towards the given theme. The scenarios can help chart possible futures by finding new solutions as they will be used to in this project, but also to find new answers in the further process (Jonas, W., Kowollik, C., 2016).

Four scenarios was developed in four extreme positions in the quattro stagioni and described in personas. The personas were used to get a common understanding of the target group in the process of designing the service.

The personas (Figure 28) include a couple of elements rated on a scale. These are not elaborated on for each of the personas, instead a description of these scales can be read here.

Responsible for health

The *responsible for health* scale is used to denote to which degree the persona feels the responsibility for their health lies with the doctor compared to

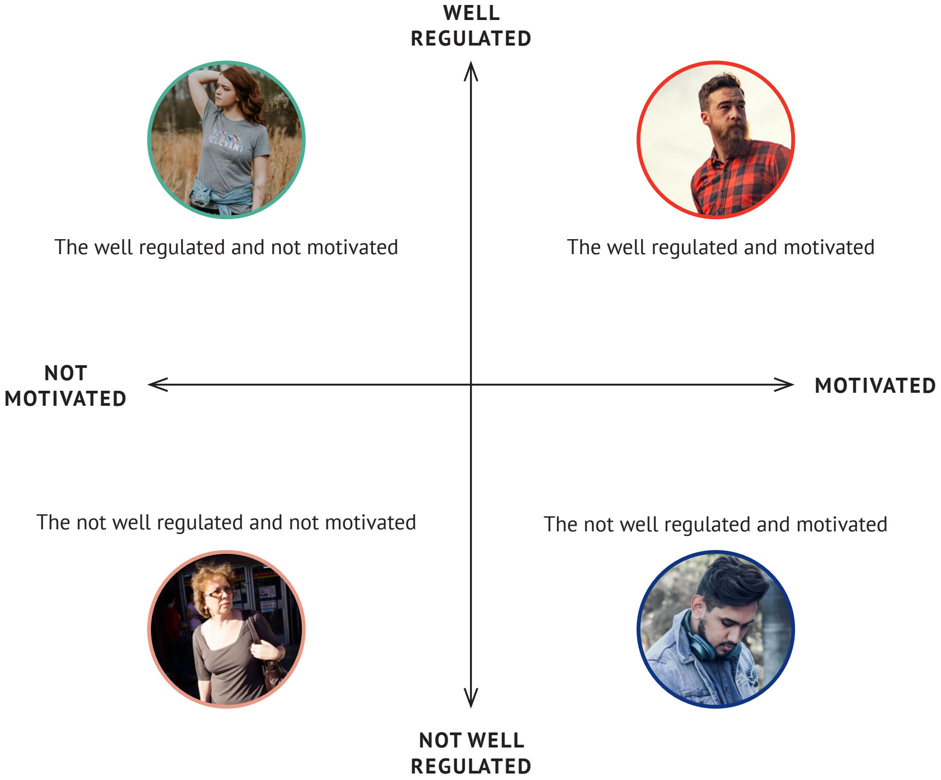


Figure 27 *- Quattro stagioni including the four extreme personas*

themselves.
A scale with no fill would mean the patient puts the full responsibility on the doctor.
A fully filled scale means that the patient takes full responsibility for their own condition and treatment

Experience with digital devices
The *experience with digital devices* scale is used to show how well the user is capable of using digital technologies. The scale goes from familiar user of digital devices to expert user of digital devices. The elaborated definition of the target group defines the meaning of *Familiar with digital devices* and since this is a requirement of the target group, this is the lowest level of experience that is expected from the potential users.

Feelings towards sharing data
The feelings towards sharing data displays how comfortable the person are about sharing his data with research, the healthcare system and other relevant partners. It ranges from will not share data to sharing all data.

The personas created has been used to visualise the target group of the service. Only one persona is presented here, to give a picture of the factors included in the personas. The rest of the personas can be found in (Appendix 2).

THE WELL-REGULATED
DIAGNOSED - 8 Y AGO
MADS, 32 Y
DESIGNER

" Self care and the right routines makes living a life with diabetes consequence free "

// ABOUT
Mads works as a designer, he lives at nørrebro Copenhagen. Upon his diagnosis 6 years ago he was overweight and lived by a bad diet. He decided that diabetes should not affect his health and decided to change his lifestyle. Today Mads has managed to drop his medicine by living by a healthy diet and regular exercise. When Mads exercises he uses his smart watch to track his progress keeping an eye on this motivates Mads to perform better, e.g. run faster and longer. He will soon participate in his first half marathon.

// DIGITAL DIVICES AT DISPOSAL

// MOTIVATIONAL FACTORS
- Running and working out in fitness centre, three times a week
- Playing board games
- Hanging out with friends
- Keeping update on technological advancements

// RESPONSIBLE FOR HEALTH
Doctor — Patient

// EXPERIENCE WITH DIGITAL DEVICES
Familiar user of digital devices ● ● ● ● ○ Expert user of digital devices

// FEELINGS TOWARDS SHARING DATA
Will not share data ● ● ● ● ● Sharing all data

// HOBBIES
- Running and working out in fitness centre, three times a week
- Playing board games
- Hanging out with friends
- Keeping update on technological advancements

// DIABETES RELATED ACTIONS
- Measures blood glucose a few times a week to make sure his values are stable
- Measures blood pressure regularly
- Following a sugar free diet
- Bicycles to work

Figure 28 - *The well regulated and motivated persona*

// DESIGN CONSTRAINTS

A aim of the define phase was to converge the scope of the problem field. All the material gathered throughout the discover phase has been analysed and structured in order to form a more structured overview of the problem. This has led to the design constraints, which forms the basis for the further development of the project. The design constraints will be a guideline ensuring that the solution and system, which will be designed through (Develop, p. 90) are based on the needs of the users and stakeholders.

- The goal of the system is to give people with diabetes a digital tool (referred to as *application* from now on) that can help them manage and live with their disease.

- Design a system that guides people with diabetes to take responsibility for their own disease which can help them strengthen self-care and their response ability.

- The system should be a platform where information and inspiration about having and living with diabetes are easy accessible.

- Create a system that collects data about people with type 2 diabetes, which later can be used for scientific research and analysis for development of precision medicine.

- The system should offer ongoing feedback and updated content in order to continuously create value for the user.

// TRANSITION

The define chapter has managed to collect on the learnings from the discover chapter. The design constraints, which has been made are going to be working as the guidelines while transitioning the project into the development phase, which will present more concrete insight into the development of a service contribution.

DEVELOP

In the following chapter, the process of developing a system and a service will be described. The chapter will describe how the system was developed through co-creation sessions, and in the end how all the findings were incorporated into a final solution showcased through tangible models and figures, which all have the purpose of describing the service more in depth.

// SYSTEM CO-CREATION

To structure the system behind the service, a co-creation workshop was planned in order to bring the future users of the service into the process of designing. The process until now has only included three interviews with diabetes people, but the process has come to a point where further involvement of the users are needed to specify the content and help elaborate on the target group.

The purpose of the co-creation session was to figure out the intentions that the potential user of the service system had towards the service, which requirements the participants had for this kind of system, and to get more empirical data about attitude and willingness towards sharing data with external stakeholders.

Participants: Type 2 diabetes people
Duration: 1/2 - 1 hour per session
Location: Online or at Health House Nørrebro
Method: Individual co-creation session utilising a desktop walkthrough.

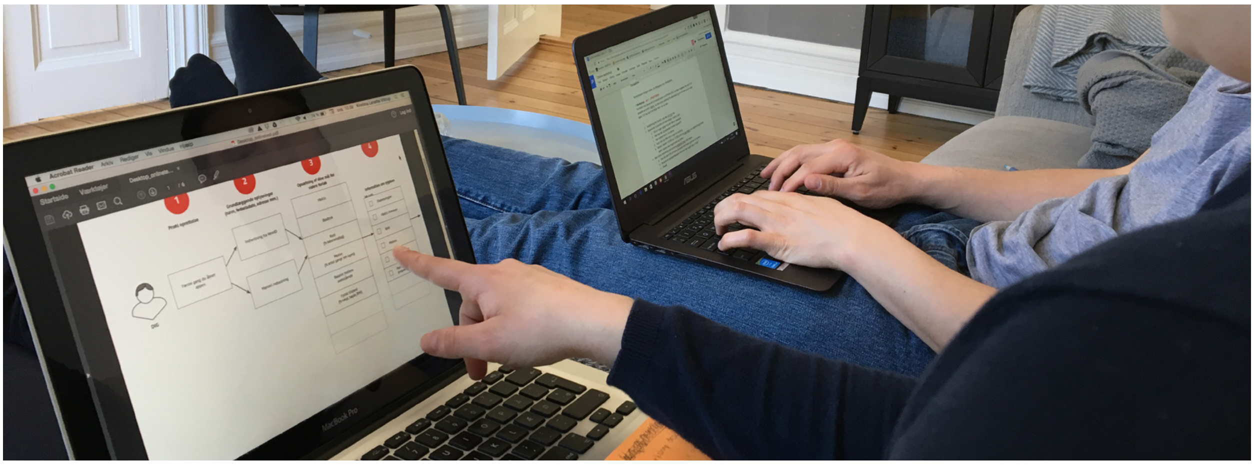
Preparation

As described in the chapter about the data workshop (Workshop about data, p. 72), the recruitment of diabetes people has been difficult. The focus for the test session was to investigate what kind of content the participants would like to gather about themselves and which functionalities a future digital tool should include. The functionalities included in the co-creation session were based on the previous interviews with diabetes people, expert interviews, and from the workshops.

In order to figure out potential users needs and intentions towards the service, a desktop walkthrough were made, that showcased four of the future processes of the application. A desktop walkthrough is a method that can be used to guide the user or customer through a service or a process, while the users imagine what they would do in the process. It is a way to question, confirm or eliminate some of the ideas from the service to examine their real needs and experiences (Bechmann, S., 2010).

The four processes studied in the co-creation sessions were:

- **Configuration**: the purpose was to figure out, how the users' would like to configure their profile in the application and what kind of data the diabetes people would like to track about themselves.
- **Request about sharing data**: the purpose was to



Online co-creation session with Jyte and Ella go deeper into the user's attitude towards sharing personal data with healthcare professionals (HCP), healthcare system (HCS), and researchers.

- **Consultation calendar**: the purpose was to figure out, which functions the calendar should include to fulfill the needs from the user, to create a better overview of the consultations the user has with HCP.
- **Feedback from the application**: the purpose was to figure out what feedback the application should give the user, regarding that the application still provides the user with control of their condition.

During the sessions, the participants were told that they could draw lines and write notes on the paper in order to adjust the system to accomodate their needs.

Execution

The co-creation sessions were divided into two rounds; the first one was online sessions with two relatives living in northern Jutland, the same people participating in the initial interviews. The second round was with a motivation group in Copenhagen. The process of the two rounds were the same. When going through the desktop walkthrough the participants were told a small story before each of the four walkthroughs to set the scene for where they would meet this process and a short introduction to the purpose of the given process. All the sessions were recorded in order for the thesis group to maintain the focus on the test participants.

First session - Jytte and Ella

The two relatives, Jytte and Ella, received the desktop walkthrough on email and was afterwards interviewed through the phone.

While the desktop walkthrough were conducted, the comments from the session were noted down in a text document in order to optimise the process of analysing the findings afterwards.

Jytte was the first one to go through the session. She followed the process step by step and added a few comments to the processes. Ella was more inventive and came up with ideas on the basis of the headlines in the document and the description given. Ella's intuitive response to the headlines emphasise that the headlines gave a good understanding about what the given process was about.

System co-creations session with people from the motivation group

The findings from the first session will be analysed and showcased in the end of this section.

Before the second round of the co-creation sessions a second iteration of the desktop walkthrough was made with some improvements that was found on the basis of the first session.

Second session - Motivation group
The motivation group (that is a part of the Danish Diabetes Association) is placed in Sundhedshuset Nørrebro (Health House Nørrebro), where Helle Lyngø and Jesper Andersen voluntarily runs the group all mondays. Currently the group consist of approximately twelve people in the age of 45-80 years old. The participants are all diagnosed with T2D. Two of the participants spouses are participating as well in order to support their husband or wife. The motivation groups is a place for diabetes people to get support in the process of living with diabetes. It is also a place where they do not have to talk about their disease all the time, because they all have some comparable struggles.

> *"The lovely thing about this [the meetings in the motivation group] is that we do not have to talk about our disease all the time - it is a haven"*
> Dorte, participant in the motivation group (trans.)

The co-creation session turned out a bit different than expected. The time at the motivations group became both a co-creation session with the use of the desktop walkthrough, interviews or talks with the participants, and shadowing of the participants that sometimes turned into a contextual interview. The thesis group managed to talk with more or less all the participants throughout the four hours at the Health House. Seven people were interviewed in depth or went through the desktop walkthrough. Two of the group members went through the desktop walkthrough or tried to go through the walkthrough with the seven participants. Some of the participants were not users of smart devices and were more in need of talking about their life, in these cases the group accomodated the method to their needs.

The last group member walked around documenting the co-creation sessions, talked with the other participants and was shadowing the motivation group both by looking at what they did and by participating in the group's activities. Sometimes the shadowing became a contextual interview about being a part of the group and what the gain of being a part of the group was for them.
Shadowing is a technique to observe and get closer to the users of a service, where you spend longer time with the participant by a hidden observation of the activities, without disturbing the user (Bechmann, S., 2010). In the situation of this shadowing the purpose was to get a deeper understanding and involvement with the participants, which the method also can be use for (Stickdorn, M Schneider, J., 2011). The simultaneous contextual interviews gave a more deep relation to the participants and made it possible to get more into depth with them and their disease and needs. A contextual interview allows for interviewing in the context, the environment. The contextual interview also allows for observation of the user in a natural context (Stickdorn, M Schneider, J., 2011) (Bechmann, S., 2010). The two methods are similar in the way of observing the user in their natural environment. This observation and interview were not used as a investigation of a service, but more a s a way to get more insights into the diabetes people‘s life and to create a stronger relation to them in order to get more knowledge about their life with the disease.

Analysis

To analyse the findings from all the co-creation sessions and interviews, the desktop walkthrough was used. Four desktop walkthroughs were filled out throughout each session. The findings and decisions made through the co-creations was gathered in a shared desktop walkthrough (Figure 29) (Appendix 4) by giving each of the participants a colour to distinguish their choices and comments from each other. The boxes with a coloured background are the additions that were made between the sessions.
After all the choices were marked in a shared desktop walkthrough each of the recordings were heard, and the findings from each person was noted down (Appendix 3). To make an overview of who test participants were, a simple profile for each participant was made including name, age, occupation, technical knowledge, and years with the disease (Appendix 3).

Findings

This section will represent the findings from the co-creation sessions. These findings are categorised into the four processes and a category explaining the general findings. Findings from each indidial session can be found in (Appendix 3).

Configuration

- The opinion about how to feed the user's fundamental informations is equal.
- The participants do not want to track their diet, but wants advices about food and inspiration to cook healthy food.
- The participants want to set goals for HbA1c, blood glucose, blood pressure, exercise, and their physical conditions.
- The participants mostly want information and advices about exercise, diet, and HbA1c levels. As a newly diagnosed diabetes person it was important to get information about how to live with diabetes, how the diabetes person are feeling, and how the balance between exercise, diet and medicine should be structured. As a diabetes person who have had the disease for a longer time it would be interesting to get advices about how the disease should be structured after a lifestyle change, what to do if an injury occur, change of mindset, and guidance about how to tell relatives about the disease.
- The applications used by most of the partici-

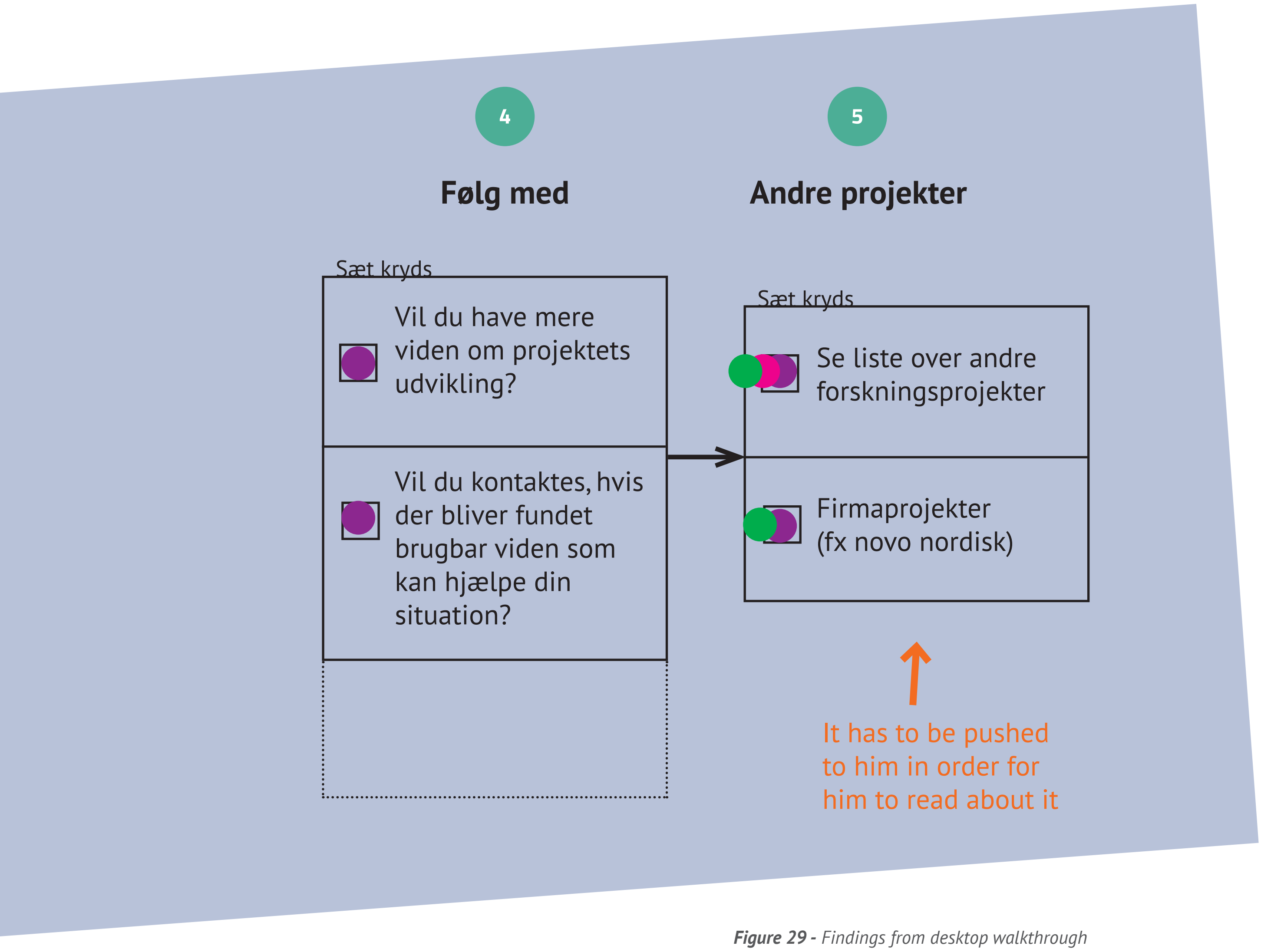
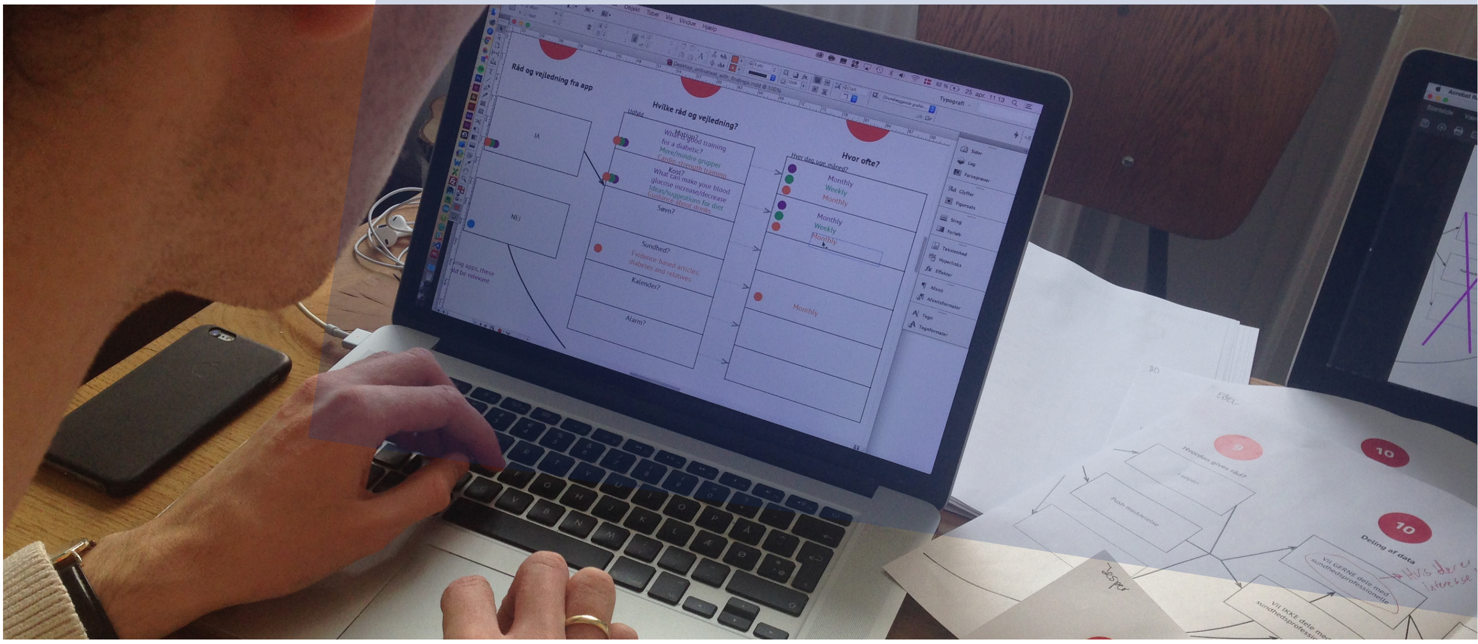


Figure 29 - Findings from desktop walkthrough



Collecting the findings from the co-creation sessions in one desktop walkthrough

pants in regards to the disease is about exercise, diet, and structure (calendar).

- The advices for exercise should be communities and information about what good training is for a diabetes person. The advices for diet could be about what could make the blood glucose increase or decrease and ideas for how to structure a diet. The advices for health should be evidence-based article about diabetes. They would like to have the advices on a monthly or weekly basis. One of the participants thinks that the idea about advices is good, but would rather use the application for taking notes and measure values. This indicates that people are individual, and that the final solution could be used in a wide variety of ways.
- Almost every participant wants to share all their data with their HCP. However, one participant did not want the HCP to watch how she treats her disease, and the choices that she takes in her daily life.

Request about sharing data

- To share data for research purposes, the participants thought it was important to know about the project, what data the project are in need of, the process of the research project, who would benefit from the results, practical information regarding physically present in the project, and a certification about if the scientific work approved.
- Most of the participants would like to share all their data sets, receive a follow-up on the progress of the project, receive the results, and see a list of other interesting projects.

Consultation calendar

- Most of the participants would like to add a consultation, get some kind of overview of the consultations, and get reminders when a consultation are approaching.
- They want to get an overview of a specific period and take notes with questions to the HCP.
- The opinion towards using the application during the consultation at the GP was even.
- Everyone would like to get the measurements, notes, and test results from the GP into the application automatically.

Feedback from the application

- Most of the participants want to get feedback from the system about their exercise and blood glucose either by inputting the number themselves or through an app.
- Most of them would like to have statistics and graphs on their measurements, ideas for courses, and communities.
- No one was interested in being compared with other diabetes people.
- The opinions about how and when the feedback should be shared are very individual based. Some of the participants wants the feedback often while other wants it rare.

Other findings

- An addition to the *feedback function* was, that *knowledge and inspiration* should be able to be deselected (diet, exercise etc.)
- A participant would like to add a function to the calendar, where he could add reminders e.g. blood pressure measurements, so he remember to perform the measurements.
- The application should contain a feature where questions to the HCP could be noted down on an ongoing basis, which could be brought to the consultations.
- Another person would like the option of syncing the calendar with his Google calendar, so he collect all his appointments in his own calendar.

Reflections

The co-creation of the system gave a better understanding of the intentions that the diabetes people had to the system.

Many things from this co-creation can be open to discussion. The use of participants from a motivation group for the co-creation resulted in a group of people that are already motivated to do something about their disease, who therefore could be more possitive towards the concept. The people from the motivation group are mostly people in their middle years, resulting in not all of them being familiar with smart devices. People in a younger age would have another technical knowledge and a more accustomed use of devices and applications. The assumption about most of the diabetes people having access to smart devices and the internet as stated in (Data, p. 40) is not completely right if taking point of departure in these people from the co-creation, which is probably not the majority of the general population. However, the assumption from the discover chapter does not take into account the age of the people using smart decives.

More participants could be involved in the co-creation sessions to form a more reliable basis on the needs to the system. From the answers given until now, the system will both be helpful for newly diagnosed and people who have had the diagnose for a longer period of time. Deselections and additional choices towards the system's functions should be a possibility to accommodate the individual needs of the users.

// DESIGN REQUIREMENTS

This section will, based on the analysis of all previous research set up design requirements for the service prototype (Figure 30).

Research conducted

(Define, p. 66) lists all the workshops and interviews conducted throughout the process before the develop phase was reached. Based on this research and the data from the system co-creation workshop (System co-creation, p. 91), which was conducted in the early stage of development, the following list of design requirements has been made. These requirements are to be used in the future development of the prototype.

REQUIREMENT	BASED ON
Make the application informative	- Diabetes people interviews - System workshop - Data workshop
Give the user control of their data and application	- Interview with Vibeke Zoffmann - Data workshop - sundhed.dk
Allow the users to set their own goals	- System workshop - Interview with Vibeke Zoffmann - Data workshop
Avoid notifications and other invasive elements	- Interview with Vibeke Zoffmann - Data workshop
Customised data for the individual user	- Interview with Vibeke Zoffmann - Data workshop - System co-creation
Regularly updated content	- Data workshop

Ongoing positive feedback about progress	- Data workshop - Interview with diabetes patients
Assist the user with planning all their activities	- System workshop - Status meeting with sundhed.dk
Include following elements: Exercise, diet, blood glucose, blood pressure and health	- System workshop
Allow the users to get/set reminders	- System workshop

Figure 30 - *Design requirements and reasonings*

// PROTOTYPE DEVELOPMENT

The following section will be used to explain the development of the prototype. Furthermore, the section will elaborate on how the prototype was made and explain the choices that was made throughout the process.

Why using a prototype

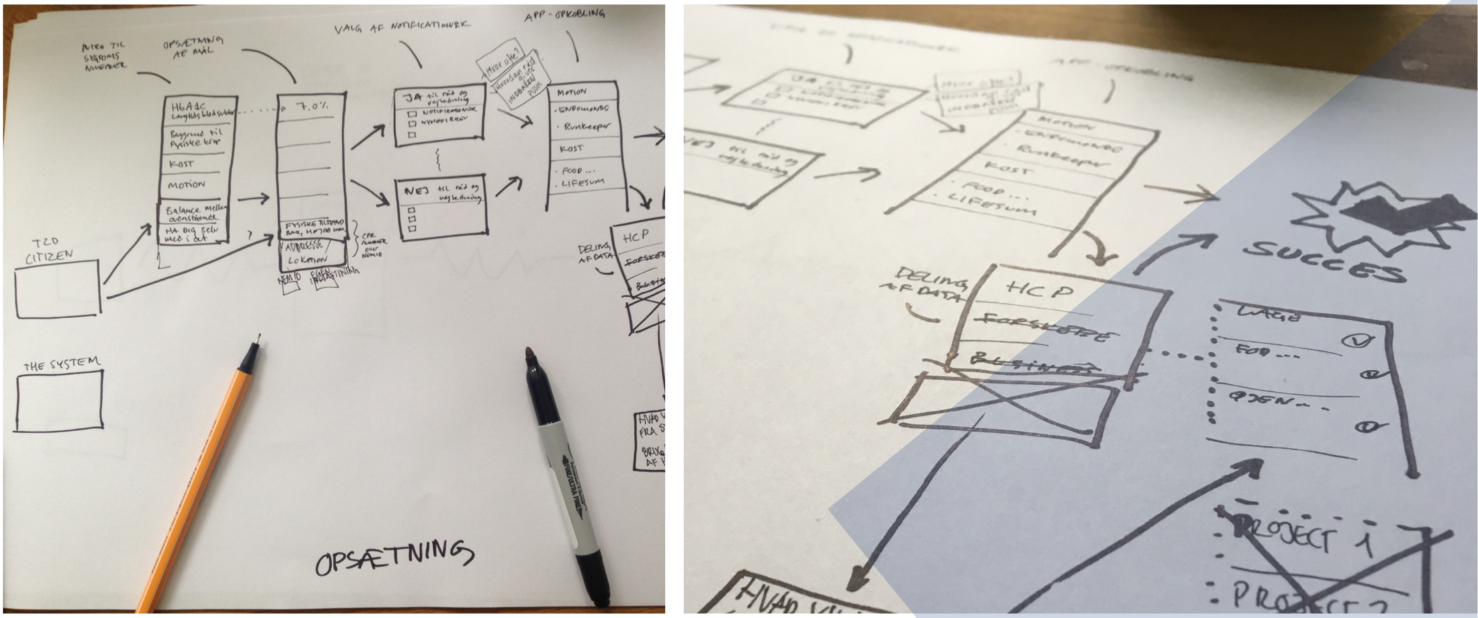
The development of prototypes makes designers able to test an idea on users by simulating an experience. It can make an idea tangible and helps to develop a deeper understanding of the service and how it is going to function (Bechmann, S., 2010) (Stickdorn, M Schneider, J., 2011). The complexity of prototypes can be adjusted to fit the designers request for the specific situation or task that they want to be able to test (Stickdorn, M Schneider, J., 2011).

> *"What I hear, I forget. What I see, I remember. What I do, I understand".*
>
> Lao-tse - Chinese philosopher (Bechmann, S., 2010)

The background

It was important for the group to be sure that the right functionalities were being designed in the prototype. A session in the thesis group was therefore conducted before starting the actual design of the prototype. During this session the findings from the define phase were discussed together with the design constraints and design requirements. It led to the definition of a hand-drawn sketch similar to a simple flowchart. The handdrawn chart acted as a guideline for how the prototype should be designed, and which kind of screens that the prototype should contain.

The process of designing the prototype started out before the system co-creation sessions (System co-creation, p. 91) were conducted. This was done to optimise the process in order to have a final prototype ready for test shortly after the co-creation sessions. When the system co-creation sessions were finalised and analysed, the findings from the sessions were implemented into the prototype.



Sketch of the initial flowchart

About the prototype

Some overall requirements for the prototype were defined in order to specify the development of the prototype. The requirements are all backed up by a reason why the specific requirement is important.

Should be designed as a mobile application

- Reason: The choice of designing for at digital device was due to the fact that the application would be able to incorporate data from the healthcare system. At the same time, a mobile application offers the opportunity of gathering data on the go and keeps the tool one click away. This is very useful when working with simplicity and returning users.

Should be made as a High Fidelity prototype

- Reason: There are various possibilities when deciding on the level of fidelity in a prototype. While sketches and wireframes are useful for ideation and validation purposes, wireframes and prototypes are more useful for testing usability and refining the prototype (Lepore, T., 2010). The fidelity of the prototype can vary from being Low Fidelity - usually sketches on paper, to High Fidelity - typically digital clickable prototypes (usability.gov, 2017). It was therefore decided in the thesis group that the prototype should be designed as a High Fidelity prototype to fit the purpose of the test. Even though the prototypes were going to be High Fidelity, it was important for the group to make the interface as simple as possible to ensure that the test participants would not be distracted by their opinion towards the specific design.

When the requirements were made, the actual design began. It was decided to design the prototype in Adobe Experience Design (Adobe Systems Incorporated, 2017). It was done due to the fact that the program offers a series of effective tools that are useful when prototyping applications. One of these functionalities are a build-in prototyping tool that gives the designer the possibility to connect the different screens inside the program, in order to make it into a clickable prototytpe.

The following elements are based on the decisions about what should be included in the prototype, each of the parts has been connected to the relevant design requirements listed in (Design requirements, p. 97).

The prototype were decided to consist of the following elements:

An introduction section including empowerment

The section includes all the introductory parts of the app. From sign-up to what the application offers to the setup of the user's profile goals.

- Make the application informative
- Give the user control of their data and application
- Allow the users to decide their own goals
- Avoid notifications and other invasive elements
- Customised data for the individual user
- Include following elements: Exercise, diet, blood glucose, blood pressure and health

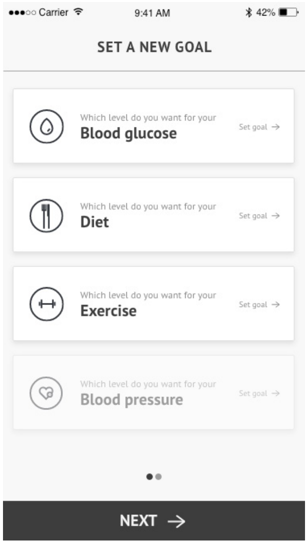


Figure 31 **-** *Prototype screen, setting a goal*

A profile

In this section all the different functions that the application utilises are showed. By designing the profile, the group was able to get feedback from the users by giving them a tangible visualisation.

- Make the application informative
- Avoid notifications and other invasive elements
- Customised data for the individual user
- Regularly updated content
- Ongoing positive feedback about progress
- Include following elements: Exercise, diet, blood glucose, blood pressure and health

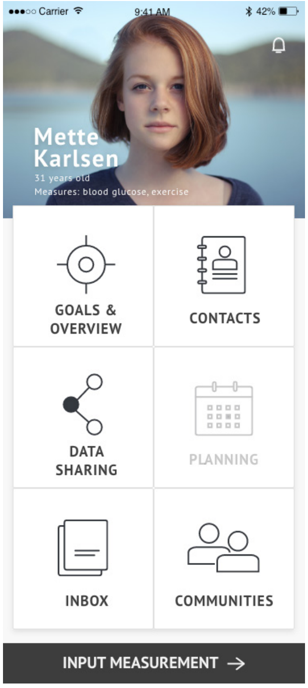
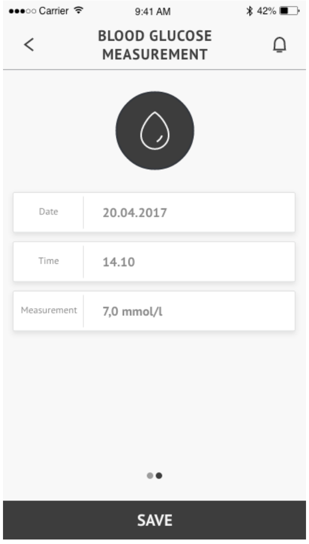


Figure 32 - Prototype screen, profile

A part for inputting of measurements

This section was important for the group to design. The input section is one of the most important sections to have, since it creates the foundation for all the user-centered content in the application.

- Customised data for the individual user
- Include following elements: Exercise, diet, blood glucose, blood pressure and health



Date 20.04.2017

Time 14.10

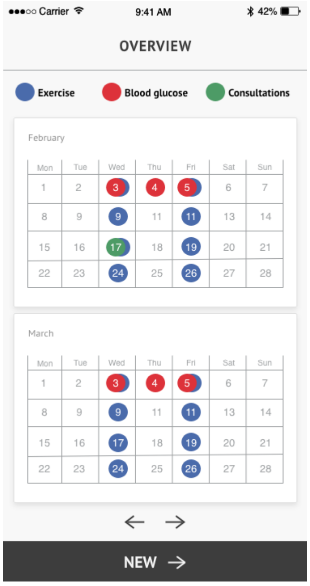
Measurement 7,0 mmol/l

Figure 33 - Prototype screen, input measurement

A calendar

The calendar section was made by a request from several test participants about having a more simple solution for keeping track of all the consultations etc. The calendar were made without a clear idea in order to be able to ideate on the solution even more.

- Customised data for the individual user
- Assist the user with planning all their activities
- Include following elements: Exercise, diet, blood glucose, blood pressure and health
- Allow the users to get/set reminders



February

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	2	3	4	5	6	7
8	9	9	11	11	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

March

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	2	3	4	5	6	7
8	9	9	11	11	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Figure 34 - Prototype screen, calendar

All four parts of the prototypes were designed in order to use them for testing purposes. The prototype can be found in (Appendix 5).

// STATUS MEETING WITH SUNDHED.DK

In order to present and get feedback on the findings so far in the process, a status meeting with the collaborating partner was arranged. The purpose of the meeting were for the group to adjust expectations and share opinions about the process. At the same time, it was planned in order to examine, if the thesis group were on the right track and to pass on knowledge and ownership to the collaborating partner.

Participants: Jakob Uffelmann and Line Langballe
Duration: 1,5 hour
Location: At Sundhed.dk, Dampfærgevej 22, Copenhagen East
Materials: Powerpoint presentation with findings and additional questions

Preparation

For the preparation of the meeting with sundhed.dk, the findings from the discover, define and develop phases were gathered in a powerpoint presentation. The findings should provide an overview of what had happened throughout the process. The elements presented were the purpose, the participants, and the key findings. The initial prototype were also presented to provide a more realistic picture of what the application could look like in the future. Even though the prototype was not finished, it was brought to be a starter for discussion.

Execution

Due to the fact that this was not the first meeting with the collaborators, the meeting was casual. The meeting was voice recorded and a few things were noted down throughout the meeting.
The group went through the presentation while discussing the themes. The findings from the thesis group were during the discussion compared with some of sundhed.dk's findings from earlier projects, which reveiled some of their presumptions and new knowledge. In the end of the presentation, questions about ownership, data and NemID was discussed.

Analysis

To analyse the meeting from Sundhed.dk, the elements discussed throughout the presentation and

Meeting with sundhed.dk

answers from the questions were studied. Most of the discussions were just confirming the findings, and will not be elaborated upon.

Findings

The findings from the meeting are as follows.

Recruitment platform
Sundhed.dk saw a big potential in establishing a platform for recruitment of diabetes people for research projects and scientific work. The functions in the platform could both be a platform for external companies to find specific datasets for research purposes, but also a platform used to gather data regularly. The recruitment platform should be a match system, where the parameters from each project could be matched with the datasets of the specific user. One of the purposes for the healthcare system (HCS) is to gather data regularly to see the effect on e.g. different kinds of medicine. The recruitment platform is not only relevant regarding diabetes, but also for other diseases as well.

Template calendar
An automated template calendar that should provide an overview of appointments was suggested by Jakob. It should feature templates that are adjusted the specific stage of the disease. This could be making a template for newly diagnosed, for the regulated, or on the basis of age etc.

Motivational strategy
They suggested a motivational strategy for the application. The motivational strategy was the burndown chart, that shows the remaining work to be done to achieve a given goal. The chart is mostly considered as a simple way to illustrate the progress of a process, but some users also consider it to have a motivational value. The downfall of the line in the chart gives a physiological incentive to the user (Clarios Technology, 2016).

Ownership
The ownership has been discussed earlier in the interview with Niels Boye (Interview w. Niels Boye, p. 50), but the advantages and disadvantages of the ownership were still doubtful for the group, so the ownership and the provider of the service was discussed with Line and Jakob. The owner of the service needs to be a public authority, because private organisations can not get access to the Danish health data from the HCS. This is because the public authority responsible for the data have to audit the ones who wants to use the data. As soon as the Danish Health Data Authority gives one private organisation access to the data, every private organisation should have the possibility of getting access. The Danish Health Data Authority namely have the responsibility of the data, and if the private organisations does not store and use the data safe enough, the authority is blamed. The authority cannot maintain their responsibilities if the data is shared with private organisations. However, the private organisations can still be subcontractors of a health service, if a public organisation takes the responsibility for the data.

Health data is very heavy and bureaucratic to work with. The responsibility of health data is one of the reasons why health apps does not make any money, because it is difficult to figure out who should pay for it.

In this project, the Danish Regions could set the task and Sundhed.dk could be the one's to solve the task – the providers, since they have the Danish Regions, government and municipalities as their owners. Sundhed.dk will have the opportunity to distribute the system across the different sectors and give everyone the opportunity to use the system.

By placing the ownership of the service in the public sector, it creates heavier working processes than in the private organisations, but it is a necessity. The public sector will drive the infrastructure in this system, but gather the data through other existing apps and systems as a ecosystem. Sundhed.dk are in the process of establishing a collaboration with Apple to get access to Healthkit, which would give access to data from the third party applications relevant for the system.
The measurements of blood pressure and blood glucose should in the future be gathered automatically through HealthKit.

If the public sector makes an app, it will be possible to both gather the personal generated data and health data from the HCS in order to provide an overall overview to each user of their data. This is what sundhed.dk wants to be the providers of.

Reflection

The meeting with Jakob and Line confirmed the results gathered from the different interviews and workshops. The meeting helped answering the more business minded questions to the project, gave them an understanding of the process and gave the group new ideas to the development of the service. Some

of their suggestions will be in the minds and some will be investigated through the next tests.
The burndown chart motivational strategy are important to consider when designing a positive experience for the diabetes person. The recruitment platform is an interesting idea in order to create more funding for the project, but also a way to use the data for more projects than just the ones in the HCS. However, the idea of a larger system will not be elaborated further in this thesis. The template calendar will be incorporated in the prototype test to get responses from the future users of the service. The ownership of the service is still a discussion at sundhed.dk and will be elaborated in the process of creating a service model canvas.

// TEST SESSIONS

To gain a realistic understanding of how the service might change the way diabetes people manage their disease, the previously described prototype was tested on the future users of the service. This section will elaborate on the test session performed, the analysis of the results, and in the end set up a list of requirements, which should be considered for further development of the prototype.

The purpose of the test was to elaborate on the four elements from the prototype and to learn from the users about what works and what does not. Finally a pinocchio exercise was used to elaborate on their feelings towards the service.

Participants: Diabetes people from the motivation group
Duration: Approximately 2 hours per session
Location: Various cafés in Copenhagen, and in their own homes
Method: Usability test, pinocchio method
Materials: Prototype, instructions, questionnaire, pinocchio material

Preparation

To complete the test, the following elements were prepared.

Setting the personal goals: The purpose of this part of the test was to learn if the user understood how to set his personal goals and whether or not enough guidance is offered to the user through the process.

Using the profile: This part of the test elaborate on whether or not the profile contains the appropriate menu points for the user.

Input measurements: The purpose of this part of the test was to investigate whether or not the user would consider using the application to input their measurements and whether or not the user was able to locate the functionality in the current design.

Questionnaire: After completing each of the previous three exercises, the participants answered a small questionnaire. The questionnaire evaluated the overall experience of the exercises.

Planning element co-creation: This part of the exercise was done in a separate prototype, the purpose was to learn how the people with diabetes and if they would use a planning tool/template tool to help them manage their calendar.

Pinocchio exercise: The purpose of this exercise was to have the test participants elaborate upon which value the application creates for the user and what motivates the user to use the application. This exercise was also connected to the question, "*would you use this system if it was available?*".
The pinocchio method (Grey, D., et al., 2010), was made with inspiration from the values and motivations from *(Motivation workshop, p. 59))*.

Execution

In order to conduct the test, the project group met with five different people with type 2 diabetes (T2D), Jesper, Bo, Helle, Dorte, and Ebel, profiles of the participants can be read in (Appendix 3).

The execution of the tests with Jesper and Bo was performed very similar, two members from the group met with them on a cafe where it was possible to perform the test. In both tests one group member were focusing on taking notes, while the other focused on guiding the participant through the different exercises.

The test session with Helle, Dorte and Ebel was performed in Helle's apartment, where the members from the group had been invited to join breakfast with the three women. Before going to the meeting it was decided to only perform the full test on Helle and instead replace the test with an interview in the case of Dorte and Ebel. The decision of Dorte and Ebel not participating in the regular test was made due to the *system co-creation workshop (System* *co-creation, p. 91)* in which they participated. In this workshop Ebel and Dorte showed to have very limited knowledge of technology, therefore an interview was a much more efficient way to gain some useful insights for the future service. Because of this decision, an unstructured interview with these participants was performed, which gave some useful insights which will be described later. To manage this, one of the group members sat down in one room with both Dorte and Ebel, performing an interview while the other member went to the next door room to perform the regular test with Helle.

Analysis

To analyse the data collected from the test session, a matrix has been made in which the explicit suggestions from the participants and the observations from the group members are combined to structure the suggestions for improvements. The matrix only focuses on changes to the application, not on their positive feedback. Only one part of the matrix has been included in this section, the *important column*. The entire matrix can be found in (Appendix 6). The *important column* are shown as *important findings* in (Figure 35) and show suggestions which has been made by more than one participant, or if the group has evaluated a suggestion to have the possibility to strongly improve the service.

The important findings are elements revealed from the test, which needs to be considered when looking at the current service prototype and moving on into a refined prototype.

IMPORTANT FINDINGS

TEST 1: setting goals

- More clear purpose of the section
- Make the recommended values stand out more
- Change the starting value for blood pressure
- Consider if body measurements should be a part of the section
- Set one overall value for the blood glucose in the section
- Visualisation in the diet section, how does an appropriate plate look
- Keep medicine as an overview, not as a goal

TEST 2: profile

- Consider how to make sure the inbox is only used for appropriate information
- Make more filters and types to the communities section e.g. social groups, exercise, age range, exercise intensity etc.
- The knowledge and inspiration menu is important and should be further developed
- Weight and waist measurements should be added to overview
- More details should be added to the data sharing section

TEST 3: input measurements

- Consider a better way to display the option
- Make statistics of the automatic information from sundhed.dk, borger.dk, LAB etc.
- Make weight and waist an option
- Assist the users when doing their blood pressure measurements

TEST 4: calendar function

- Needs to synchronise with own calendar
- Is mostly useful for newly diagnosed with no routines
- Missing details in exercise section e.g. type and location
- Structuring reminders might be useful (weight, medicine)

Figure 35 - *Important findings from tests*

Test sessions

Questionnaire
This section collects the answers to the questionnaire to gain insights into what the participants thought about different parts of the application.

Based on the responses the group got through the supplementing questionnaire, it can be concluded that the overall user experience was above average (Appendix 7). None of the users seemed to be confused by the layout. This being said, some observations point a bit in a different direction. The users seemed to experience some issues with elements such as the position of the *input measurement* button and the text on the screens, which they seemed to skip reading in many cases. Therefore, the findings will include a couple of suggestions to improvements that the thesis group should be aware of when making refinements to the prototype.

Pinocchio
To gain an understanding of the service from the perspective of the user the Pinocchio exercise was used. This allowed the test participant to highlight the value of the service and the primary points that would make them use this service (Grey, D., et al., 2010). This section will present the words/sentences used to describe the service.

What does the application do for you?
The purpose of this exercise was for the user to confirm or reject what the project group assumed as the values that the service could bring to the user. (Figure 36) shows the value the service provides to the users, according to their answers to the exercise. Values chosen by multiple users are shown multiple times. Elements such as support, overview, improvement of results, help for better regulation, and inspiration was some of the things the group hoped would be part of the services values. Safety was one of areas where the group were a bit more sceptical. Because, the service is made to collect data from the users, however this seemed to be a small issue to the participants.

What would make you use the application?
The words represents the features or use of the service that would make the participants use the service (Figure 37). Therefore the primary focus when continuing with the service development should evolve around the suggested points. This means that giving the users inspiration should be prioritised together with the overview, feedback and communities.

Figure 36 *- What does the application do for you*

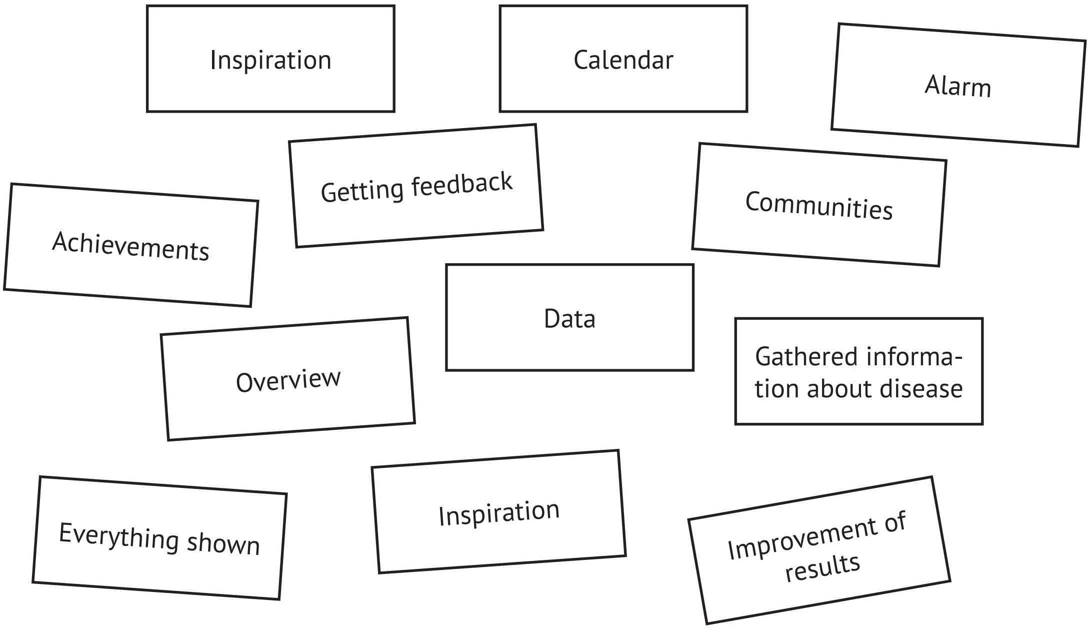


Figure 37 *- What would make you use the application*

Reflections

An important thing to consider according to the prototype test session is that only three actual tests was performed. This makes the samples too few to conclude anything definitive. However, the group members chose the most relevant findings to move along with. Optimally a large sample with a more diverse crowd would have been optimal, this might also have made the group able to conclude something more about the applications usefulness for old versus new diabetes people. The testing has tilted towards parts of the application being mostly a tool for newly diagnosed people. However, since only one participant is actually considered newly diagnosed, it is hard to say if this is actually the case but the participants told that they could have used this kind of tool when they were newly diagnosed. This specific element does however make sense since a newly diagnosed person has no predefined routines for how to manage the disease, thus the application can become part of the routines. A person who already has routines would have to change the way they manage their disease in order to get the full benefit of the application, and if what they are doing works this will be a hard change. This being said there are many grey zones, e.g. a badly regulated patient who decides to that it is now time to do something. In this case the routines of the patient are not working and a change of routines e.g. starting to use this tool could mean a large difference.

The participant in the test were the same as the ones from the system co-creation. It can result in an easier understanding of the prototype. However, new users could have resulted in more objective feedback.

Findings

This section will look at the accumulated findings from the entire test of the prototype and suggest what should be prioritised in the further development of the service. Some of the take outs are shown in (Figure 35), the following will present additional findings from the tests.

User behaviour

- The input measurements button was mistaken for a back option in some cases and seemed to confuse the users. Changing the way this works is definitely a priority. The user suggested idea of making it a menu point might be one way to approach this.
- The information attached to each screen was initially read by the users, however at some point the users seemed to stop reading all the details and navigate the application without it. An example was a user overlooking the suggested values on one of the screens. Based on this the information displayed should be narrowed down and the most important should be highlighted better.
- The general layout seems to be appealing to the users and most parts of the navigation also seems to make sense.

Interview with Dorte and Ebel

- Consider adding a traveling checklist to the application
- Add emergency access to overview of patients medicine

These take outs shows the suggestions for improvements which has been made based on the prototype test session. The following suggestions should, when working towards a future service be prioritised based on the values and the features highlighted by the users in the pinocchio exercise. These include the features: overview, feedback and communities. The values which the service should fulfil for the users are: support, overview, improvement of results, help for better regulation, inspiration, and safety.

Based on this section some refinements has been made to the prototype, the changes will be described in the following section.

// REFINEMENTS OF THE PROTOTYPE

The refinements to the prototype was made in order to be able to showcase how the group would use the findings from the tests to iterate on the prototype.

The focus on the refinements were on four parts of the prototype which are shown below.

The profile screen
- The focus was on making the input of a new measurement and a new goal more intuitive for the user.

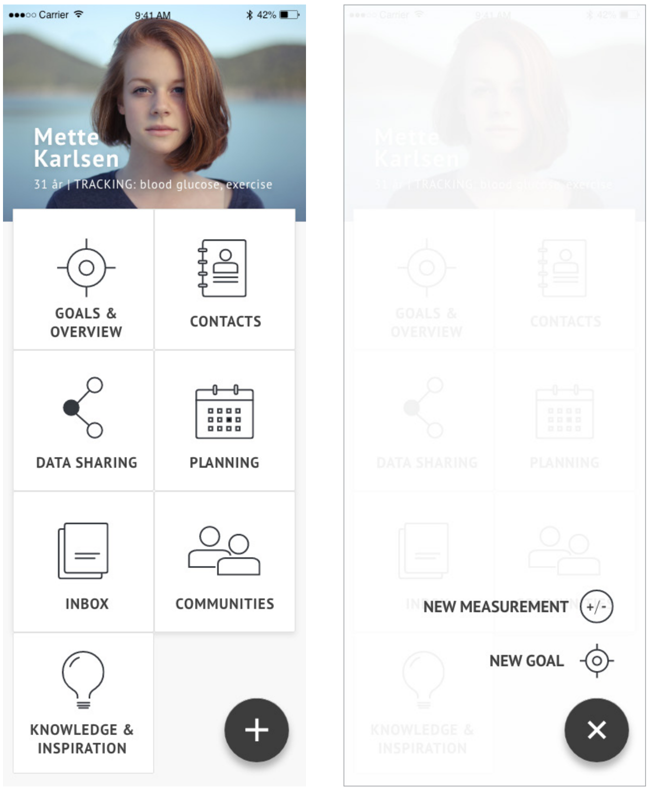
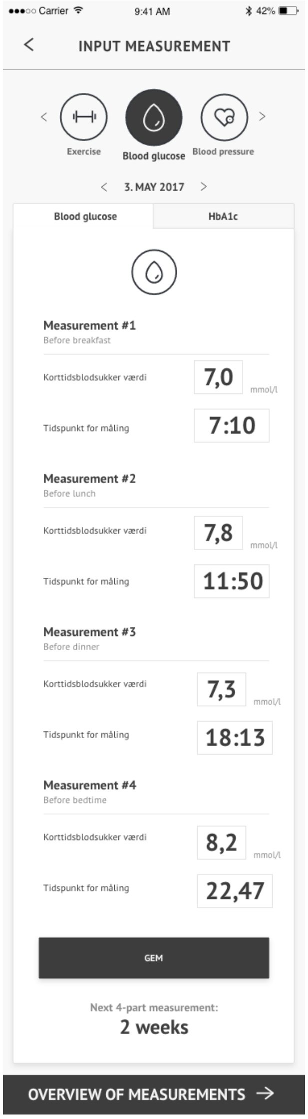


Figure 38 - Refined prototype, profile

Input of measurement
- The focus was to guide the user when performing self-measurements



Measurement #1
Before breakfast
Korttidsblodsukker værdi 7,0 mmol/l
Tidspunkt for måling 7:10

Measurement #2
Before lunch
Korttidsblodsukker værdi 7,8 mmol/l
Tidspunkt for måling 11:50

Measurement #3
Before dinner
Korttidsblodsukker værdi 7,3 mmol/l
Tidspunkt for måling 18:13

Measurement #4
Before bedtime
Korttidsblodsukker værdi 8,2 mmol/l
Tidspunkt for måling 22,47

GEM

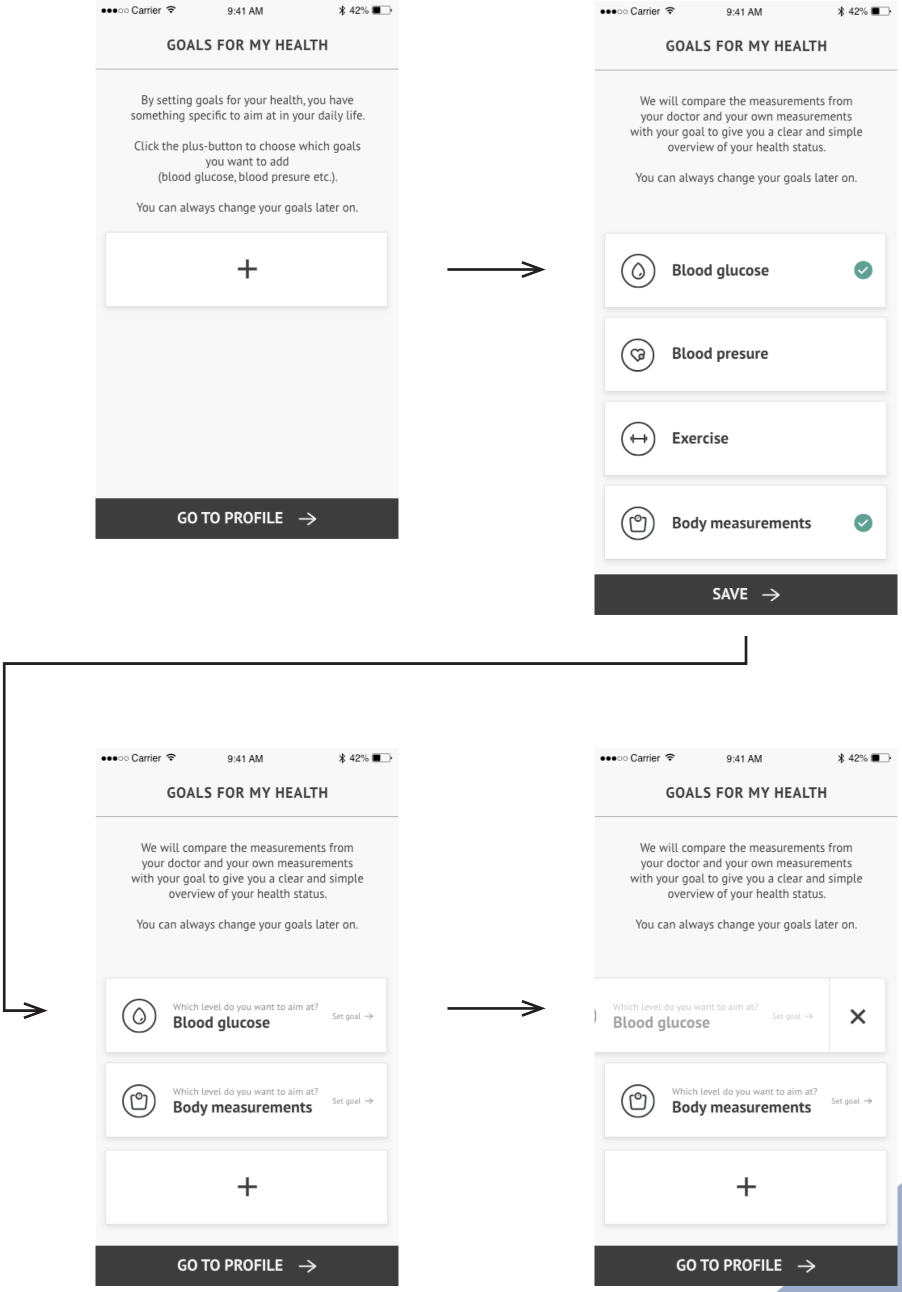
Next 4-part measurement:
2 weeks

OVERVIEW OF MEASUREMENTS →

Figure 39 - Refined prototype, input measurement

Setting goals

- The focus was to make a more clear purpose about setting goals for the user's health. At the same time, it should be more simple for the user to understand that they do not have to set goals for everything, only the elements that they want to measure.



By setting goals for your health, you have something specific to aim at in your daily life.

Click the plus-button to choose which goals you want to add (blood glucose, blood presure etc.).

You can always change your goals later on.

We will compare the measurements from your doctor and your own measurements with your goal to give you a clear and simple overview of your health status.

You can always change your goals later on.

Which level do you want to aim at? Blood glucose

Which level do you want to aim at? Body measurements

Figure 40 **-** *Refined prototype, setting goals*

Diet section

- The focus in the diet section was to guide the users towards healthy living by using a simple overview of how they should compose their plate (DiabetesUdvalg Region Syddanmark, 2014), inspiration, and diet plans.

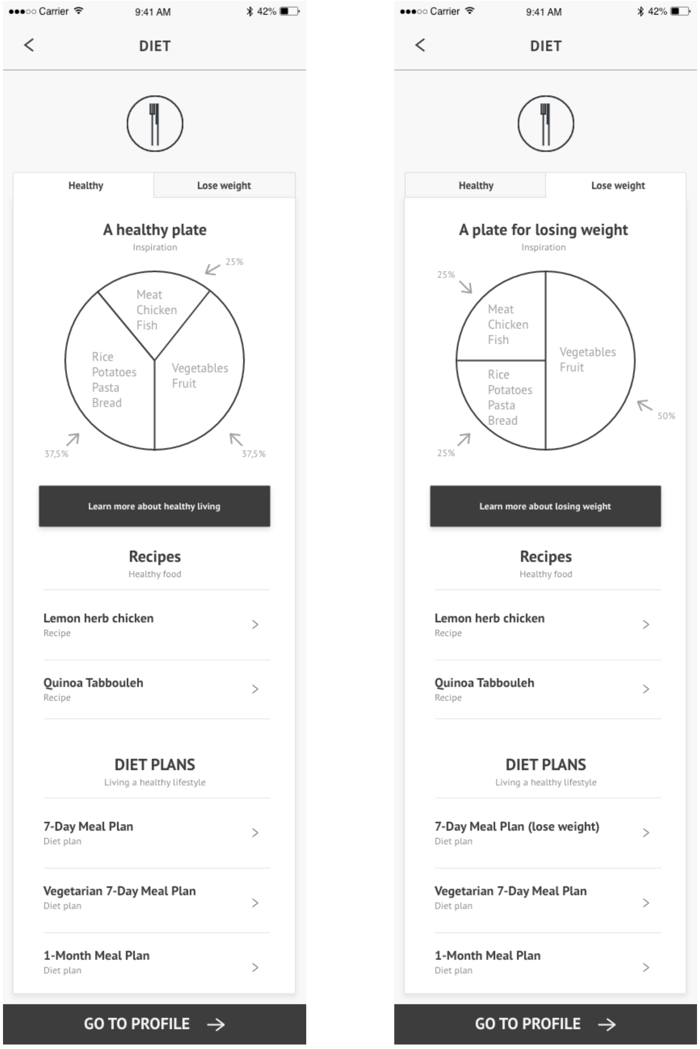


Figure 41 - *Refined prototype, diet*

More refinements and a new complete updated prototype could be made, but it was chosen to only focus on some elements to give an idea about how the test results could be incorporated in the future.

// EXPLAINING THE SERVICE

The following section will present the service system through different models and diagrams, each one will explain the service more in-depth.
The service will through this section be more elaborated and decisions will be made towards a more defined service solution. The models and diagrams will help elaborate upon the service and explain in a more specific way what happens in the front and back stage of the service and how a future business model could look like.

// STAKEHOLDER MAP

To give an overview of the actors and stakeholders included in the service, and how these are linked to the user and each other, a stakeholder map centred around the user has been made (Figure 42).

The map groups the actors and stakeholders based on their primary role according to the user (the blue circles). All stakeholders included in the map are considered important for the service to function as proposed and to fulfill the users' needs. The icons on the lines connecting the different actors and stakeholders in the map defines the data, support, or participation.

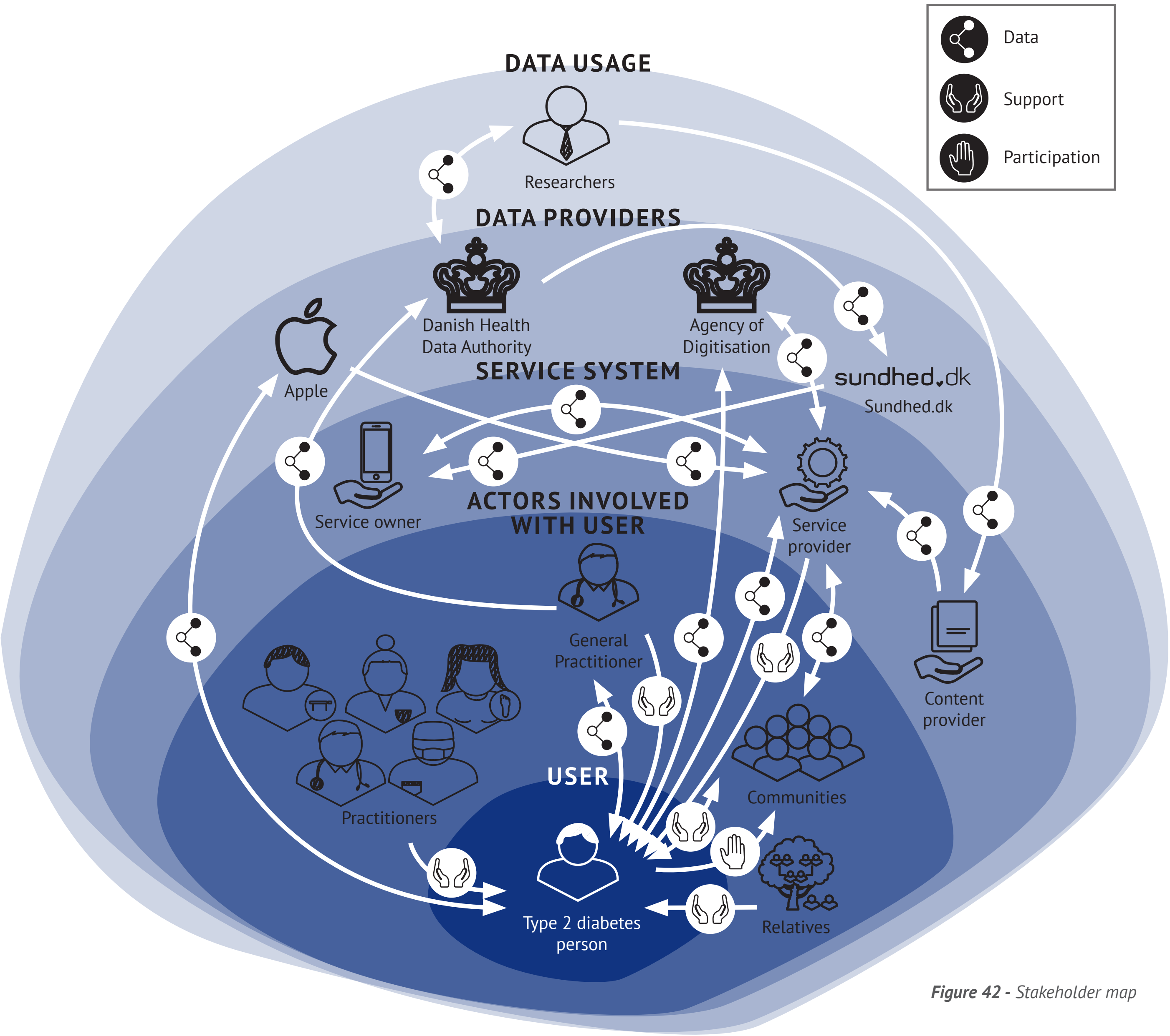


Figure 42 - Stakeholder map

// FLOW CHART

A flowchart is a diagram used to communicate a process or a system. It provides a quick, simple, and systemic overview for the reader to understand how a process or system functions (Lakin, R. et. al., 1996). A flowchart is build up as a timeline of boxes connected by arrows. The different shapes indicates the actions that are performed in the given step. (Figure 43) explains the different boxes used in the flowcharts.

About the flowcharts

Nine different flowcharts were made to represent the system. They were made separately to simplify the system for the reader.

- Flowchart 1: Overall (sign-up)
- Flowchart 2: Profile
- Flowchart 3: Knowledge & Inspiration
- Flowchart 4: Planning
- Flowchart 5: Community
- Flowchart 6: Data sharing
- Flowchart 7: Inbox
- Flowchart 8: Contacts
- Flowchart 9: Goals & Overview

Flowchart 3-7 represent functionalities from the profile. When a flowchart is connected to another, it is showed by a text explaining in which flowchart the flow will continue.

Flowchart 1 can be seen in (Figure 44), the rest of the flowcharts can be found in (Appendix 8).

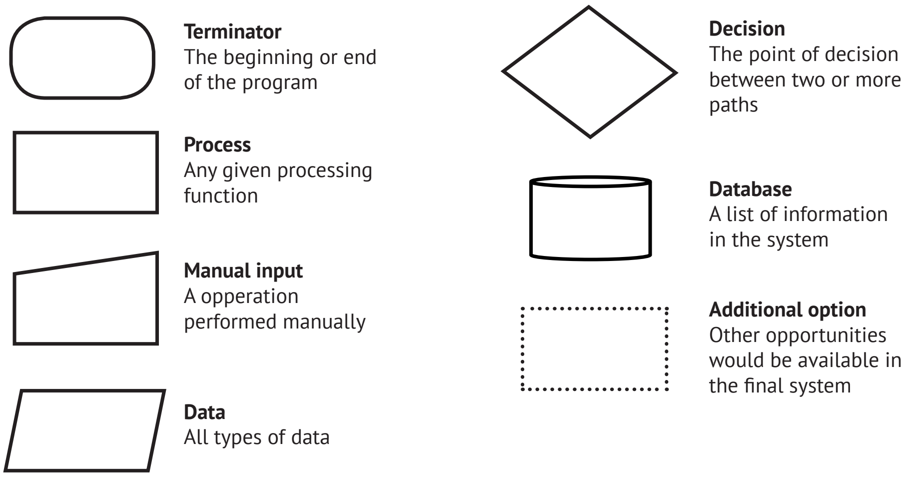


Figure 43 *- Flow chart symbols*
Based on the ANSI standard flowchart symbols (Chapin, N., 1970)

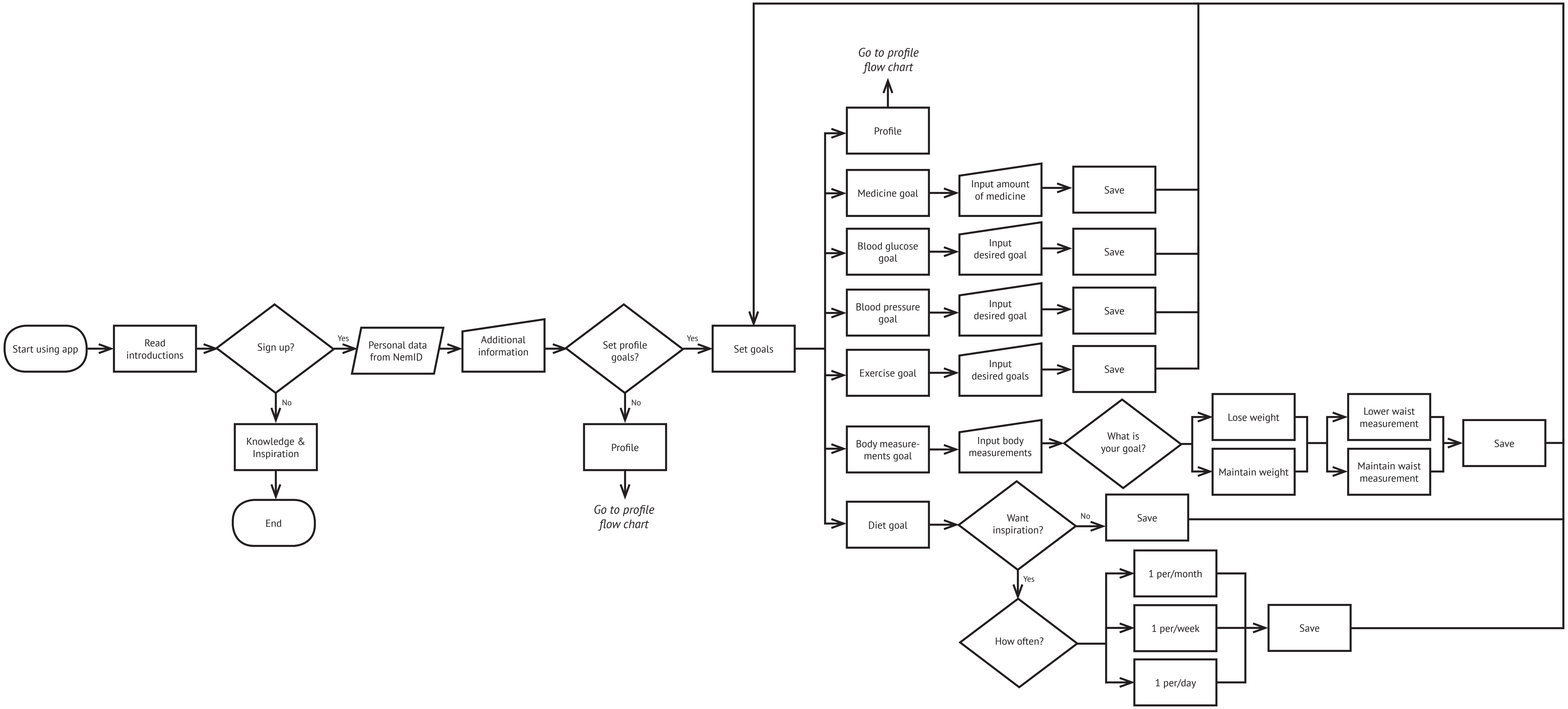


Figure 44 *- Flow chart #1, overall (sign-up)*

// DATA USAGE

The intention with this section is to describe the implementation of data in the service system. The following models will show the data inputs and outputs needed in the service and who the owner, provider and receiver of the data sources are.
The data inputs to the service are described in three overall headlines in (Figure 45), the *owner* and *provider* of the data and the kind of *data* provided to the system.

Elaboration on inputs

The manual entry of data made by the user can hopefully be replaced by new technologies in the future, that automatically can import the data to the application. At the moment multiple blood glucose instruments can import the measuremts via USB.

The data from the Danish Health Data Authority is provided by sundhed.dk and can be accessed through the individual citizen's NemID that is pro-

OWNER	PROVIDER	DATA
Citizen	User	Manual entry of measurements, data to Healthkit, gives access to NemID data
Danish Health Data Authority	sundhed.dk	E-journals (patient records), Laboratory answers (lab data), Medicinkortet (medical charts) and health offers in municipality
	A-DATA A/S	Aftalebogen.dk and Emailkonsultation.dk, Lægesystemet WinPLC
Agency for Digitisation	Nets DanID A/S	Nem ID user log-in to gather data about citizen
Apple Inc.	Apple	Healthkit
Research institutes	Relevant authors	Evidence-based sources about diet and exercise towards diabetes and sources about progress in scientific work about diabetes.
Municipalities and private companies	Different sources with activities in municipalities, sports clubs and public events	Community activities

Figure 45 *- Data input*

vided by Nets DanID A/S and owned by the Agency of Digitisation.

A-DATA A/S is the provider of the software to gather the appointments with the general practitioner (GP), to get in contact with the healthcare professionals (HCP) and to get the answers from the GP. A big wish from the people with type 2 diabetes (T2D) was to get the measurements from their GP, and that data should be gathered from Lægesystemet WinPLC (A-DATA, n.d.). The other two systems makes it possible to use the existing systems to make appointments and to get in contact with the GP.

To gather data about the users' diet and exercise, Apple Healthkit would be used. In order for the system to access that data, the user needs to give permission to import data from Healthkit.

The diabetes people were also in need of a place to get some more knowledge and inspiration about diet, exercise and evidence-based sources about the progress in diabetes. The idea is that the relevant authors authorised by the provider of the service should write articles and give advices to diet and exercise on the basis of scientific work in the category of *knowledge and inspiration*.

Since many diabetes people were interested in communities, the system should gather different events and activities that could be offered.

Elaboration on outputs

The service should give the users a place to gather all their data from the many involved actors combining it with their own measurements. The service should also make data visualisations to give them an overview of their goals and measurements, using this to advise and guide them in their decision-making.

The healthcare system (HCS) and researchers will get the datasets from the users of the system, if the users agree on sharing their data.

Apple Inc. is sharing data with the system through Healthkit and will get the same data as they gather already through Healthkit.

Open or big data

The open data used in this service is the *knowledge and inspiration*, which is available for everyone without signing up with NemID. Furthermore, the *knowledge and inspiration* database should be openly available and redistributable for people and institutions who are interested in using the data generated. This makes the knowledge database meet the criterias of open data (Data, p. 40). It can help reach one of the goals of this service, which is to improve the conditions for people with T2D. The rest of the data collected through the service is considered as sensitive personal data, because access to the datasets will only be allowed through permissions by the users and provider. However, the data can only truly be considered big data when the data collected reaches a certain volume and velocity (Data, p. 40).

RECEIVER	DATA
User	Data visualisations, advices and guidance on the basis of measurements and goals
Healthcare system	Datasets generated by the people with T2D
Healthcare professionals	Quantifiable self data
Researchers	Datasets generated by the people with T2D
Apple Inc.	The data that are gathered by Healthkit
Everyone	Inspirational articles and information

Figure 46 *- Data output*

// DISTRIBUTED SYSTEM

The system can be defined as a distributed system, on the basis of the definition by Coulouris, G., et al. (2012) as:

> *"...one in which hardware or software components located at networked computers communicate and coordinate their actions only by passing messages.".*
>
> (Coulouris, G., et al., 2012)

The characteristics of a distributed system can be defined by the concurrency of components, no global clock, and independent failures of components. These makes it among others possible for multiple users to use a given system at the same time, to share data in the system and leave the system running, if one component fails (ibid).

The purpose of a distributed system for this service system is the desire to share different data between the involved stakeholders in the service and to create a gathering point for the users' health data. The distributed system makes use of the smartphone as hardware to contain the software, the different applications and to gather the data to the system (Coulouris et al., 2012). Gathering data through software, enables the users to use the system whenever and wherever. At the same time it makes it possible for the user to get data that can be used to improve their condition and for research purposes (ibid). By using a distributed system the medical direction towards algorithm-based treatment and precision medicine becomes reachable (Elaboration on findings, p. 55).

The data accessed by the user is converted into understandable interfaces to give the user a meaningful interaction with the system. The data in the backend is stored and managed in encrypted databases and servers by the Danish Health Data Authority, which meets the privacy demands for sensitive personal data.

Cloud computing

When working around a distributed system, the use of cloud computing is relevant. Coulouris et al. (2012) defines clouds as

> *"...a set of Internet-based application, storage and computing services sufficient to support most users' needs, thus enabling them to largely or totally dispense with local data storage and application software."*
>
> (Coulouris et al., 2012)

The clouds are the ones storing all the data in different ways in the components of the databases and servers. A cloud stores the data in different ways regarding the sharing of the data; in public, private, community or hybrid clouds. All of the before mentioned cloud types are influenced by reliability, scalability, security and cost (Jamsa, K. A., 2013). A private cloud is owned and used by a specific entity, a public cloud is available for the general public and the community cloud is shared between more organisations, while the hybrid cloud is a combination of two or three of the cloud models (ibid).

This service system should be accessible for the users therefore the use of cloud computing has been adopted. When gathering the different inputs in the service the data is gathered and stored from private clouds from Healthkit, health data and personal data from the Danish Health Data Authority and Agency of Digitisation as well as the measurements the user is entering. The *community activities* and the *knowledge and inspiration* to the users are gathering from and stored in public clouds, since it is available for the general public. Therefore, this system is using a hybrid cloud to be able to store the different kinds of data accessing the service.

To explain how the clouds interact with the user there is taken point of departure in three kinds of cloud service models – SaaS (software as a service), PaaS (platform as a service) and IaaS (infrastructure as a service). This service is a SaaS, because it provides the user with a software to access and store data. The service does not provide the user with hardware technology or makes the user manage his own operating system as the two other service models requires (ibid).

The service is therefore a distributed system providing a SaaS with a hybrid cloud with user access to the assigned data for the different users in frontstage and backstage.

// SYSTEM ARCHITECTURE

A system architecture map has been developed to show the distributed system using cloud computing and how the data is shared through the system.
The method for describing system platforms, will be used to build the system architecture map. Morelli, N. and Tollestrup, C. (2006) describes what the system platform does as:

> *"A platform for a systemic solution should put together different actors (service providers, manufacturers, institutional actors and final users) and describe each actor's competences, as well as the interactions (material and immaterial flows) which generate specific system architectures."*
> (Morelli, N., Tollestrup, C., 2006)

The purpose of this system architecture map is to give an overview and a visual representation of the more technical aspects of the service, by showing what is happening in the frontstage and backstage in correlation to where the data is coming from.
The map shows how the different actors are connected and what they are providing each other and the service system as well as visualising where the data is stored.

The service provider and owner is not defined, but since sundhed.dk is the provider of the project to the thesis group and have a big interest in providing the service, they could be a good suggestion. Sundhed.dk and Niels Boye both suggested the Danish Regions to be the owners of the service to easy expand the service to all regions and municipalities.
The service owner is the responsible for the whole service system, and especially for maintaining the responsibility of the security of data. The service provider is maintaining the service by supporting the user and updating the content.

The service platform is part of the front stage of the service and available for the general public through the public cloud. The already existing and newly generated personal- and health data is stored in the database in the server in a private cloud. These two represent the hybrid cloud.

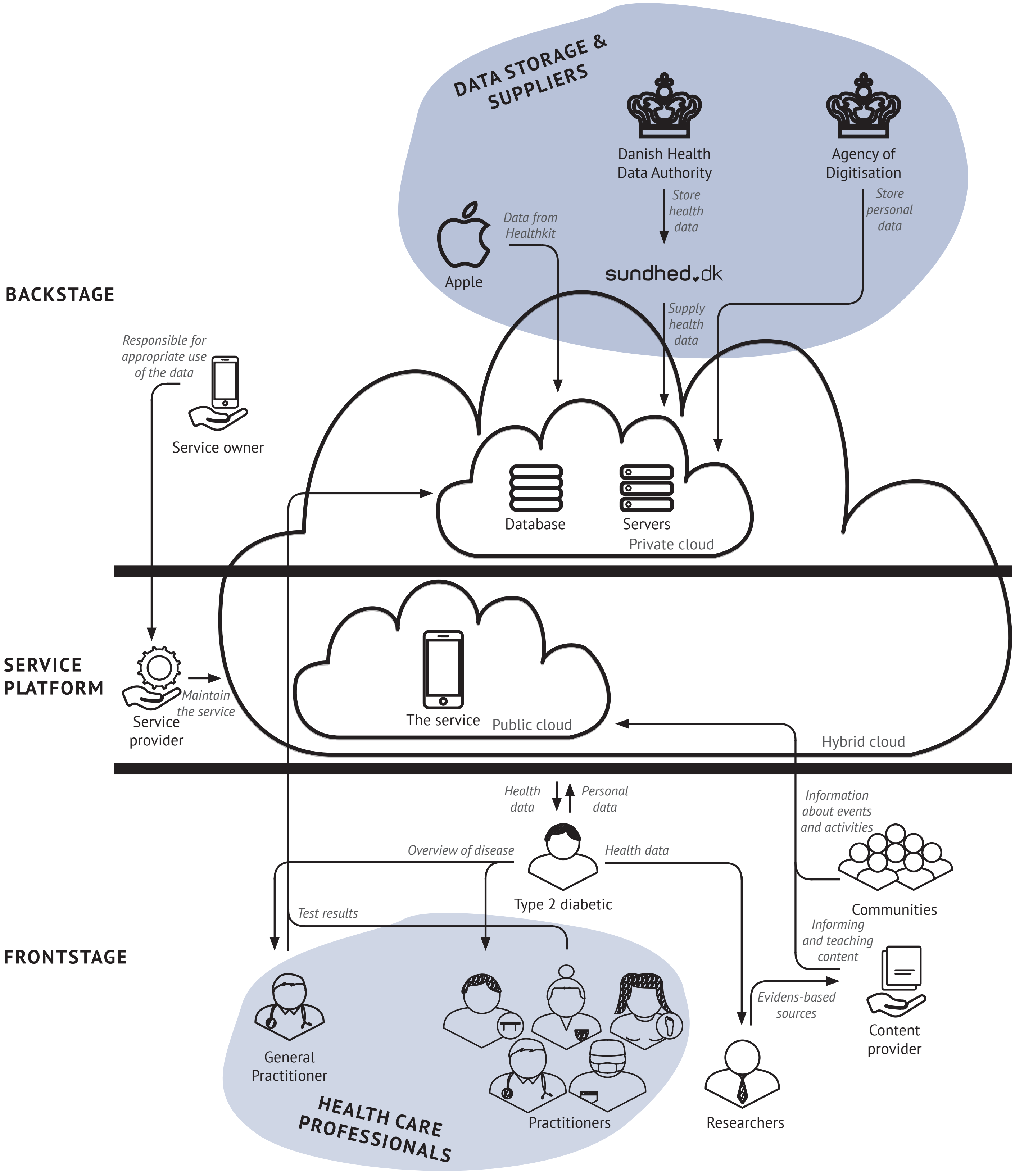


Figure 47 - *System architecture*

// DATABASE DIAGRAM

The purpose of a database diagram (database schema) is to show the structure of how a database is organised. There are two types of schemas, a physical and a logical. The logical, which is the one provided here is made to give an overview of the database whereas the physical is the actual implementation of the database (Chapple, M., 2017). The following section will present part of a database diagram representing a potential database setup for the described service. The symbols and structure of the diagram follows the *Crow's foot notation* (Dybka, P., 2016).

This section will describe the different elements of the database diagram.

Types

(Figure 48) shows the types used in the database diagram and their meaning.

Entity

An entity is a representation of a class in the system. (Figure 49) is showing a entity representing the blood pressure of a user. The items inside the entity is the attributes connected to blood_pressure in the system, each value has a specific type e.g. systolic has the type int (integer) the type defines which value the attribute represents, see the following list of used types (Dybka, P., 2016).

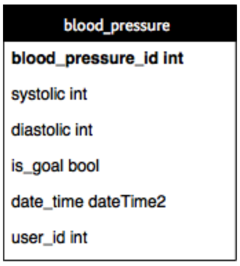


Figure 49 - *Database entity*

TYPE	DESCRIPTION
int	Represents a whole number
float	Represents a fractional number
bool	Represents the value of true or false
string	Represents a sequence of characters
datetime2	Represents a date and a time, based on the 24h clock

Figure 48 - *Datatypes*
(Microsoft, 2017)

Relationship

(Figure 50) describes the relationship notations used in the database diagram. Relationships express the association between the two entities (Dybka, P., 2016).

ICON	DESCRIPTION
	from 0 to one
	from 0 to many
	from one and only one
	from one to many

Figure 50 - Relationships

Relationship examples

(Figure 51) shows a many to many relationship created in the database, in databases an intermediary link is needed to establish such a connection, in this case it is activity_user (Techopedia, no date). A many to many relationship is created when the two entities needs to share elements in between each other (Techopedia, n.d.). In the case below the relationship is created because an *activity* can have many *users* and a *user* can also have many *activities*. To achieve this the two are connected through the intermediary link *activity_user.*
This sets up a relationship as follows: *activity* can have zero or many *activity_user* and *user* can have zero or many *activity_user*. However, each instance of *activity_user* can only have one *user* and one *activity*.

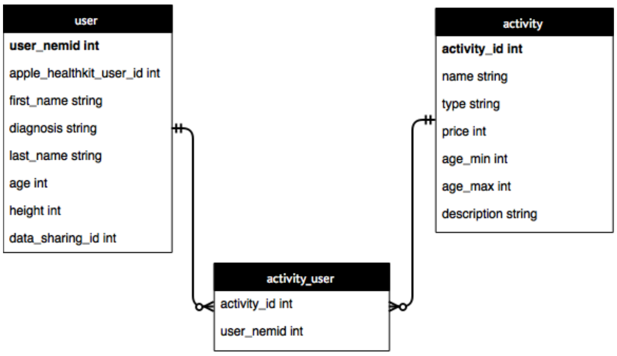


Figure 51 - Many to many relationship

Database diagram

The database diagram in (Figure 52), only covers some of the more important parts of the service system, aiming to show how a database structure of such a service could look. It includes setting goals, adding values, setting data sharing settings, and assigning users to community activities. It also displays that values could but not necessarily should be imported from Apple Healthkit. Additionally it shows some information that could be acquired through sundhed.dk.

Note about the diagram:
Some of the attributes in the entities have been marked with yellow. This displays what exactly these entities will contain is still unknown. Furthermore, the entities that has fields marked in yellow are still very theoretical and modifications to the relationships might also become relevant.

The database structure should allow for a part of the implementation of the current iteration of the system. However, since the service is still missing further iterations which might affect how a potential database should be designed, completing a full database diagram would not make sense. The elements implemented in this database, are some of the elements which are thought to be close to their final form thus this part of the database diagram should not change too significantly.

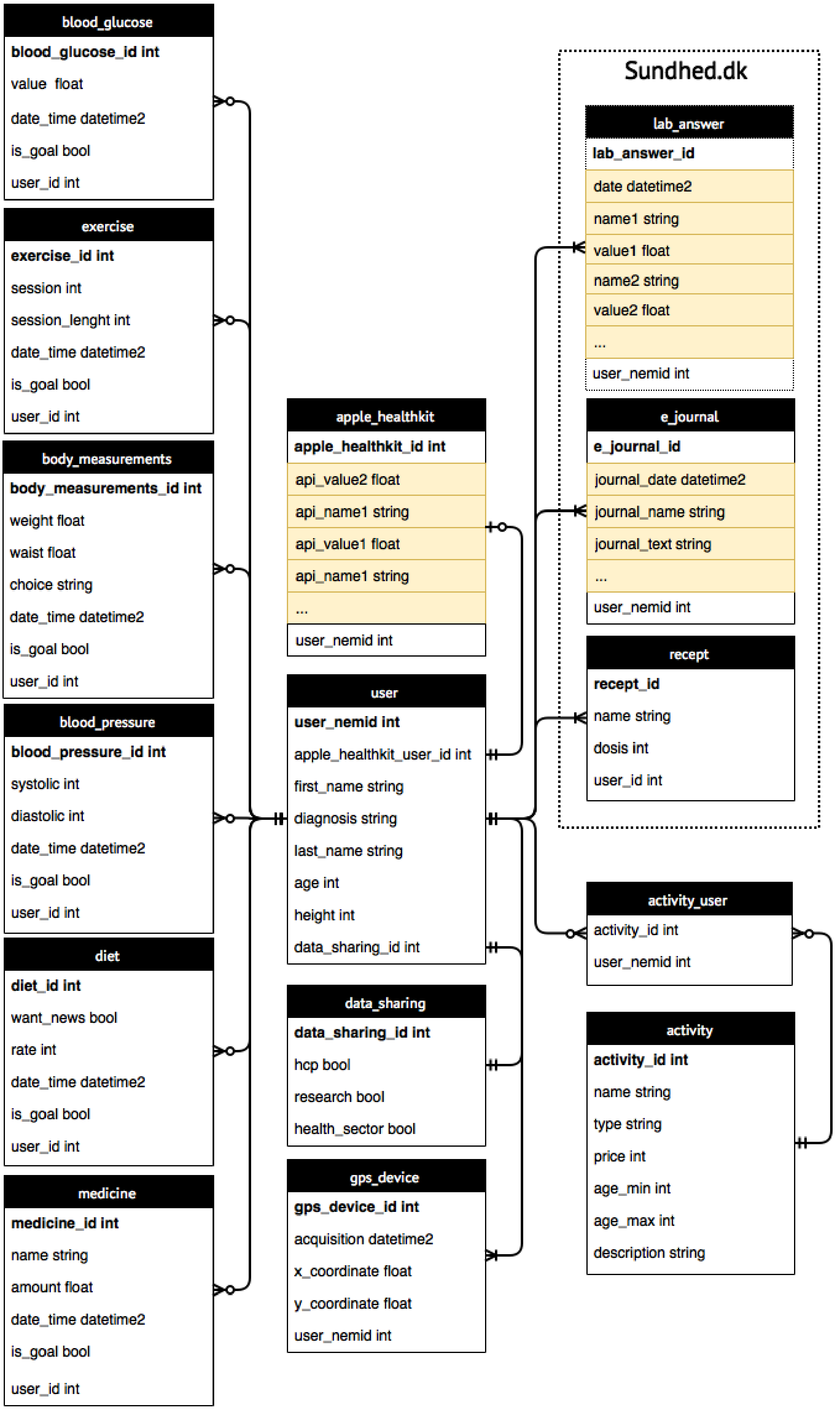


Figure 52 - Database diagram

// SERVICE MODEL CANVAS

This section will describe a service model canvas (Turner, N., 2015) used to elaborate and document the model of the service created.

The service model canvas is developed based on the business model canvas. The purpose of the canvas is to help develop and document service models (ibid). The way this is done, is by asking questions about the users and usage of the service. The canvas is not supposed to capture all details of the service, its strengths is more in its ability to frame a discussion around the service (ibid), and this is how it has been used in this case.

The service model canvas

One important thing to remember when looking at the service model canvas is that it is not considering the service in its current state. The canvas is considering a future scenario where the service concept would be finished and ready for implementation. Therefore, elements which has not previously been elaborated upon might appear.

The service model canvas (Figure 53) are meant as, and has been used as a tool for discussion. which means that some sections might not be entirely elaborated. Another area in which the service canvas showed its strengths was in collecting and further considering many of the things previously researched and written throughout the report. Through the creation and discussion of the canvas the group also learned things not previously considered about the service. This includes a chance of considering the service as a business looking into KPIs (key performance index) and ROIs (return on investment). But also a chance of discussing potential competition and the key activities needed to actually provide such a service.

USERS

Users

Primary target group:

- Type 2 diabetes people familiar with digital devices
- Especially newly diagnosed

Other potential users:

- Citizens with other chronic diseases
- Citizens with technical knowhow, interested in collecting private data and sharing data for research

Service proposition

Personal empowerment

- Overview
- Guidance
- Inspiration
- Ownership of own data
- Gathering point for all data

External

- Communication with relatives
- Help improving research conditions

Channels

- Mobile application (IOS, Android)
- Website

Usage

Regular usage (daily)

- Inputting measurements

Less frequent usage (A couple of times a week)

- Checking progress
- Accessing knowledge database

Rare usage

- Joining communities

Lifecycle

- Long user lifecycle, frequent usage equals a more meaningful system

SERVICE DELIVERY

Actors

- Sundhed.dk (Owner, providing a trustworthy name)
- Specialists e.g. dietician, doctors (Validating content)
- Journalists (Content creation)
- Community providers (adding activities)
- Development team (building and maintaining the service)
- Support team (assisting users)

Key activities

- Generating meaningful content (knowledge database)
- Providing guidance (preference based suggestions)
- Update website and app
- Promote the product
- Resolve support issues

RISKS

Challenges

- Providing users with supportive but not interventive feedback
- Creating a habit for users to use the service
- Gathering enough data for it to be relevant and to earn revenue
- Convincing communities to join into the idea
- Convince users that continuously gathering data can support their disease management

Competitors

- Google Fit
- Systems allowing for indvidual tracking (Kulhydrat, Endomondo)
- Dia+ (Diabetes foreningen)
- Bluestar

PERFORMANCE

ROI

Economic

- Income from healthcare sector (using data for research)
- Funding from research institutions (using data for projects)
- Infrastructure costs (servers etc.)
- Support, development, and content creation costs

Empowerment

- Users reducing medicine usage
- Increase in user well being
- Precise and effective care

KPI

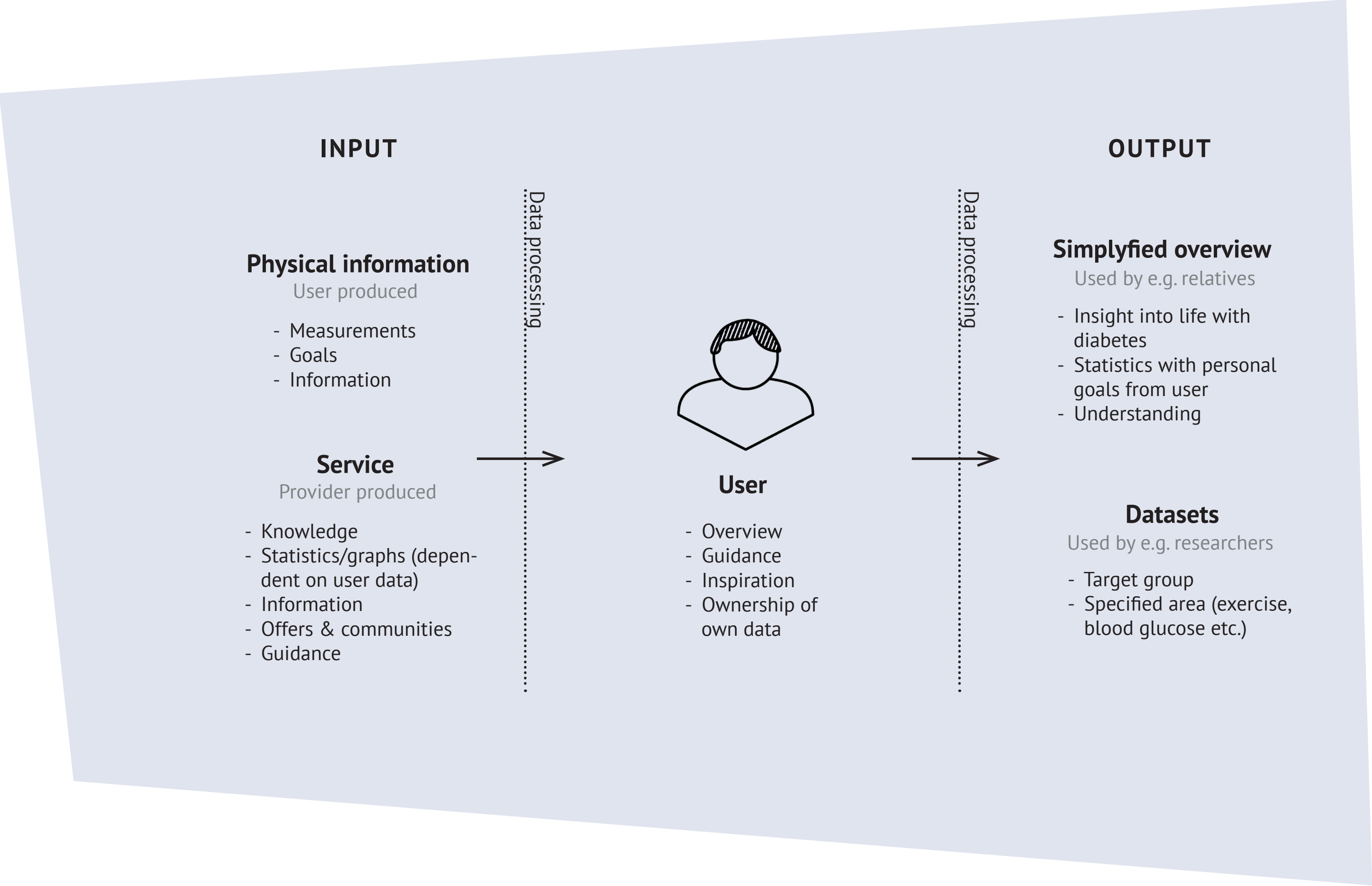
- Number of active users based on frequency
- % of users actively contributing to data sets
- Increase in user wellbeing
- User satisfaction

Figure 53 - *Service model canvas*

// VALUE PROPOSITION

The following section will present a value proposition aimed on showing the value of the service created (Figure 54). According to Strategizer who has developed the *value proposition canvas*, the purpose of a value proposition is to help locate the users most pressing jobs, pains, and gains (Osterwalder, A., et al., 2014). The initial research e.g. interview, workshops etc. have been used to localise which pains, gains and values the users experience in the current system, (The current system, p. 70). Furthermore, the prototype and pinocchio exercise (Test sessions, p. 105) have been used to analyse the pains, gains and values of the service. Because of this previous research using the *value proposition canvas* was considered irrelevant, and instead the following figure was created.

The purpose of the figure is to display the value proposition related to the user and other connected actors based on the input and output of the service.



INPUT

Physical information
User produced

- Measurements
- Goals
- Information

Service
Provider produced

- Knowledge
- Statistics/graphs (dependent on user data)
- Information
- Offers & communities
- Guidance

User

- Overview
- Guidance
- Inspiration
- Ownership of own data

OUTPUT

Simplyfied overview
Used by e.g. relatives

- Insight into life with diabetes
- Statistics with personal goals from user
- Understanding

Datasets
Used by e.g. researchers

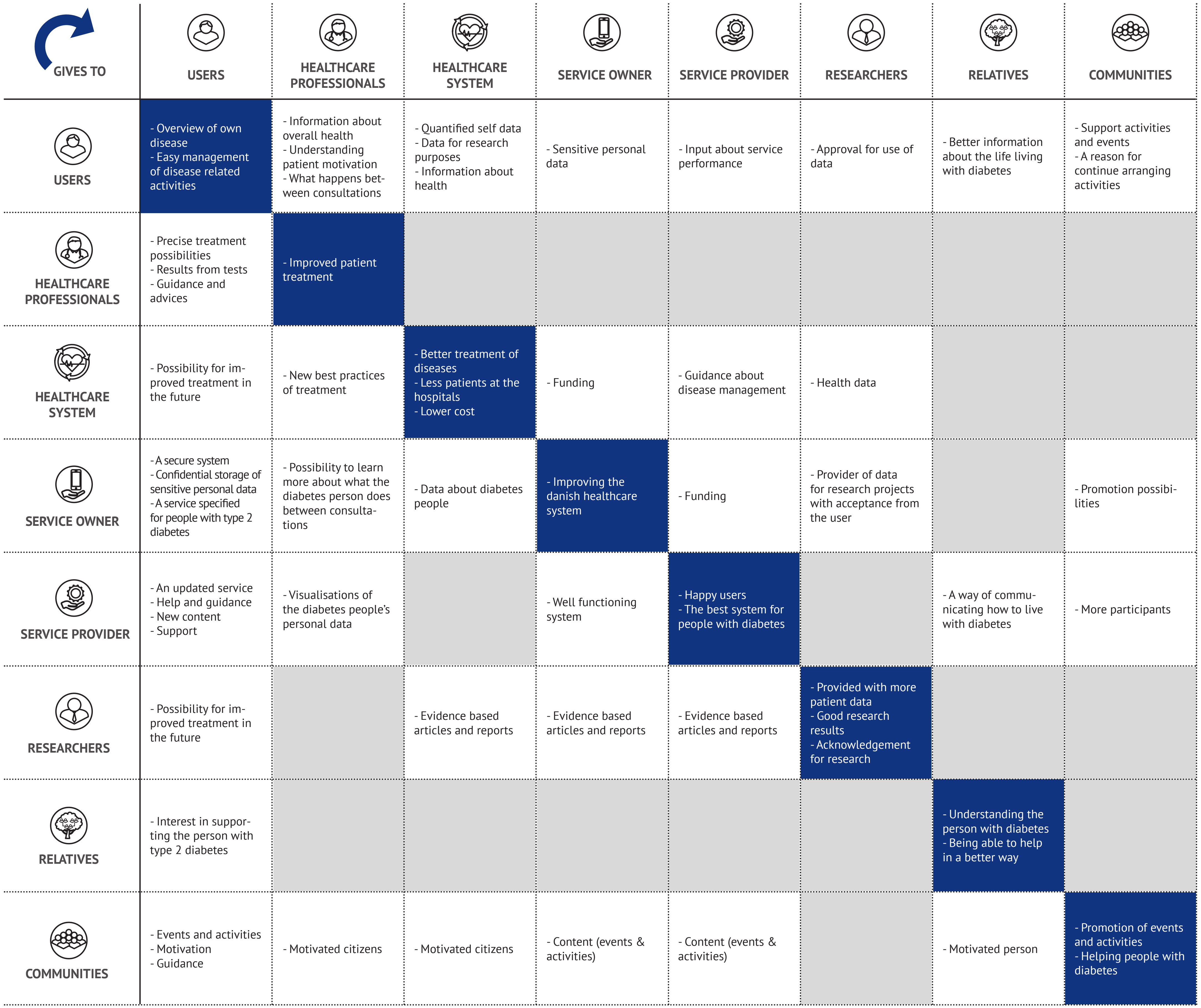
- Target group
- Specified area (exercise, blood glucose etc.)

Figure 54 *- Value proposition*

// MOTIVATION MATRIX

A wide variety of actors are a part of the service, which often results in different expectations and agendas. The motivation matrix are used to examine the actor cooperation and is an important tool when trying to understand what each actor brings to the system (Morelli, N., Tollestrup, C., 2007).

The blue boxes in the motivation matrix (Figure 55) represent what the actor gets out of being a part of the service.
The grey boxes represent the cases where there are no direct cooperation between the actors in the service.



GIVES TO	USERS	HEALTHCARE PROFESSIONALS	HEALTHCARE SYSTEM	SERVICE OWNER	SERVICE PROVIDER	RESEARCHERS	RELATIVES	COMMUNITIES
USERS	- Overview of own disease - Easy management of disease related activities	- Information about overall health - Understanding patient motivation - What happens between consultations	- Quantified self data - Data for research purposes - Information about health	- Sensitive personal data	- Input about service performance	- Approval for use of data	- Better information about the life living with diabetes	- Support activities and events - A reason for continue arranging activities
HEALTHCARE PROFESSIONALS	- Precise treatment possibilities - Results from tests - Guidance and advices	- Improved patient treatment						
HEALTHCARE SYSTEM	- Possibility for improved treatment in the future	- New best practices of treatment	- Better treatment of diseases - Less patients at the hospitals - Lower cost	- Funding	- Guidance about disease management	- Health data		
SERVICE OWNER	- A secure system - Confidential storage of sensitive personal data - A service specified for people with type 2 diabetes	- Possibility to learn more about what the diabetes person does between consultations	- Data about diabetes people	- Improving the danish healthcare system	- Funding	- Provider of data for research projects with acceptance from the user		- Promotion possibilities
SERVICE PROVIDER	- An updated service - Help and guidance - New content - Support	- Visualisations of the diabetes people's personal data		- Well functioning system	- Happy users - The best system for people with diabetes		- A way of communicating how to live with diabetes	- More participants
RESEARCHERS	- Possibility for improved treatment in the future		- Evidence based articles and reports	- Evidence based articles and reports	- Evidence based articles and reports	- Provided with more patient data - Good research results - Acknowledgement for research		
RELATIVES	- Interest in supporting the person with type 2 diabetes						- Understanding the person with diabetes - Being able to help in a better way	
COMMUNITIES	- Events and activities - Motivation - Guidance	- Motivated citizens	- Motivated citizens	- Content (events & activities)	- Content (events & activities)		- Motivated person	- Promotion of events and activities - Helping people with diabetes

Figure 55 *- Motivation matrix*

// THE FINAL SERVICE SOLUTION

This section will present the current state of the final service solution based on the research conducted through the process. It will be presented through a user journey and three different blueprints with associating scenarios.

The overall goal for the service has been to develop a service system to empower people with type 2 diabetes (T2D). To attain the goal, the service system combines the quantified self data from people with T2D with the data from the healthcare system.

Based on the project idea from sundhed.dk, this service system focus on the users' point of view. The purpose from sundhed.dk to gather data from diabetes people to make precision medicine, have been merged with the needs from the users.
The service solution is an application, for people with T2D to gather all their existing health data and their own data continuously. The system is constructed based on the users' needs and findings from the experts. The system gets the user to set goals for their disease making them take responsibility for their disease and decided how they want to live. On the basis of the set goals, health data stored by the Danish Health Data Authority and their personal data will by the system give the user a better overview of their disease and support them towards achieving their personal goals.

The user gets access to the service through NemID, where the user is guided through the different goals for the various parametres a person with T2D should measure in connection to their disease. The user have the possibility to skip this step, but completing it will allow the application to give more personalised guidance. After filling in the goals the user will have the possibility to connect the application with Apple Healthkit, allowing the application to import the various numbers on exercise, diet, and other relevant factors collected in third party applications. When the two previous steps, of setting goals and allowing Apple Healthkit access, the user arrives at the profile section. The profile gives the user the opportunity to follow his progress, get knowledge and inspiration regarding the disease, see his healthcare professional (HCP) contacts and get answers from his HCPs. The overview of the user's activities and measurements will be both shown advanced for the user and simplified for the user to have a tool to help explain about his disease to relatives, enabeling them to become involved in the diabetes person's life. From the profile and the *goals and overview* section in the application will allow easy access to adding new measurements.

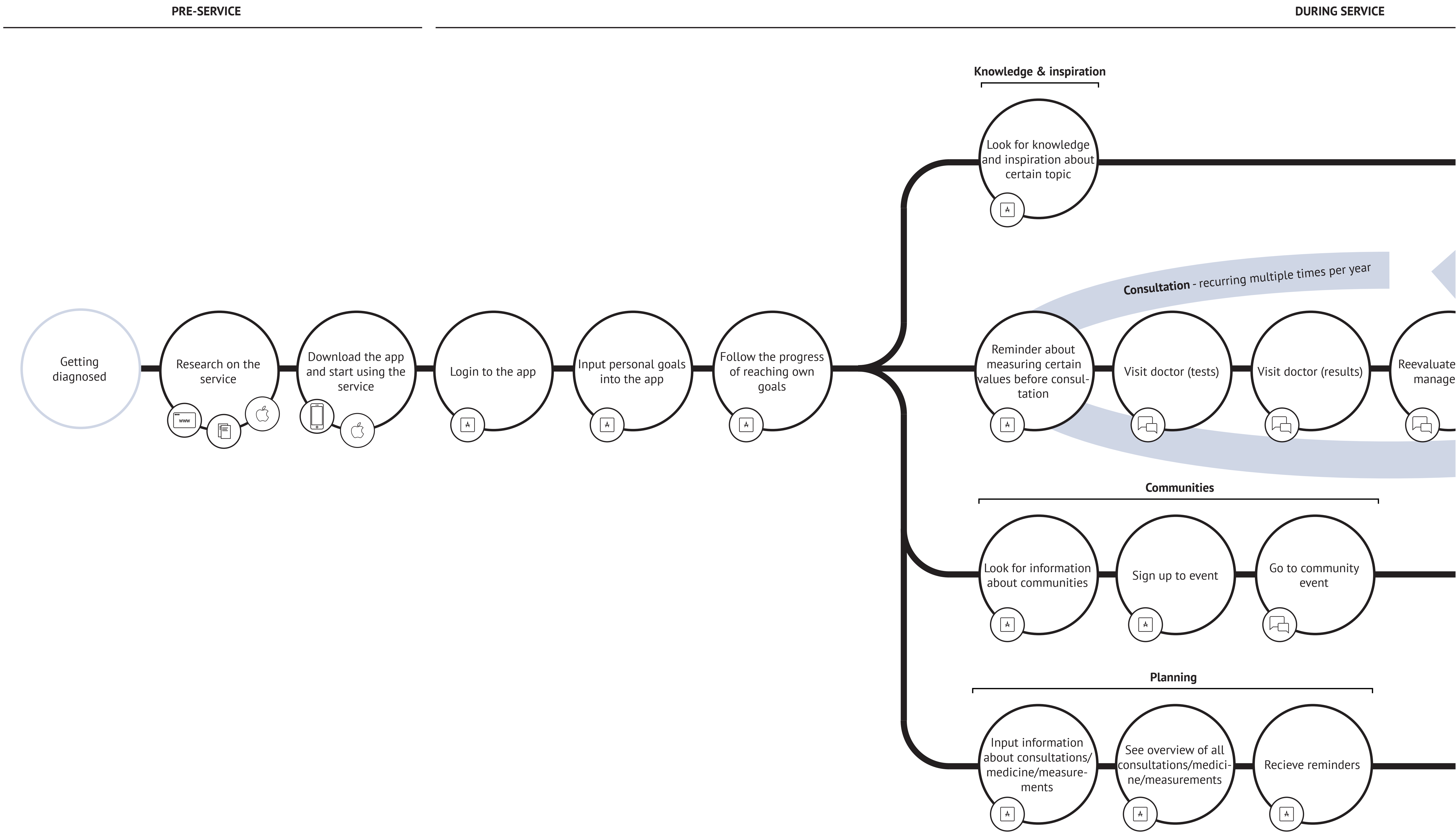
This system is a place for people with T2D to gather all their different data regarding their disease giving the user a collected overview and a tool that enables them to take control and responsibility of their disease based on their own goals, while guiding them towards achieving these goals. The data gathered through the service system should in the future help detect diseases or complications in an early stage and help improve the treatment of the diseases.

// USER JOURNEY

A user journey (or customer journey) map are a useful tool in order to create a overview of a user's experience with a service and the processes in the service. A user journey is made from the users point of view (Stickdorn, M., Schneider, J., 2011; Bechmann, S., 2010). This user journey is furthermore used to provide an overview of the final service solution. It can help generate a general impression of the whole service from beginning to end.

This user journey (Figure 56) consists of a user's overall one-year journey with the service, from the user are diagnosed with diabetes and the following process. The journey showcase four different functions of the service. These functions can be used at different times than where they are placed in the journey - this way of representing the journey is used to simplify the map.
Touchpoints are added at the different points in the journey to provide an overview of how the user interacts with the service.

The *post-service* part of the journey are almost non-existing due to the fact that people using this service has a chronic disease. The *during service* part is therefore recurring until the user decides to stop using the service. The *post-service* part will not be elaborated further in this project.


PRE-SERVICE
DURING SERVICE
Getting diagnosed
Research on the service
Download the app and start using the service
Login to the app
Input personal goals into the app
Follow the progress of reaching own goals
Knowledge & inspiration
Look for knowledge and inspiration about certain topic
Consultation - recurring multiple times per year
Reminder about measuring certain values before consultation
Visit doctor (tests)
Visit doctor (results)
Reevaluate
manage
Communities
Look for information about communities
Sign up to event
Go to community event
Planning
Input information about consultations/medicine/measurements
See overview of all consultations/medicine/measurements
Recieve reminders

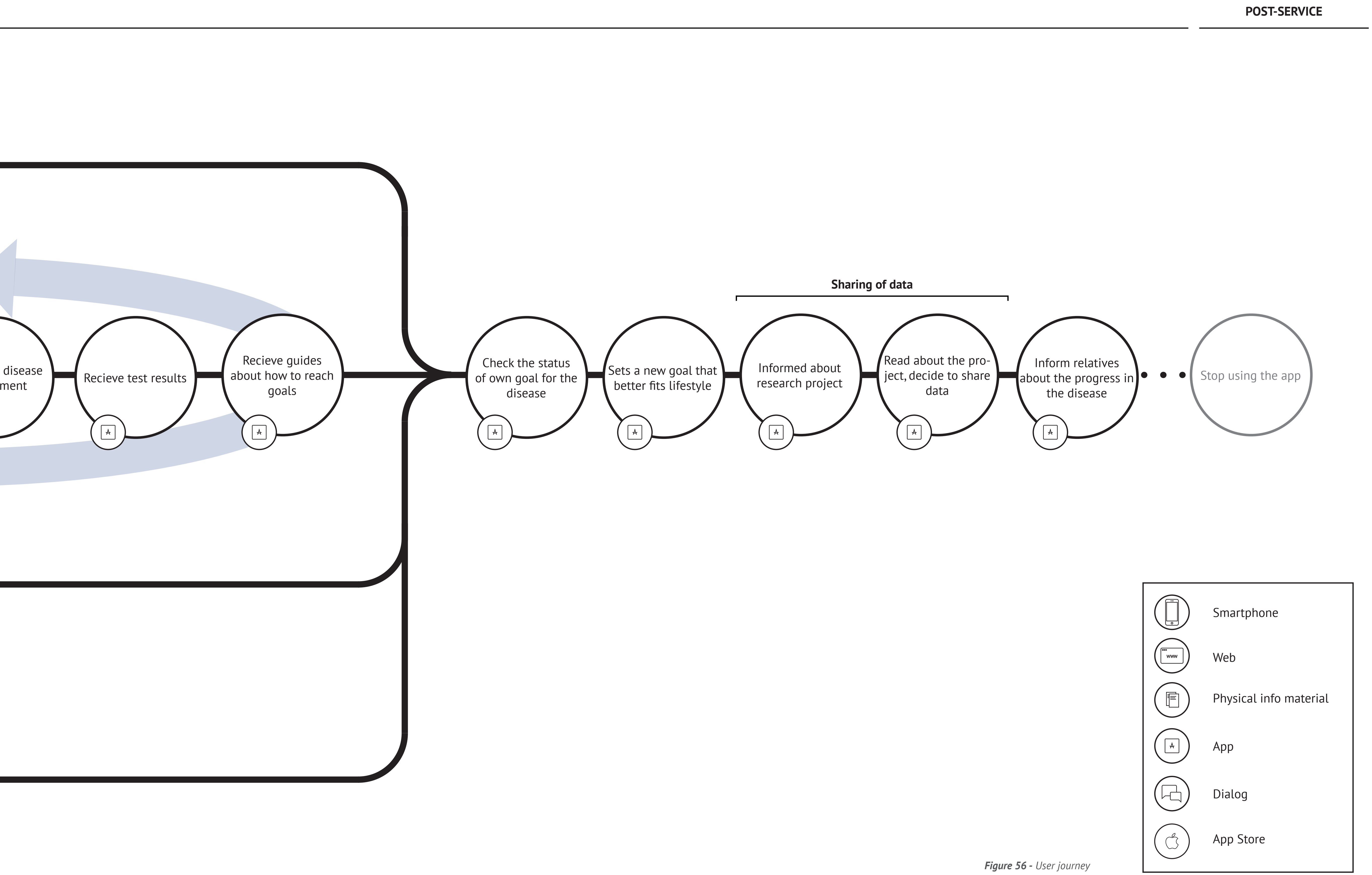


Figure 56 *- User journey*

// BLUEPRINT

A service blueprint is a model used to describe the elements of a service. Blueprints shows how the user interact with the service along with other relevant actors. Furthermore, a blueprint describes both the frontstage and backstage processes within the service (Stickdorn, M., Schneider, J., 2011).
The following blueprints are used in order to describe the future service in depth, and how it ideally would function.

Three blueprints has been developed together with scenarios to showcase the use of each blueprint for the service. They are as follows:

- Blueprint #1 - Pre-service & start (Figure 57)
- Blueprint #2 - Data & overview (Figure 58)
- Blueprint #3 - GP check-up (Figure 59)

The three blueprints represent important parts of the service.

About the blueprints

The blueprints consist of a series of horizontal blocks that each represents a group of actors (main users, healthcare professionals, healthcare system, communities, and relatives). In the bottom of the blueprints the front- and backstage of the service are described. The frontstage describes the visible aspect of the service while the backstage presents what is going on in the service - 'behind the scenes'.

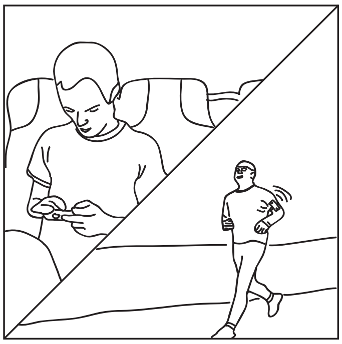
Time are being shown in the top of the blueprints. It is used to give an overview of how long time each process takes. The amount of time for each process are an estimate made by the thesis group and are not based on exact documentation.

In the bottom right corner of each blueprint a description of the symbols used in the blueprints can be found. It explains what each symbol and touchpoint used in the blueprints represents.

BLUEPRINT #1
PRE-SERVICE & START

Gets introduced to the service and decides to start using the application to better handle the disease.

Learns about what a goal means, and input own goals into the system



Starts to use the service on a daily basis. Experience how nice it is to have everything about the disease in one service.

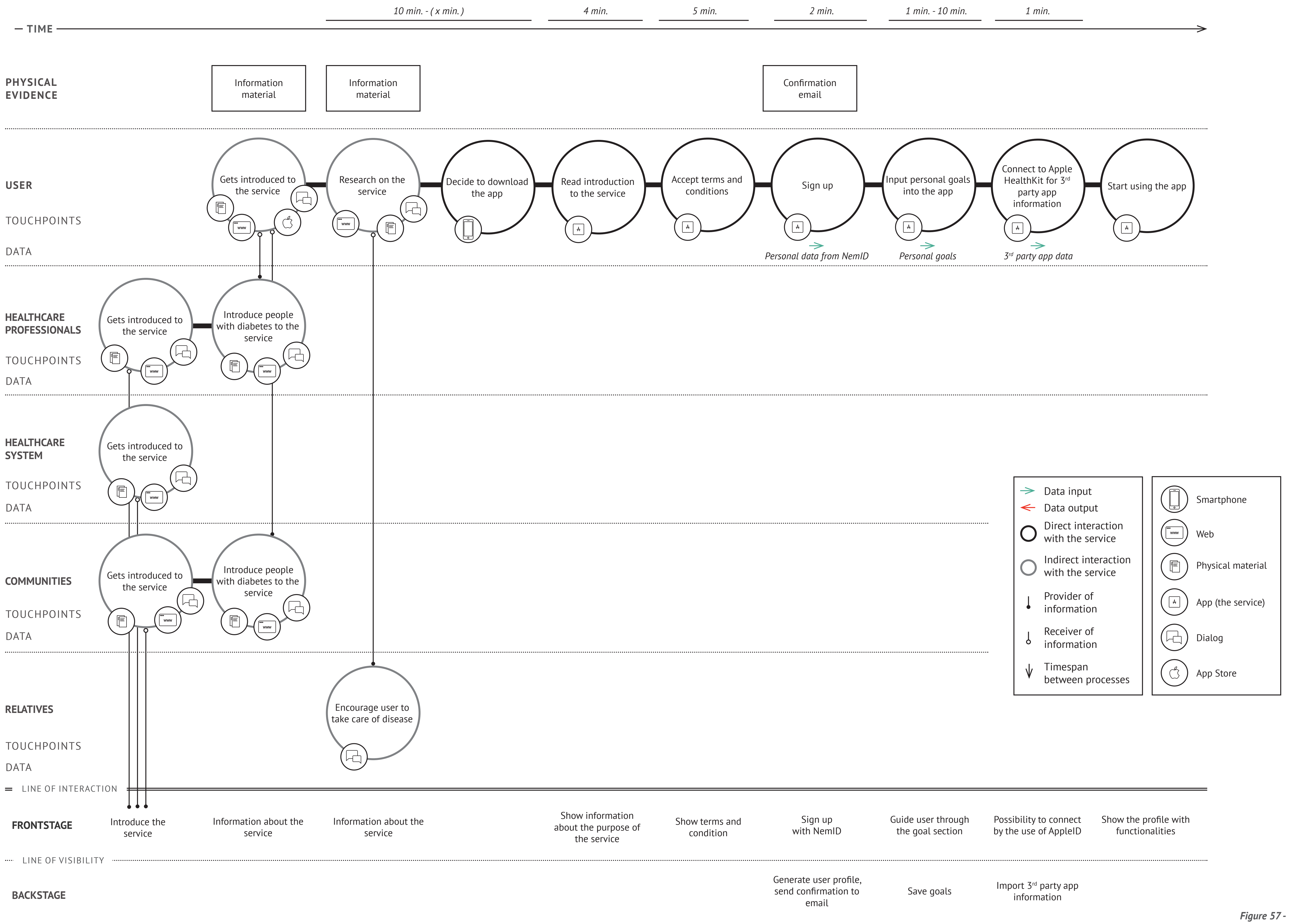
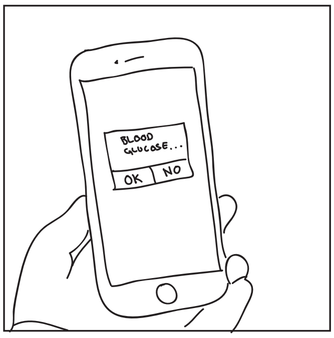


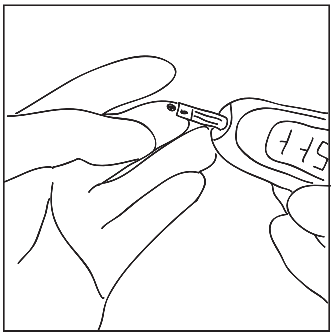
Figure 57 *- Blueprint #1*

BLUEPRINT #2

DATA & OVERVIEW



Is being reminded about measuring blood glucose



Performs measurements and inputs values into the system

Receives guidance about how to reach goals

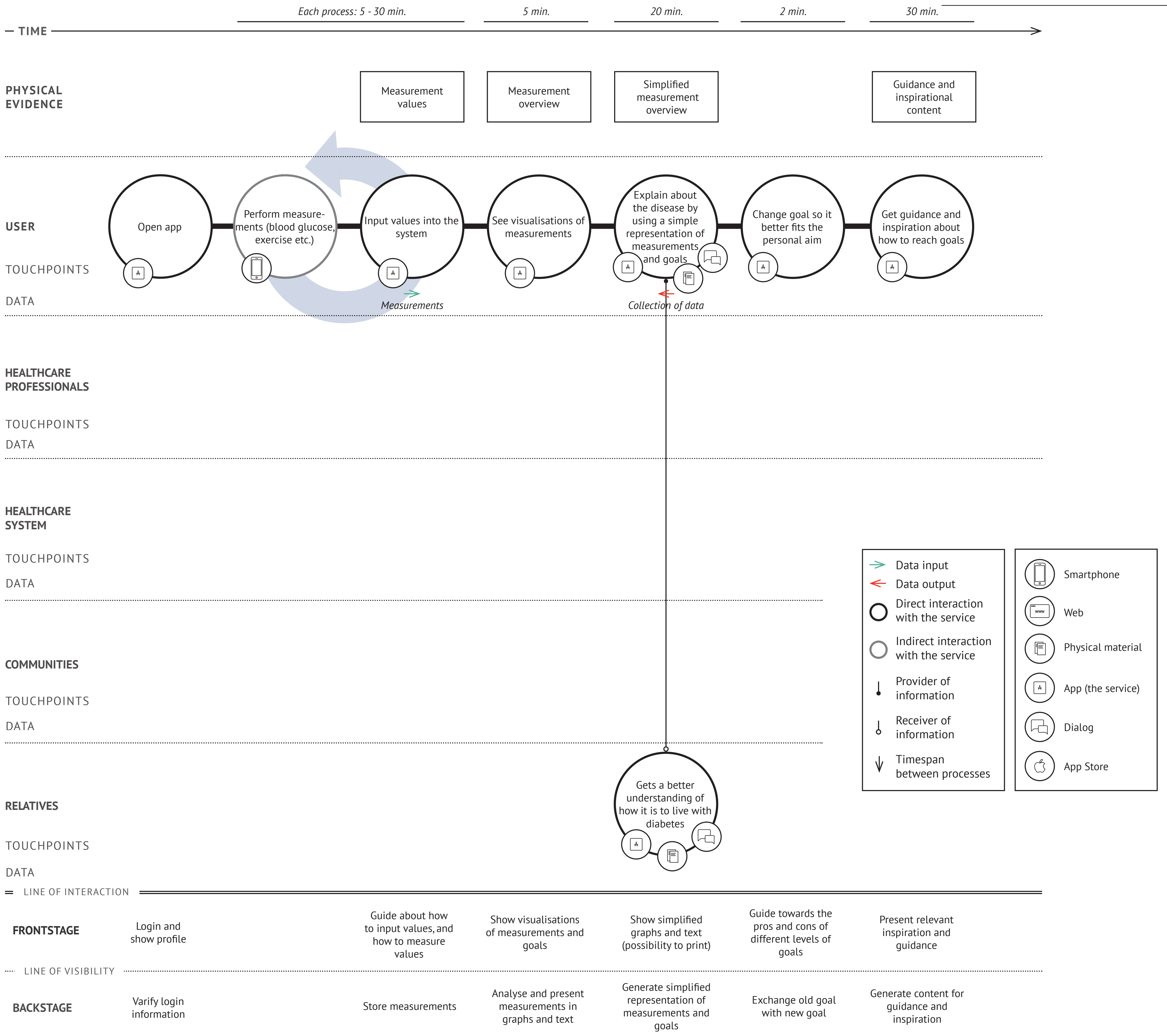


Figure 58 - Blueprint #2

BLUEPRINT #3

GP CHECK-UP

Reminder about GP appointment and measurement before going to the consultation

Visits GP for check-up and tests. Shows GP own measurements in the app.

Recieves test results from GP and looks at the test results

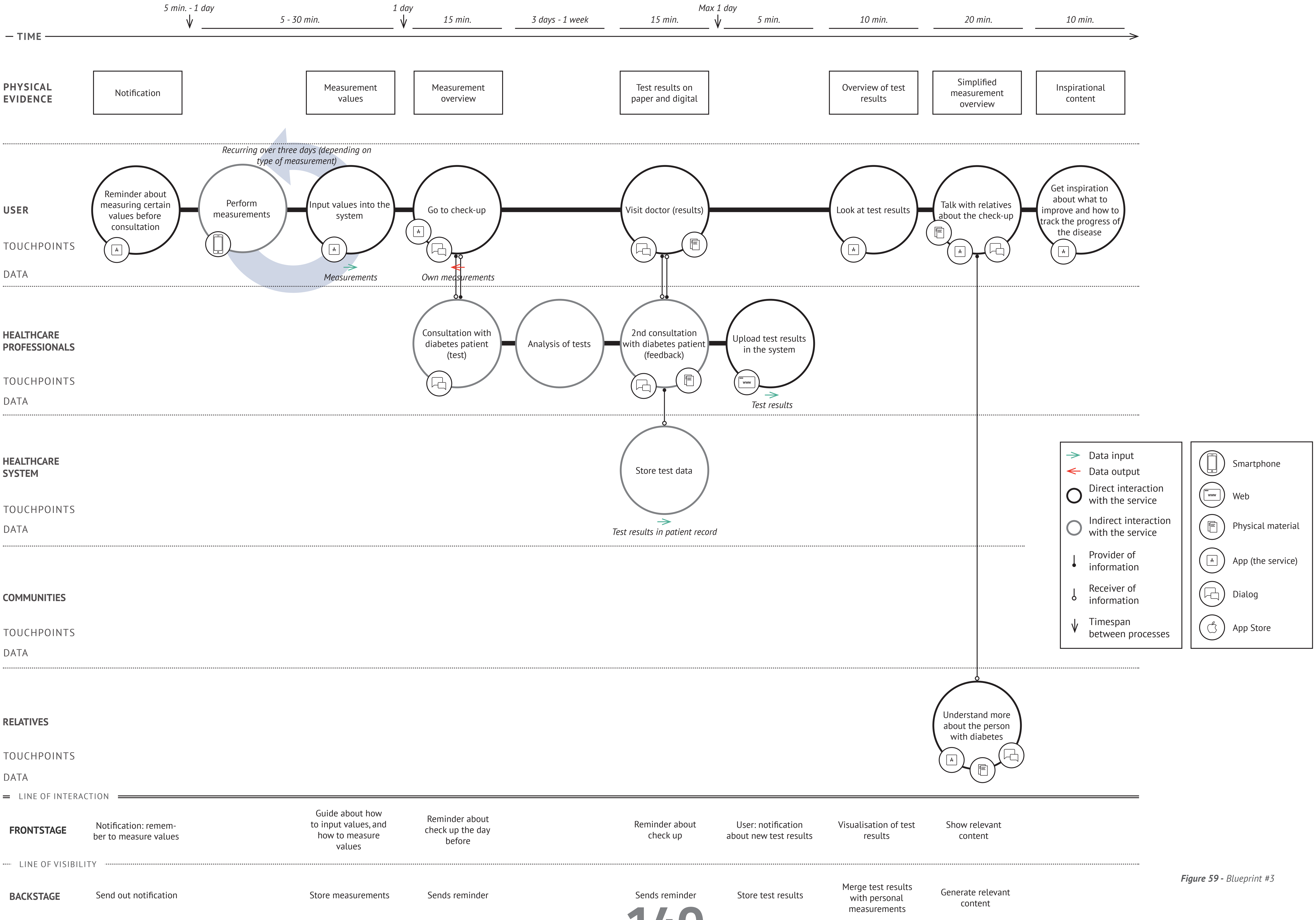


***Figure 59** - Blueprint #3*

// FUTURE SCENARIO

During the process of designing the service, several decisions were made about how the service system should function and how it should behave according to the related systems that the service is tapping into e.g. the Danish healthcare system.

When designing a service it is important to consider when the service will be launched and if the society or processes in the surrounding systems will change before the new system is being launched. At the same time, when being a designer, it is important to think ahead of time in order to improve the processes that do not work optimal. Therefore, the group has decided that the service should not be limited by a process that has the possibility of being improved.

In the following text the scenario that are used in the service will be described.

Test results from GP

When talking to people with diabetes, the group discovered that some of the people ask their general practitioner (GP) to print out the test results from the consultations in order for them to be able to study the results when they come home afterwards.

It was decided that the system should utilise this function because it would make the life easier for people with diabetes and at the same time make the service more complete due to the fact that more information would be incorporated in the system.

The tests that are performed on the diabetes people are being analysed at the hospitals, these data would be visible at *Min Sundhedsplatform*. However, the test that are being analysed by the GPs are not visible for the diabetes people, and the GPs would have to input these data into the system by themselves.

The optimal solution in the future would be to synchronise these systems to avoid manual work.

Reflection

It has not been explored whether or not it is possible for the GPs to input the test results manually into the system, but due to what the thesis group know about the GPs and their workload, there would not be time for this kind of manual process.

// TRANSITION

The develop chapter has described how the service system has been developed. This leads to the deliver chapter that will describe how all the findings through this project and the final solution will be delivered to the collaborating partner.

DELIVER

Considering the double diamond model, which is the process model followed in this project. The delivery phase is about taking the final product to a point where it can be produced and launched (Design Council, 2005). However, this project can be condisered a research project made for sundhed.dk, delivering a service concept.

This section will describe how the delivery of the findings from this thesis project will be delivered. It will be targeted the collaborating partner – sundhed.dk, who is considered the client. The deliverables will be the research, the findings, and how to continue from this point.

// DELIVERY

The following section will present the deliverables to sundhed.dk.

Deliverables

To present the deliverables and handover the project to sundhed.dk, a service presentation report has been prepared and a service handover meeting will be held.

Service presentation report

The service presentation report will display all relevant deliverables and explain the primary findings of the project, which is desired by sundhed.dk. To keep the report short and precise, it will focus on the conclusions and findings. Furthermore, it will suggest how to continue potential future research and development.

Purpose
The purpose is to give a thorough overview of the important findings and values from this project, while making sure some clear recommandations about how to continue the work are provided.

THE POTENTIAL OF DATA
IN APPLIED SERVICE DESIGN
A case study of how data can be used to
empower citizens with type 2 diabetes

SERVICE SYSTEMS DESIGN
AALBORG UNIVERSITY COPENHAGEN

MASTER THESIS
SPRING 2017

Kristina Lenette Vittrup, Nikolaj Thomsen, Rasmus Læssøe Kure

SERVICE PRESENTATION REPORT

The service presentation report

Service handover meeting

The service handover meeting will be a presentation of the key points also listed in the service presentation report. It serves as a final status meeting giving the thesis group and the contacts from sundhed.dk a chance to exchange the final remarks. At the same time the meeting serves as an opportunity to pass over the ownership of the project in order for sundhed.dk to take the project to the next phase.

Purpose
To physically present the learnings from the project, giving a change on elaborating on potential comments or questions. This makes sure the final handover of the research is done and potential questions has a chance of being answered.

OUTRO

// REFLECTION

In this section the intention is to reflect upon the design process, the service system developed, and the project case.

Participants

The participants used in the process of designing the service have both been people in general and people with type 2 diabetes (T2D), not focusing on if they were users of digital devices or not. Only few of the participants have been within the target group (familiar with digital devices). The reason why the participants involved in the research, co-creation, and tests have been a mixed group of people are due to challenges in finding and recruiting people with T2D, who were interested in participating.
A lot of time were used on the recruitment process. Many different methods were used in order to get in contact with the target group e.g. posts on diabetes groups on Facebook, posters at Steno Diabetes Center Copenhagen, personal messages, phone calls, and many others. One reason people would not participate could be that a lot of research projects are dealing with diabetes, this could be making people tired of being asked to participate. Another reason could be that the people did not find the specific project interesting to participate in.

Since the recruitment process has been difficult, the group have not been critical towards how participants have been fitting into the target group. Therefore, it is important to reflect upon the participants who have been used and if they represent the actual population of diabetes people. It is possible that the people who have agreed to participate in the research for this thesis are already active towards the improvement of their disease e.g. the people from the motivation group.The diabetes people who are not yet motivated to improve their condition would probably not be interested in participating in a project aiming to help them control their disease. These people are however a very interesting target group for this service since they are in need of being empowered.

The people with T2D involved in the co-creation were very assorted, which have required many adjustments in the exercises during the sessions. The group has learned a lot from acting on unpredictable situations in regards to be flexible and ready for adjustments.

The future development of the service will definitely require more co-creation sessions and tests with people with T2D in order to prove the service empirically.

A holistic approach

The service design approach helps taking the bigger picture surrounding a service into consideration. This thesis is dealing with a huge system that has to be connected. The thesis group had to confine the problem to be able to deepen a part of the project. The future users of producing data has been the focus, because the system will not be able to exist without them – no data, no system.
The holistic picture could have been more elaborated. The relationship that the users have to their relatives have to be elaborated further, especially what kind of help they are in need of to clearly explain about their disease, which could result in a optimised collaboration and shared understanding. This is actually one of the values in the value proposition.
Only one doctor – Niels Boye, has been included in the project and that interview was mostly about the overall eco-system of the case study. Since the doctors and different practitioners play a central role in the treatment of diabetes people, it would have made sense to involve them in co-creation sessions. Besides the interview with Niels Boye, the disease management programme and the initial interviews with diabetes people are the only information the thesis group have about what is happening at a consultation. Many interesting elements could possibly occur by investigating these processes more.

Empowerment

Empowerment has been a theme researched a lot in the beginning of the process, and has also been a part of the development of the application. The method by Zoffmann, V. et al. (2015) has and can not be directly incorporated since it requires human-to-human interaction or two entry points in the system for the patient and the healthcare professional to share the decision-making.

The idea from the method of self-exploration and self-understanding of the diabetes person's own disease, is some of the elements thought of while developing the service. It is incorporated by the user setting goals for his disease and by making a feature, where the diabetes person can find help to answer questions related to the disease. Furthermore, the user's data should help the user understand and explore his own disease to improve his response ability towards the disease, but first of all the self-understanding and motivation needs to come from the user, to be able to start using this system. The self-understanding before using the service has not been considered for this project. This is however something that should be produced in the interaction between the doctor and diabetes person, since the doctor is the first interaction after receiving the diagnosis. The question is if the doctor would be able to help the diabetes person form a self-realisation, enabling the person to take responsibility of his own disease.

The implementation of empowerment in the service, has not been tested sufficiently. That means the use of empowerment in the application should be investigated further to learn if the service manages to empower the users. This can help understand if the research about empowerment should be expanded to find other methods to compare with Zoffmann, V. et al. (2015) for the best possible implementation of the theme in the service.

Constraints in the process

The constraints towards the gathered needs from the research and development of the service could have been more confined. The thesis group has tried to cover a large task by involving many features in the application, instead of elaborating on a few. The basics of the service should be to gather the personal data and to support the people with T2D in order to be empowered in their disease. Focussing on the basic features in relation to gather personal data, could have allowed the group to create a service closer to a final solution. However, the broad research has provided valuable insights into many of the needs and wishes from the diabetes people.

The role of the doctor

Based on the findings from the diabetes people, the doctors have not always provided the guidance that were needed for the diabetes people. The question is whether or not the doctors fulfill their role of supporting and guiding the diabetes people, or if they just see their role as providing results on check-ups four times a year. No matter what, the diabetes people who have been talked to throughout this project were in need of more guidance and referrals to relevant health offers. This could be a reason why this service could be a useful tool for the diabetes people, to get some help and guidance that they not are offered elsewhere.

The healthcare system

Nobody knows how the healthcare system (HCS) would meet this service. Some of the people from the HCS may be critical towards giving the citizen the responsibility of collecting their own data, which should be used as a basis for treatment and research. Are the data reliable? There is no doubt about that there are going to be a shift in the way the HCS functions due to the fast growing technological evolution. The question is, when the people inside the HCS will accept this shift, and start using services such as the service developed through this thesis in their treatment and research.

Digital or human interaction

The system developed for this service is based on digital interaction. However, a lot of people may be critical towards digital guidance and help. The HCPs has build up a trustworthiness towards what they tell, and people in general trust the HCPs. However, based on the growth of the quantified self community, there could be a tendency that people tend to find their own answers without asking the HCPs. The younger generations may find the service more appealing, while the older generation may tend to trust the guidance from the doctor. In any way, this service should not act as an alternative to the HCS, but as a supplement.

Service owner/provider

Who are the service owner or provider of the this service? This question has formed the foundation for a lot of discussions both within the group and together with sundhed.dk and Niels Boye. There are pros and cons for both public and private ownership. However, the service owner or provider would at the moment have to follow some strict rules in regards to dealing with health data, this points towards a public ownership. However, the public authorities have a reputation for having bureaucratic and heavy processes that could influence the development and management of the service negatively. At the other hand, the private organisations are known to be much more flexible and fast in their processes, which could result in the service being at the forefront in the area of healthcare services.

Push notifications

During the interview with Vibeke Zoffmann, she told the thesis group that push notifications should be avoided. This was backed up by several people from the data workshop. However, push notifications has been shown in the blueprints and scenarios and are therefore a part of the service. This is due to the fact that there are different kinds of push notifications. The ones that tells you what to do, and the ones that inform you about something. The first mentioned is the bad one, since many people do not want to be told what to do. The last mentioned has been used for this service in order to remind people about specific tasks that they already have decided they want to include in the system (e.g. remember a consultation or a specific measurement).

Digital health data

According to the global health systems transparency index presented in KPMG International Cooperative (2017), the Danish HCS scores lowest in Communication of Healthcare data whereas the highest scores are Governance and Personal Healthcare Data. This emphasise that the Danish HCS already are succeeding in creating personal healthcare data e.g. electronic patient records systems. However, the communication of healthcare data e.g. an accessible data portal, extend to which data is up-to-data, and use of open data file formats can be improved. This is something that this future service can try to improve.

Usage of data in service design projects

Service design is about optimising processes and services. To achieve this, data is a great resource in order to generate personalised content, which the users has shown desires towards. At the same time, data makes a service able to be dynamic meaning that the service will act according to what the user puts into the system. The service will therefore be relevant for the individual person and will be adjusted their needs.

A potential challenge when dealing with data – in this case sensitive personal data, is that some precautions has be to taken. These precautions can in some cases be a limitation for the project e.g. sharing of data, privacy, and regulations. They can affect the user experience in a service or set some limits on what data that can be used. It requires the designer to find solutions that do not compromise the usability or experience. If this is done right, the limitations can be turned to advantages. There is a reason why these elements exist namely to ensure the users' rights.

System perspectives

In the development of this service system, several services have been investigated in order to find inspiration and see what already exists on the market. Three services will be highlighted, because they all have some elements that are similar to the service designed in this thesis. Argumentation why each of the services differs from the service designed in this thesis will be given.

Dia +

Is the service found, that are most similar to the service designed throughout the thesis. Dia+ helps the diabetes person to set goals for the disease in order to improve it. This thesis' service differs from Dia+ because it among other has the function of automatically importing data from the HCS.

HealthKit

Collects all quantifiable measurements that the smartphone or smart devices collect. At the same time it collects data from third-party applications. All this data are used to provide the user with an overview of his health, in order to be able to live a healthier life. The thesis' service connects to HealthKit in order to get access to all the quantifiable measurements that already exists in the platform. The reason why the service differs from HealthKit is because the measurements are used in another way. It is used to provide concise feedback and guidance to the user about how to improve a disease (diabetes).

e-journal

E-journal from sundhed.dk provides the user with data from the HCS. This is a platform used to give the user access to e.g. records from the doctor. This thesis differs from e-journal in the way healthcare data are provided to the user. This service aims towards providing dynamic personalised content based on healthcare data and quantifiable measurements.

// CONCLUSION

This section will conclude on the thesis based on the research conducted and design development throughout the thesis. However, due to the small amount of participants included in the process, it is not possible to make any definitive conclusions.

The purpose of this thesis has been to research the potential of data in applied service design. It was done through a case study of data used to empower citizens with type 2 diabetes.

Data shows huge potential in the field of service design. One possibility it provides is to create personalised and customised services, which the users demands. The methodological approach behind service design is useful when designing services that include data. Data has through service design methods become a valuable resource for the healthcare system (the companies who deliver the service) and to assist in meeting the user's needs (providing value to the user).

In order to answer the case study, the following problem statement was made:

"How can a service system utilising quantified self data, empower citizens with type 2 diabetes, to take responsibility for their disease by supporting them in their decision making?"

The service system gives an example of how the citizens with type 2 diabetes can gather their quantifiable self data and connect it with data produced in the healthcare system. The mix of these two data streams help the citizens to get personal and customised guidance towards improving their health. Ultimately making the citizen take responsibility and making him aware of the effect of his decisions.

Empowerment can only happen when the person himself accepts his condition, takes responsibility for his own health, and is motivated towards doing something about it. Empowerment has been incorporated into the service through a section in the application, which informs the diabetes person about an area related to his disease (e.g. blood glucose, blood pressure). Afterwards he is allowed the chance of setting a personal goal related to the area, making an informed decision based on the information provided. Following, the system will be based on the decided goal advising the person in reaching his goal.

The support of the type 2 diabetes person is happening through the advices and guidance the system gives the person towards reaching his previously set goal.

The service development and tests conducted revealed that the target group, who would be interested in using the service, can be narrowed further. It has been suggested multiple times that the service could be especially useful for newly diagnosed people with type 2 diabetes and people who were not currently well regulated but were motivated towards doing something about the disease.

Based on the interviews and workshops conducted through this study, it was found that people with diabetes are in need of better guidance and support towards their disease – elements that are not fulfilled by other actors. It can not be concluded if the service system manages to empower the people with diabetes due to the type of tests completed. The tests conducted were focussing on evaluating the importance of different elements through usability tests and value mapping. In general the test participants were positive towards the service system. In various cases they stated that they would like to try using the system in their everyday life.

// FUTURE PERSPECTIVES

Further development of the project (short-term)

This section describes the areas of interest if more time were available on the a short-term basis.

Finding more users
As discussed earlier in the report, there has been a lack of involvement from the target group. The first area of interest is therefore to find some users from the target group and make further co-creation on the actual system together. It would prove or disprove the results that the thesis group have from the earlier test sessions making sure that a service developed in the future would be a service that fits the interest of the target group.

Pretotype the service
More emphasis could be put into the specific development of the feedback that the user receives. A pretotype would therefore be a great tool for creating a low-fidelity test where an actual output on a given person's measurements would be achievable.

Basic system requirements
At the moment the system utilises many different functions. It would therefore be a priority to identify, which of these functions that are the most useful and relevant for the users. By identifying the basic functions, it would be possible to work towards launching a MVP (Minimal Viable Product). A MVP is a good way of testing the market and can be build using the basic functionalities without investing too much money. If the MVP shows promise, additional functionalities can be added.

Motivation
Empowerment has been a focus throughout this project in order to get the user started and to take responsibility. Furthermore, motivation are a theme that could be interesting to look more into. By investigating people's motivation, functionalities in the service could support the users in order to keep using the service. Gamification elements are an obvious example, which could offer some functionalities that would retain the users. It is especially important when working with people with chronic diseases, to encouraged them to keep using the service for their own good. An interesting question to investigate is: What would make diabetes people more interested in doing something about their disease?"

Possibilities in regards to the overall problem field (long-term)

This part will elaborate on the long-term possibilities that the overall problem field has to offer.

Expand the service to feature other chronic diseases
Some of the legwork has been done in order to empower diabetes people and at the same time the basis for the system has been developed. Some elements from different chronic diseases can be compared - the person has to live with the disease for the rest of his life and the motivation about doing something about the disease may vary. It would be possible to scale the system to support other chronic diseases as well, more work would just have to be put into developing specific content for each disease in order to make the service relevant for each of the diseases.

Expand the service to reach the general citizen
This system could be developed for all Danish citizens, whether or not they have a chronic disease. It would then be a platform for collecting quantified self data, setting goals, and getting feedback on the health. The advantage of this kind of system is that the HCS would be able to collect a large amount of data about the health of the general public. Data, that can be used to analyse patterns in progression of diseases and in the future be able to prevent diseases before they strike.

Recruitment platform
The eco-system around the diabetes project has been described throughout this report. In order for this eco-system to become operational, a recruitment platform would have to be made. The purpose

of such a platform would be to pair research projects or company projects with users of the service and their datasets. The user would still need to approve that the data can be used for the given purpose, but the platform would make the match more effective. The recruitment platform will be the foundation for the business model and the way in which this service should break even.

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AALBORG UNIVERSITY
COPENHAGEN

THE POTENTIAL OF DATA IN APPLIED SERVICE DESIGN

A case study of how data can be used to empower citizens with type 2 diabetes

SERVICE SYSTEMS DESIGN
AALBORG UNIVERSITY COPENHAGEN

MASTER THESIS
SPRING 2017

Kristina Lenette Vittrup, Nikolaj Thomsen, Rasmus Læssøe Kure

SERVICE PRESENTATION REPORT

// PAGE 0

Master thesis

Service presentation report

Title:
The potential of data in applied service design:
- A case study of how data can be used to empower citizens with type 2 diabetes

Programme: MSc Service Systems Design,
4th semester

Project Period: 1st February 2017 - 31st May 2017

Collaboration with an Organisation:
Sundhed.dk

Place of the Organisation:
Sundhed.dk
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Abstract

In today's society, lifestyle diseases such as diabetes are becoming more and more common. Diabetes is the disease in Denmark that has the highest incidence rate, and the Danish healthcare system will therefore need a solution in order to overcome this challenge.

This thesis has investigated the potential of data in applied service design, through a case study of how data can be used to empower citizens with type 2 diabetes. This has been answered through the following problem statement

"How can a service system utilising quantified self data, empower citizens with type 2 diabetes, to take responsibility for their disease by supporting them in their decision making?"

The research conducted has involved the actors through interviews, co-creation, and workshops. Based on the research the service system contribution presented in this report, is a proposal to the challenges with diabetes.

The service solution has been developed and tested as an high fidelity prototype for people with type 2 diabetes, to better control and take more responsibility for their disease,

The study has included too few test participants, to conclude anything definitive, however it has shown clear tendencies. These tendencies show that data has a large potential in a service design context. It provides the possibility to create personalised services, which has been found as a rising demand from the users. Considering the case study, a service to support and empower citizens with type 2 diabetes, has shown to create value for the participants. Continuing the work are definitely worth the effort. Such a service would both be capable of supporting the users and gather valuable data for research purposes.

// READING GUIDE

The presentation report is divided into four chapters explaining the service.

The first chapter, **background,** introduces the reader to the background of the project, the problem, the methodological approach, the target group of the service, and all the key findings from the thesis study.

The second chapter, **the service**, shows the reader the service system through different models and visualisations, the actors and stakeholders involved in the service and an evaluation of the user needs and functionalities in the service.

The third chapter, **outcome**, will present the user to the motivation and roles of the actors involved in the service and how a future service model will look like.

The last chapter, **conclusion**, will give recommendations of how the project can be continued and a final conclusion on the problem statement and the overall theme of the thesis project.

// TABLE OF CONTENTS

BACKGROUND

The following chapter will present the background material from the thesis, that forms the basis of this report. This chapter will present the problem statement, the methodological approach behind the thesis, the target group of the service, and the key findings from the research in the thesis.

// INTRODUCTION

The thesis that is the background for this *service presentation report* takes point of departure in a collaboration with sundhed.dk. The report is made as a deliverable for sundhed.dk, but the content is relevant for everyone interested in the themes surrounding the thesis project. This report will introduce a smal part of the thesis project.

The thesis has the following headline:

The potential of data in applied service design:
A case study of how data can be used to empower citizens with type 2 diabetes

The thesis is a problem-based study investigating the following problem:

> *"How can a service system utilising quantified self data, empower citizens with type 2 diabetes, to take responsibility for their disease by supporting them in their decision making?"*

The problem statement highlights the use of collected data to support and empower citizens with type 2 diabetes, whereof the collected data should supply the health sector with important data sets for scientific work. The proposal to a system answering this question will be presented in this report, together with the methodological approaches used in the process and the findings from the research and service development.
The report is completed with four different recommendations to the further development of the service system and a conclusion towards the stated problem.

// METHODOLOGY BEHIND THE PROJECT

The thesis project has been dealt with as a service design project. This section will shortly describe what service design is about and some of the key methodological approaches used throughout this thesis. It will describe why these specific methodological approaches have been the tools of choice while developing this service concept.

Service design

Service design can be defined in many different ways. Stickdorn, M. & Schneider, J. (2011) describes the discipline as:

> *"...an interdisciplinary approach that combines different methods and tools from various disciplines."*

Moritz, S., (2005) describes it as:

> *"Service Design helps to innovate (create new) or improve (existing) services to make them more useful, usable, desirable for clients and efficient as well as effective for organisations. It is a new holistic, multi-disciplinary, integrative field."*

The approach can be described on the basis of the five following basic principles, which illustrates the thought process behind service design thinking:

- **User centered:**
  "Services should be experienced through the customer's eyes.";
- **Co-creation:**
  "All stakeholders should be included in the service design process.";
- **Sequencing:**
  "The service should be visualised as a sequence of interrelated actions.";
- **Evidencing:**
  "Intangible services should be visualised in terms of physical artefacts.";
- **Holistic:**
  "The entire environment of a service should be considered." (Stickdorn, M., Schneider, J., 2011)

A large part of service design is to involve users and the necessary stakeholders actively in the design process. The following will describe how design benefits from this thought process, by going deeper into user centered design and the ways of designing with users.

User centered

> *"The inherent intention of a service is to meet customer's needs and, as a result, be used frequently and recommended heartily"*
> (Stickdorn, M., Schneider, J., 2011)

Considering the statement above, it explains the intent of adopting the user centered way of doing things very well. If a service is to gather data from the users, it requires those users. If it is to collect data continuously from users it requires returning users. If a service is designed based purely on the intent of gathering data without considering user needs and creating value for the users, making it unlikely that they will use the service making it useless.

With this in mind, the thesis group decided to focus their attention on understanding the users and their needs. To achieve this, acquiring authentic customer insights are necessary, thus using the correct methods and tools which allows the designer or researcher to slip into the user's shoes are required (Stickdorn, M., Schneider, J., 2011). The following methods have been applied throughout the research aiming to learn what the user wants and how it is possible to deliver value, meanwhile collecting data with the user's consent.

Designing with users

User centered design does originally cover the process of centering the design process around the user, however observing and questioning the user is not always enough. In the process of localising the needs of the users, *co-design* has been used to actively involve the users in the design of the service. The concept and difference between co-design and *user centered design* is well explained by Jørgensen, U., Lindegaard, H., and Rosenqvist, T. (2011), who explains it as:

> *"{...} going the final step towards the user from observing the user (user-centred design), to engaging the user (participatory design), to collaborating with the user (co-design)."*

Following the goal of collaborating with the users through *co-design*, *co-creation* has been used. A core aspect, which needs to be understood when designing based on *co-creation* is that there might be more than one group og users as expressed by Stickdorn and Schneider (2011):

> *"Potentially there is more than just one customer group, and each group possesses different needs and expectations."*

Why the above-mentioned statement is important, is that a service is made for different people with different purposes. In this case the people who would be the primary users are the person with type 2 diabetes, and for example the doctors or people using the collected data. Each of these stakeholders possesses different expectations and have different viewpoints of the service, which makes it important to involve as many and various stakeholders as possible in the design process, both from the frontstage and from the backstage (Stickdorn, M., Schneider, J., 2011).

Qualitative methods

To achieve an understanding of the users and their needs, qualitative methods were prioritised, which includes e.g. interviews, workshops etc. The advantage of qualitative approaches is as suggested by Bjørner, T. (2015):

> *"The advantage of qualitative methods is that they can provide some interesting interpretations and understandings of the individuals' or groups' perceptions acts, and beliefs."*
>
> (Bjørner, T., 2015)

As stated by Bjørner, qualitative methods allows to gain an understanding of the individuals or groups. To learn the needs of the users, who in this case, are people with type 2 diabetes, qualitative methods was chosen for their ability to make the group gain a deep understanding of the users, instead of the quantitative methods more superficial insights. The group did however not neglect the power of including quantitative methods, and examples of qualitative approaches combined with some quantitative methods will be seen, while going through the report.

Service design in healthcare

Since the focus of the thesis is on a health related issue, this section will shortly describe how such an approach can positively influence the healthcare system.

A swedish study from 2013, with the purpose to compile the knowledge about designing services within the focus of healthcare, has explored the effects service design can expect to give when applied in a healthcare context (Capire/HCM, 2013). The study shows a big potential of service design in healthcare. The following model (Figure 1) shows the potential of service design within healthcare by changing from a producer-oriented approach towards a user-oriented design approach. The following elements are amongst the potential benefits:

- Increased empowerment and better health for *the patient*
- Better results and processes for *the healthcare professionals*
- Reduction in cost for *the healthcare system*
- More presence in *the societal environments*

(Capire/HCM 2013)

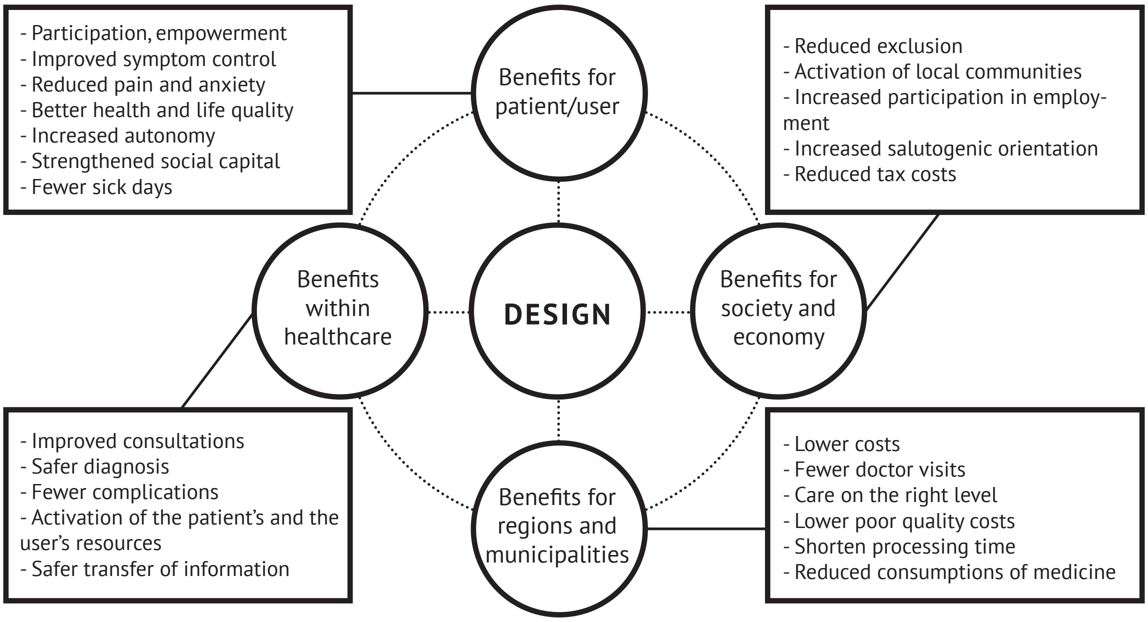


Figure 1 - *Example of direct and indirect gains, that can be achieved by patient- and user-centered design projects (Capire/HCM 2013) (trans.)*

// TARGET GROUP

The initial target group of the thesis was people with type 2 diabetes. The target group has later been narrowed down slightly. The reasoning is that the service, which are required to collect data from the users would be a digital solution. This results in a target group, which are defined as:

> *People with type 2 diabetes who are familiar with digital devices.*

The definition *familiar with digital devices* is in regards to smartphones or tablets and are defined by the thesis group as: "*The user should at least be capable of navigating to an application opening it up and typing in values into fields.*"
A relevant consideration based on this is that users with very low familiarity of digital technologies would require high motivation to use the system, since it requires a bigger effort. Users who are experts with digital technologies could however use such a system with no effort, thus their motivation is not required to be as high.

Personas

To better communicate the needs of the users four personas has been created. A persona is a representation of a particular group of people. A persona offers a way to shift the focus from abstract demographics towards the real needs of a certain user group (Stickdorn, M., Schneider, J., 2011). The personas created represents the real users by being a representation created based on the interviews, workshops and encounters with experts and people with type 2 diabetes. Based on an interview with empowerment expert, Vibeke Zoffmann (Key findings from design process p. 15), two parameters which tells about people with diabetes' condition was identified. These are parameters all people with type 2 diabetes, will possess to some degree – motivation and regulation. The two factors has been used to create four different extreme cases of personas, as shown in (Figure 2-5).

The personas highlights key features connected to diabetes people, and which are relevant to a digital service. They will be used to elaborate on elements throughout the report, when needed. The features, which are not clearly explained on the individual persona is described here.

Responsible for health
The *responsible for health* scale is used to denote to which degree, the persona feels the responsibility for his own health.

Experience with digital devices
The *experience with digital devices* scale is used to show how well the user is capable of using digital technologies.

Feelings towards sharing data
The *feelings towards sharing data* displays how comfortable the persona is about sharing his data with research.

THE NOT WELL REGULATED AND MOTIVATED

DIAGNOSED - 3 W AGO

JAKOB, 27 Y

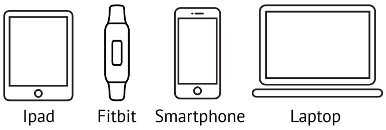
STUDENT

> ” The diagnosis came as a shock, but now there is only one thing to do. Learn to live with it ”

// ABOUT

Jakob studies software engineering in Odense he lives alone in a small apartment. Before the diagnosis Jakob was rarely exercising and his diet was generally unhealthy focusing on the easy ways of preparing his meals. When he was diagnosed with diabetes it was a huge chock. After a meeting with his doctors and reading about the disease online he realised that for him to live with as little consequences as possible he had to make changes. Now Jakob has started a new lifestyle trying to get into shape and learning how to control his disease.

// DIGITAL DIVICES AT DISPOSAL



// MOTIVATIONAL FACTORS

- Reducing the symptoms of the disease
- Showing that he is in control
- Reduce the amount of medicine he needs
- Become more healthy
- Live as regularly as possible

// RESPONSIBLE FOR HEALTH

// EXPERIENCE WITH DIGITAL DEVICES

Familiar user of digital devices ● ● ● ● ● **Expert user of digital devices**

// FEELINGS TOWARDS SHARING DATA

Will not share data ● ● ● ● ○ **Sharing all data**

// HOBBIES

- Computer games
- Going out with friends

// DIABETES RELATED ACTIONS

- Daily measurements of blood glucose and pressure
- Following a diet plan
- Exercise groups and attending spinning lessons

Figure 2 - *The not well regulated and motivated persona*

THE WELL-REGULATED
AND MOTIVATED
DIAGNOSED - 8 Y AGO

MADS, 32 Y

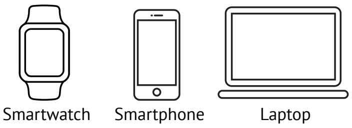
BARISTA

> Self care and the right routines makes living a life with diabetes consequence free

// ABOUT

Mads works as a barista, he lives at Nørrebro in Copenhagen. When getting diagnosed 6 years ago he was overweight and lived by a bad diet. He decided that diabetes should not affect his health and decided to change his lifestyle. Today Mads has managed to drop his medicine by living by a healthy diet and incorporating regular exercise. When Mads exercises he uses his smart watch to track his progress keeping an eye on this motivates Mads to perform better, e.g. run faster and longer. He will soon participate in his first half marathon.

// DIGITAL DIVICES AT DISPOSAL



// MOTIVATIONAL FACTORS

- Living without medicine
- Living without being limited by his disease
- Becomming more fit

// RESPONSIBLE FOR HEALTH

Doctor ▬▬▬▬▬▬▬▬▬▬▯ **Patient**

// EXPERIENCE WITH DIGITAL DEVICES

Familiar user of digital devices ● ● ● ● ○ **Expert user of digital devices**

// FEELINGS TOWARDS SHARING DATA

Will not share data ● ● ● ● ● **Sharing all data**

// HOBBIES

- Running and working out in fitness centre, three times a week
- Playing board games
- Hanging out with friends
- Keeping update on technological advancements

// DIABETES RELATED ACTIONS

- Measures blood glucose a few times a week to make sure his values are stable
- Measures blood pressure regularly
- Following a sugar free diet
- Bicycles to work

Figure 3 - *The well regulated and motivated persona*

THE WELL REGULATED
AND NOT MOTIVATED
DIAGNOSED - 5 Y AGO

ANNA, 38 Y

REAL ESTATE AGENT

> ” It was a hard blow being diagnosed with diabetes, however now i have it under control and can feel when i go off track and need to make changes ”

// ABOUT

Anna lives with her boyfriend, Mark, and their little girl Lise in Tønder where Anna works as a real estate agent. When Anna was diagnosed she made a lot of changes to improve her way of life, such as exercise, regular measurements, and a large diet change. When Anna and Mark got their girl, time became a more limited and now Anna rarely does her measurements since she got the diabetes under control and the doctor appointments are regular. When she has spare time she will rather use it on keeping in touch with her friends or spending quality time with her daughter. The diet has recently become more focused on what is easy to manage, than what is the most healthy choices.

// DIGITAL DIVICES AT DISPOSAL

Ipad Smartphone Laptop

// MOTIVATIONAL FACTORS

- Keeping connected with social circles
- Feeling of control
- Her daughter

// RESPONSIBLE FOR HEALTH

Doctor **Patient**

// EXPERIENCE WITH DIGITAL DEVICES

Familiar user of digital devices ● ● ● ○ ○ **Expert user of digital devices**

// FEELINGS TOWARDS SHARING DATA

Will not share data ● ● ● ● ○ **Sharing all data**

// HOBBIES

- Coffee, lunch, and dinner with friends
- Taking care of her daughter

// DIABETES RELATED ACTIONS

- Very rare measurements of blood glucose and pressure
- Exercise 1 - 2 times a week
- Semi controlled diet (can be hard when eating out)

Figure 4 - *The well regulated and not motivated persona*

THE NOT WELL REGULATED
AND NOT MOTIVATED
DIAGNOSED - 15 Y AGO

LISBETH, 58 Y

UNEMPLOYED

> ”Diabetes is an illness and medicine is how you treat it. I don’t have time to make too significant changes I rather want to use my time on my grandchildren”

// ABOUT

Lisbeth is currently unemployed, she previously had a job at an office assistent. She lives in Aarhus with her husband Jørgen and their dog Pluto. She has a large family two children and 4 grandchildren. Currently Lisbeth spends a couple days each week searching for a new job. When she is not searching for a job there is always plenty to do taking care of her grand children. One of Lisbeth’s hobbies has always been baking, however she knows she has to cut down on sugar, so currently she primarily bakes for her children and grandchildren.

// DIGITAL DIVICES AT DISPOSAL

Smartphone Laptop

// MOTIVATIONAL FACTORS

- Eating what she enjoys
- Being close with her grandchildred

// RESPONSIBLE FOR HEALTH

Doctor Patient

// EXPERIENCE WITH DIGITAL DEVICES

Familiar user of digital devices ● ○ ○ ○ ○ Expert user of digital devices

// FEELINGS TOWARDS SHARING DATA

Will not share data ● ● ● ○ ○ Sharing all data

// HOBBIES

- Takes care of her grandchildren
- Bakes for her children and grandchildren
- Searches for a job
- Walking her dog

// DIABETES RELATED ACTIONS

- Reduced sugar in baking
- Minor changes to diet
- Measure blood glucose periodically each month

Figure 5 - *The not well regulated and not motivated persona*

// KEY FINDINGS FROM DESIGN PROCESS

As mentioned in the methodological approach section, the primary approach to the thesis has been focused around the user. This section will describe the different interviews and workshops, which has been performed throughout this thesis, explaining the various key findings inferred and which value these findings has had in context with the thesis.

Interviews with people with type 2 diabetes

To be able to build a service for people with diabetes, it was important to understand the current course of disease of a person with diabetes. The initial step towards understanding this and how it is to live a life with diabetes, was to perform three semi-structured interviews with type 2 diabetes persons.

Participants: Three people with T2D
Duration: 30 min. per interview
Location: Every participant was sitting at home, while the group interviewed them over phone.
Method: In-depth semi-structured interview

Findings

- Some people with diabetes tend to believe they can regulate their disease by following their body's signals, this is however not always the case.
- The offers and information supplied to the people with diabetes in the start of their course of disease are very limited.
- There is very little communication between healthcare professionals.
- When being diagnosed the motivation to improve the state of their condition is very high.

From the interviews individual journeys of each participant's course of disease was created. The purpose of these was to be able to compare and find similarities and differences in the individual journeys.

> *"They [the healthcare professionals] did not know at all, what each other were doing."*
> Ella

> *"They [the healthcare professionals] do not work together at all."*
> Rasmus

Take outs
The findings was used and combined with background research to create a general blueprint displaying a general course of disease a person with diabetes can expect to go through when getting diagnosed (Figure 6). This journey and the interviews also helped localise pain points which were important to consider while creating the service.

Phone interviews, and photos from additional visit

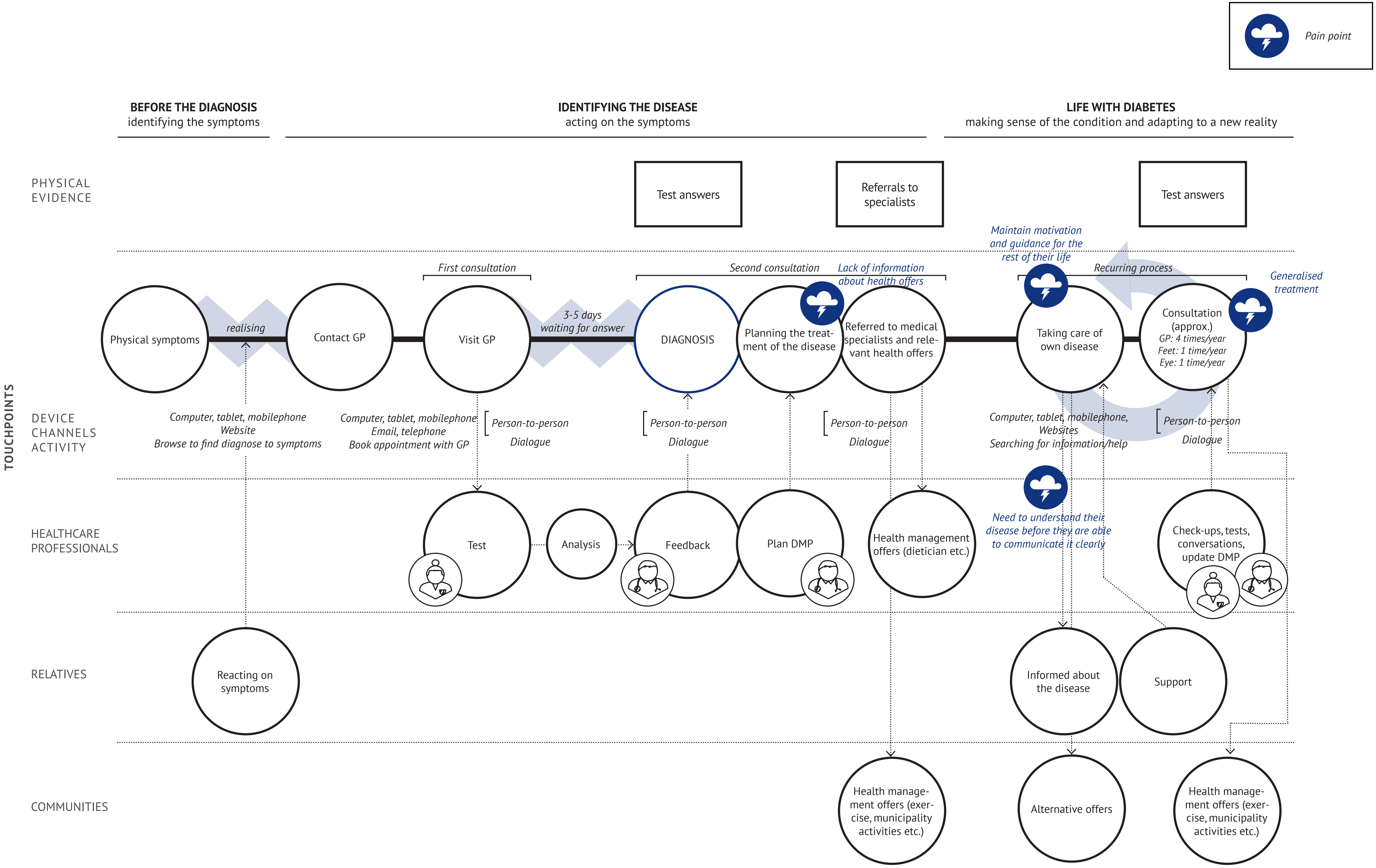


***Figure 6 -** Blueprint of the current system*

Interview with Vibeke Zoffmann

In the problem statement the theme of empowerment is highlighted as one of the key themes, which should be used to engage the users of the service. To deepen the knowledge of patient empowerment, an interview was planned with Vibeke Zoffmann. Vibeke are doing research within the field, and has a lot of knowledge applying empowerment into the lives of people with diabetes.

Participants: Vibeke Zoffmann - Head of Research Unit for Women's and Children's Health at Rigshospitalet
Duration: 1 hour
Location: Juliane Marie Centeret
Method: Semi-structured interview

Findings

- As mentioned, Vibeke brought to our attention the parameters motivation and regulation, which has been used to create the personas.
- The patients can not be forced to make the necessary changes, they should be guided towards understanding the reason for the change.
- Avoid pushing the patient, instead make the patient capable of setting their own goals and support them towards achieving these goals.
- All patients are different, thus how they should be empowered are very individual.

> *"The kind of decision-making that are used as treatment for diseases does not work at chronic diseases - only on the acute diseases. The fact that the patient just expose a problem for the HCP, and the HCP then find a solution to that problem."*
> Vibeke Zoffmann (trans.)

The above-mentioned quote by Vibeke, explains one of the main reasons why to include empowerment, when working with patients who suffer from a chronic disease. Patients cannot expect the healthcare professionals to give them the solution for their disease, instead the healthcare professionals should give them the tools to deal with their condition. This is also supported by the statement from Bjerregaard, who suggest that the treatment should be individualised (Bjerregaard, M., 2016).

> *"...there is economic savings to be made by individualising the treatment of patients especially the ones who are less well-off..."*(Bjerregaard, M., 2016)(Trans.)

Take outs

The interview with Vibeke gave a better understanding of how empowerment can be used when working with people with diabetes. It also serves to further confirm the thesis group's goal of working with the users to create the service. The learnings have been used and considered while working towards the service prototype, where the focus have been largely on the needs and empowerment of the individual users.

Interview with Niels Boye

To learn more about diabetes from a doctor's perspective, an interview was set up with Niels Boye, a doctor specialised in endocrinology. The interview was planned to learn more about the data, which are relevant to collect through the system. Because of Niels' and sundhed.dk's collaboration, the interview also served as a chance of elaborating on the purpose of the overall project goal.

Participants: Niels Boye - Physician, specialist in Internal Medicine, Endocrinology and Health Informatics
Duration: 1 hour
Location: Café at Østerbro
Method: Semi-structured interview

Findings

The main themes which was discussed with Niels Boye will be elaborated upon in the following.

Patient - Doctor responsibility

One of the themes was the responsibility between the patient and the healthcare professional and its balance. This is something that is relevant when talking about chronic diseases. The doctor meets the patient a few times each year, this means that the time in between is the patient's own responsibility.

> *"There should be a clear distribution of the responsibility. The doctors can not shift their responsibility to the patient, and the patients can not shift their responsibility to the doctor"*
> Niels Boye (Trans.)

The doctor's responsibility is to treat and detect complications related to the disease and to prescribe the right medicine to assist the patient in managing their triangulation of the disease (exercise, diet, and treatment). Exercise and diet are the patient's own responsibility.

Data to collect
A lot of data are relevant for the diabetes person according to the treatment of the disease. However, only limited amounts of the data are relevant for the general practitioners. The reasoning is that the doctors will only need a little of the data to give guidance. Furthermore, it can not be expected that the general practitioners take the patient's self gathered data into account. For the general practitioners who would include the patient data in their suggestions, Niels highlighted the physiological data as the relevant parts, e.g. blood pressure, HbA1c and weight. It could serve as an improvement of the guidance for the diabetes person if data from the time in between consultations can be seen by the general practitioner.

In the context of research all possible data, which can be collected would be relevant, this would enable researchers to use the data to find possible tendencies towards better treatment of diseases.

Business model
To give the thesis group an understanding of the business model, Niels explained the system behind the eco-system of the potential service. A service model was afterwards created, based on this explanation and will be shown in (// Ownership p. 49).

Take outs
From the points above the following was the primary take outs, which was used when moving along with the thesis.

- It is important for the diabetes person to be aware of their own responsibility compared to the doctors. The system should support the diabetes people in managing their disease during the periods between the consultations, not at the consultations.
- The data collected through the service can be anything, because everything has value.
- Locate the users' wishes and help them track and collect this data.
- Insights into the overall project's business model, has been used when developing the service model canvas for the system suggested through this report, see (Key findings from design process p. 15).

Motivation workshop

To get potential users to use a product or service, digital or analogue, it is important to understand what motivates people. The purpose of the motivation workshop was therefore to learn why people have started using the tools they use, and why they chose to continue using the tools after a period of time.

Participants: Supervisors and students from the Service Systems Design programme
Duration: 30 min.
Location: Aalborg University Copenhagen
Materials: Table to map out the analog or digital tools and their values.

Findings
(Figure 7), shows the collected findings of the value or reason why they use certain tools, and the given tools these values are connected to.

Take outs
The values represents areas, which would be interesting to look into in order to get an understanding of why users use a digital service and what should be applied to a service in order for the user to continue using it. Therefore, the values listed should be investigated and considered while developing the service, since incorporating these values would make it more likely that the users would use and continue using the service.

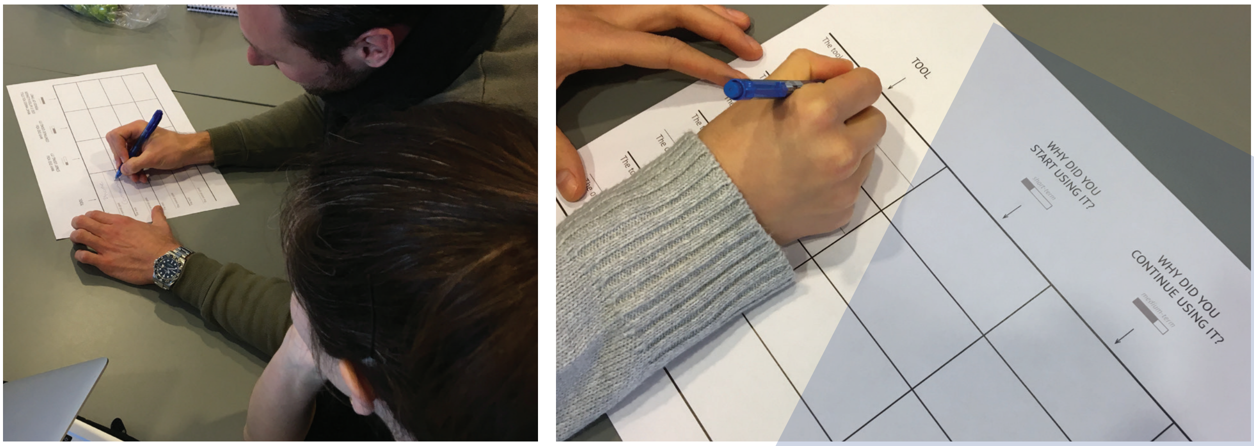
START USING A TOOL

VALUE	THE SOURCE TO THE VALUE
Novelty	Twitter, Snapchat
Practicality	Bike, communication, carrier cycle, Google Drive, smartphone
Community	Whats app, Slack, laptop, smartphone, Instagram
Forced habit / necessity	Toothbrush, Slack, laptop
Fun / entertainment	Snapchat, Instagram
Economy	Bike to save money on public transportation, carrier cycle

USING A TOOL FOR A LONGER PERIOD OF TIME

VALUE	THE SOURCE TO THE VALUE
Environmental	Bike
Usability	Bike, Instagram, Spotify
Practicalities	Carrier cycle, bike, smartphone
Necessity	Communication to work, smartphone (contains everything), computer/ laptop ("basic need in Denmark")
Habit	Bike, Whats app, Instagram, toothbrush
Economy	Whats app, bike
Community	Whats app, smartphone
Continued novelty (unique, updated content)	Twitter, Instagram, Spotify
Adaptable	Smartphone, Google Drive
Communication	Whats app, smartphone
Flexibility	Bike, smartphone
Addiction	Spotify (to move everything from one program to another is too time-consuming, takes too much effort)

Figure 7 - *Findings from the value exercise*



The workshop participants during the exercise

Data workshop

In the interview with Niels Boye, it was mentioned that all data can be considered relevant for the system. The question was then about, what data the users would produce. A data workshop with a three-part purpose was created. The first purpose was to learn which data the potential users produce. The second purpose was to learn the users' requirements for a system that aims to collect data. The third purpose was about the user's considerations about sharing data.
Since data is produced by everyone and the attitude towards data can be similar for people with and without a chronic disease, the participants invited to this workshop were people in general.

Participants: Friends
Duration: 1,5 hour
Location: Aalborg University Copenhagen
Method: Co-creation workshop

Take outs
The collected findings has been listed as requirements for a service system, that aims to collect and utilise data from its users. The list both contains elements to include and not to include.

What the system should and should not contain:
- The system should be build to provide value for the users
- Allow healthcare professionals to learn from the system
- Clear choice about which data is shared and which data is displayed
- Empowering, user specific and preference-based guidance and feedback
- Focus on positive encouragement not a slap on the wrists
- High level of security
- Location based information about activities and offers

Top: The two groups during an exercise. Bottom: Energizer during the workshop

- Ongoing rating based on adjustment of system content
- The system should only use user requested reminders and in application notifications
- No commercials should be used in the system
- It should give the users control of their data
- Relevant and personalised data is important
- Allow the users to set their own goals

The requirements show some important considerations to take into account, when creating a data-based service system. These have been used as inspiration for what to include in the later workshops and tests throughout the thesis.

System co-creation

For the system co-creation sessions, a desktop walkthrough of a potential service system was prepared. The desktop walkthrough guided the users through a system concept, but left fields blank and allowed the user to mark the most important points in the exercise. This allowed the user to co-create the system with the group. The findings has been split into four sections and includes the elements that has had the largest impact for the prototype.

Participants: Type 2 diabetes people
Duration: 1/2 - 1 hour per session
Location: Online or at Health House Nørrebro
Method: Individual co-creation session utilising a desktop walkthrough

Findings

Configuration

- The participants expressed an interest in setting goals through the system, the main points of interest were: HbA1c, blood glucose, blood pressure, exercise, and their physical conditions.
- It was found that the users are interested in gaining knowledge and advices about food, exercise and body measurements related to diabetes (blood glucose, blood pressure, etc.).

Request about sharing data

- Getting people to share data should not be a large issue, most of the participants would share all datasets collected.
- The users would like to be informed about which research projects that uses their data.

System co-creations session with people from the motivation group

Consultation calendar
- There is an interest towards adding consultations to a calendar, getting reminders and adding notes about the consultation.
- Using the application during consultation: Half of the participants would be interested in using the data gathered during their consultations with a general practitioner.
- All participants was interested in automatically getting consultation information (values and notes) imported to the application.
- Syncing the calendar with the primary used calendar is a desired feature.

Feedback from the application
- The participants are very interested in getting feedback in the form of graphs and statistics. As well as advices about how to improve based on the data provided. Opinions on how feedback is provided was individual.
- Comparing information with other diabetes people was not something people were interested in.

The findings from this co-creation workshop has been a large part of developing the following prototype which has been used for tests. However, learnings from the previous workshops has also been included in the considerations.

Prototype test session

The test session of the prototype which has been created based on all the previous findings, gave a lot of insights connected to improvements to the prototype. However, this section will not focus on the improvements to the prototype, it will instead look at the overall feedback and suggestions to the overall idea of creating a tool to collect data, using it to assist the users in managing their condition.

Findings

The test included a usability test of the prototype together with a small supplementing questionnaire about the overall feeling of the prototype. Finally the users was rating the values, such a service could provide them.

Usability test
The overall feedback from the usability test was positive, the users saw a large potential in the application. The fact that it was made to gather and combine data from all relevant data sources was largely appreciated by the participants. Therefore, this is an important factor to include. The focus on encouraging the users to improve with positive feedback and not a slap on the wrist also got positive feedback.

> *"You are never too old to be rewarded"*
> Bo, participant (trans.)

It was suggested that it would be a particular good service for newly diagnosed people with diabetes and people with a motivation towards making changes.

By relating the prototype to the personas, the persona *Jakob,* who is not well regulated, but motivated is at a stage, where changes are necessary to progress thus making changes is a natural step.

People such as the persona *Mads,* who is well regulated and motivated, has their condition under control. Implementing a new system would require a lot of energy compared to the potential benefit, which makes him unlikely to use the system.

A person such as *Anna*, who is currently well regulated, but not motivated, or *Lisbeth*, who is not well regulated and not motivated could benefit from the service. However, since they are not motivated it would make it unlikely, that they would be interested in making the changes needed, to benefit from the system.

> *"Such an application is strongly needed, even if only some of the functionalities are possible"*
> Bo, participant (trans.)

> *"If it is going to be launched, call or write me"*
> Helle, participant (Trans.)

Considering the prototype and its layout, the questionnaire showed that the setup was simple to navigate. The amount of text on the different screens seemed to be a bit too much and some of the other screens required additional refinements. This being said the general layout of the prototype was appealing to the user.

As part of the workshop an interview with two diabetes people was conducted, the following two additions are findings from these interviews. These functionalities are not considered a priority in the proposal of the service, however the ideas can for some people with diabetes generate value, therefore they can be considered part of a future implementation of the service.

Additions

- Add a traveling checklist to the application, to help the users remember all the important things, e.g. medicine.
- Add emergency access to overview of patients medicine, inspired by Apple Healthkit.

Additional exercise

As an addition to the test the thesis group had made an exercice, to allow the test participants to highlight the value of the service and the primary points that would make them use this service. The following two figures will present the words and sentences used by the participants to describe the service (Figure 8-9).

Test sessions

Figure 8 - *What does the application do for you*

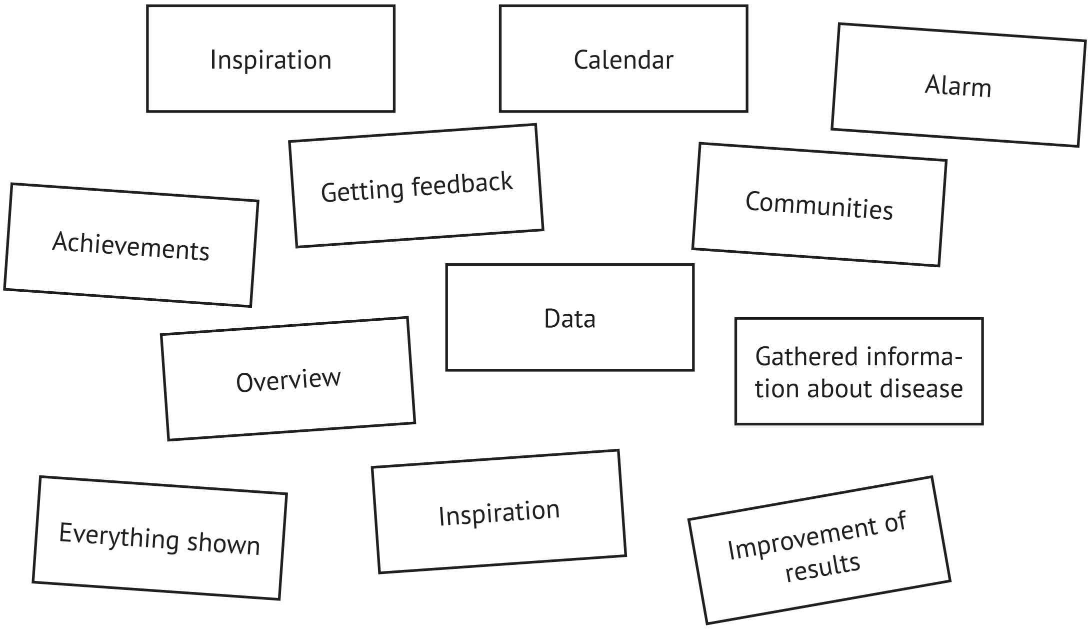


Figure 9 - *What would make you use the application*

THE SERVICE

The previous section has described the research and findings made throughout the thesis. These findings has all aimed towards creating a service, which would fulfill the problem statement and be able to help users better regulate their disease, while collecting data for research. Even though the service is still quite conceptual, this section will elaborate on the service in its current state and present an evaluation of the functionalities fulfillment of user needs.

// STAKEHOLDERS IN THE SERVICE

(Figure 10) will present a stakeholder map centred around the user. The stakeholder map is made to give an overview of the actors and stakeholders included in the service, and how these are connected.

The map groups the actors and stakeholders based on their primary role according to the user (the blue circles). All stakeholders included in the map are considered important for the service to work as proposed, and for it to be able to fulfill the users' needs as suggested in the final section of this chapter.

The arrows between the different actors and stakeholders in the map defines the data, support or/and participation between them, to underline the links.

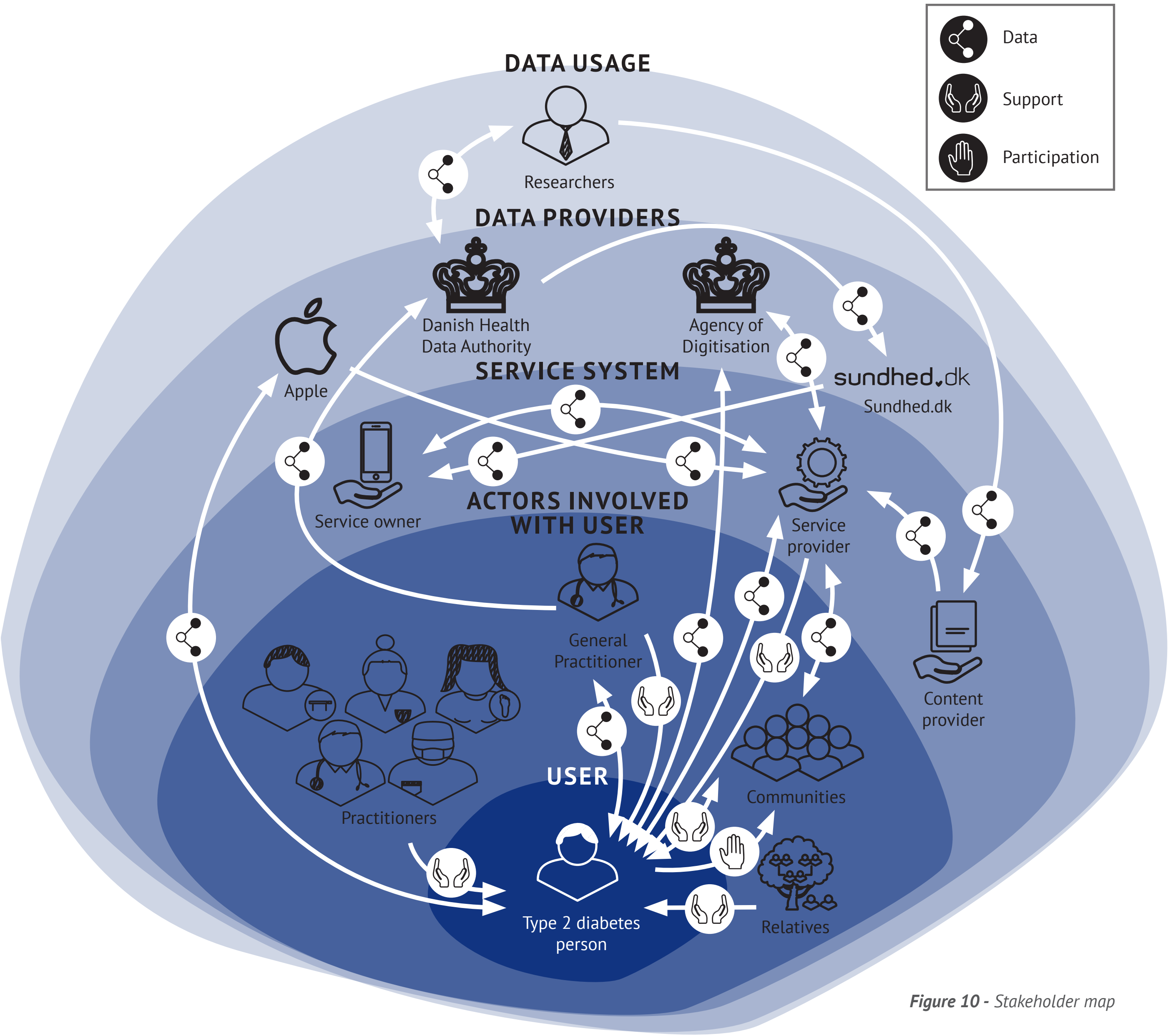


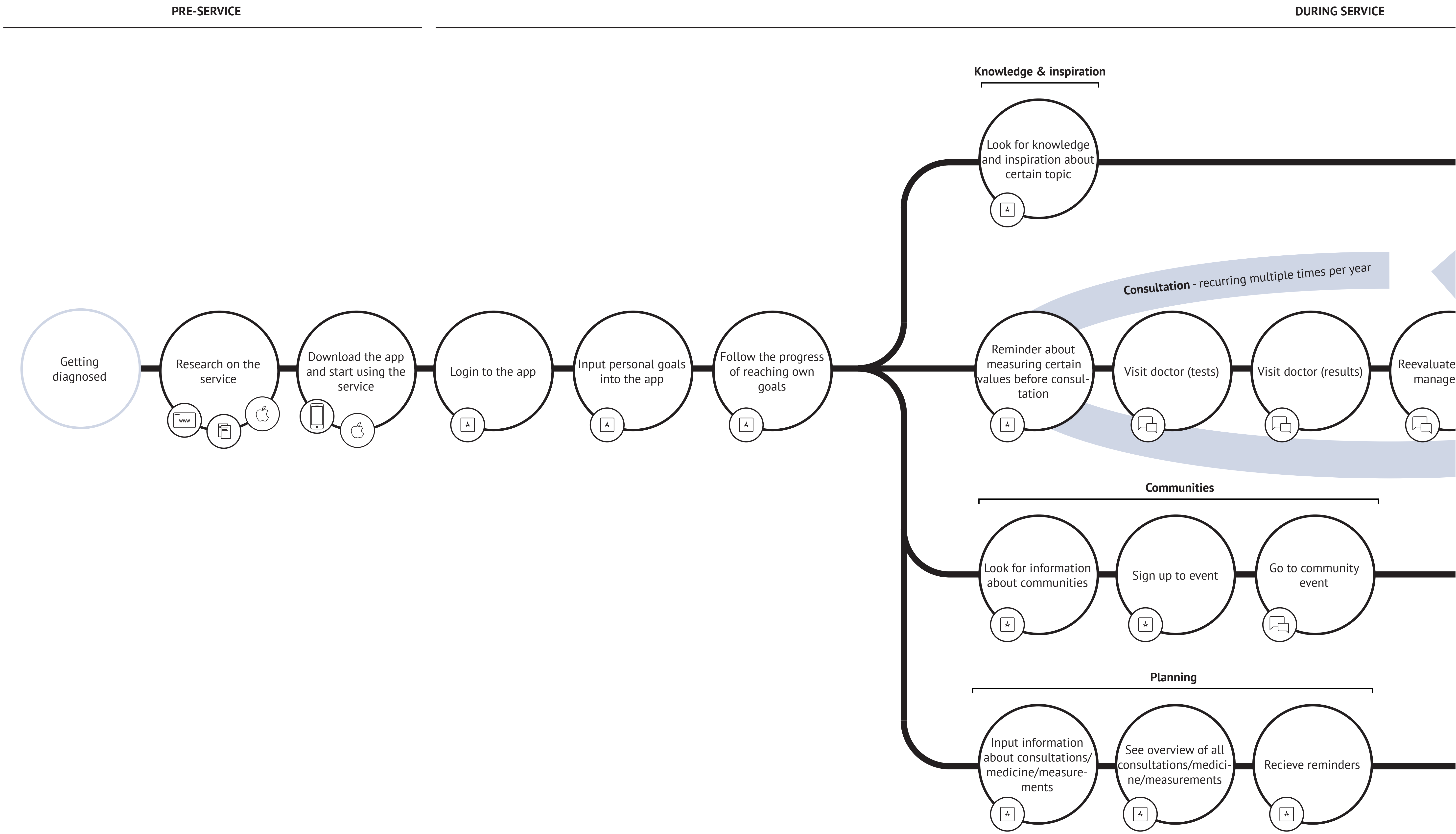
***Figure 10 -** Stakeholder map*

// USER JOURNEY

To provide an overview of the final service solution a user journey has been made (Figure 11). A user journey is used to give an overview of a customer or user's experience with a service and the processes in the service (Stickdorn, M., Schneider, J., 2011). This journey has been created to give insights into how the user experiences the service from beginning to end and will explain how the service ideal would function in the future.

The journey consists of a user's overall one-year journey with the service, from the user are being diagnosed with diabetes and forward. The figure displays four different functions that has been included within the service.

1. **Consultations** - represents how the service can assist the user through all the regular consultations they attend.
2. **Communities** - a function to help the users localise available offers e.g. a place to exercise.
3. **Planning** - a function that helps the user plan the activities related to having diabetes e.g. consultations.
4. **Knowledge and inspiration** - a database that supplies the user with relevant, updated and useful knowledge e.g. about diet.


PRE-SERVICE
DURING SERVICE
Knowledge & inspiration
Look for knowledge and inspiration about certain topic
Consultation - recurring multiple times per year
Getting diagnosed
Research on the service
www
Download the app and start using the service
Login to the app
Input personal goals into the app
Follow the progress of reaching own goals
Reminder about measuring certain values before consultation
Visit doctor (tests)
Visit doctor (results)
Reevaluate
manage
Communities
Look for information about communities
Sign up to event
Go to community event
Planning
Input information about consultations/medicine/measurements
See overview of all consultations/medicine/measurements
Recieve reminders

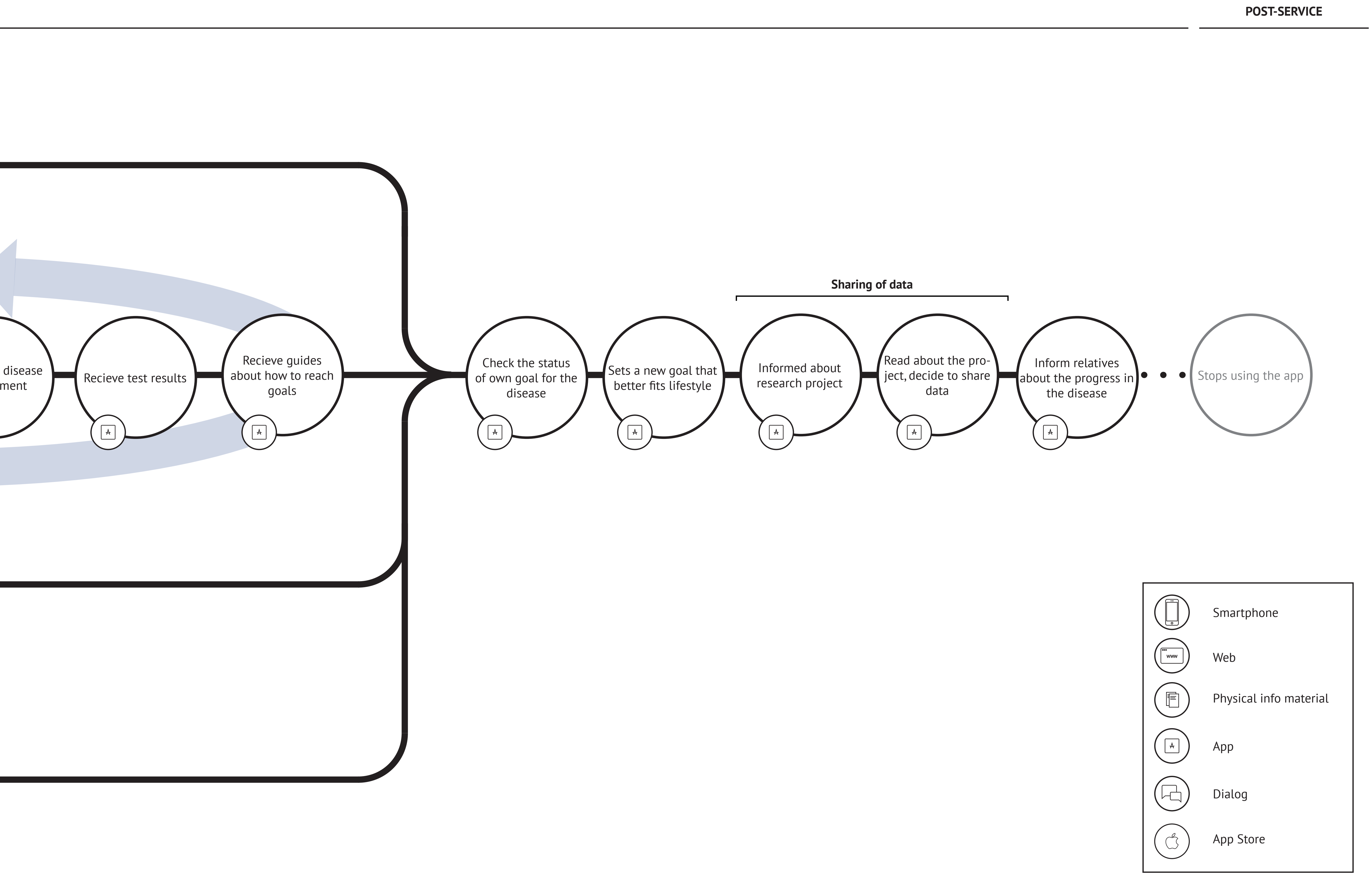


Figure 11 - *User journey*

// BLUEPRINTS

The following blueprints are used in order to describe the future service in depth, and how it ideally would function (Figure 12-14). A service blueprint is a model used to describe the elements of a service. Three blueprints has been developed together with scenarios to showcase the use of each blueprint for the service. They are as follows:

- Blueprint #1 - Pre-service & start
- Blueprint #2 - Data & overview
- Blueprint #3 - GP check-up

The three blueprints represent important parts of the service.

The blueprints consist of a series of horizontal blocks that each represents a group of actors (main users, healthcare professionals, healthcare system, communities, and relatives). In the bottom of the blueprints the frontstage and backstage of the service are described. The frontstage describes the visible aspect of the service while the backstage presents what is going on in the service - 'behind the scenes'.
Time are being shown in the top of the blueprints. It is used to give an overview of how long time each process takes. The amount of time for each process are an estimate made by the thesis group and are not based on exact documentation.
In the bottom right corner of each blueprint a description of the symbols used in the blueprints can be found. It explains what each symbol and touchpoint used in the blueprints represents.

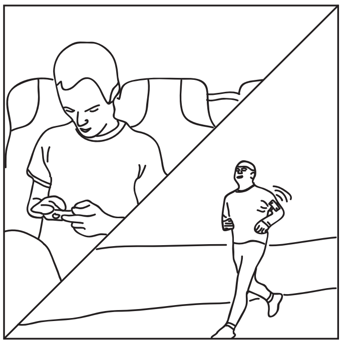
BLUEPRINT #1
PRE-SERVICE & START

Gets introduced to the service and decides to start using the app to better handle the disease.

→

Learns about what a goal means, and input own goals into the system

→



Starts to use the service on a daily basis. Experience how nice it is to have everything about the disease in one service.

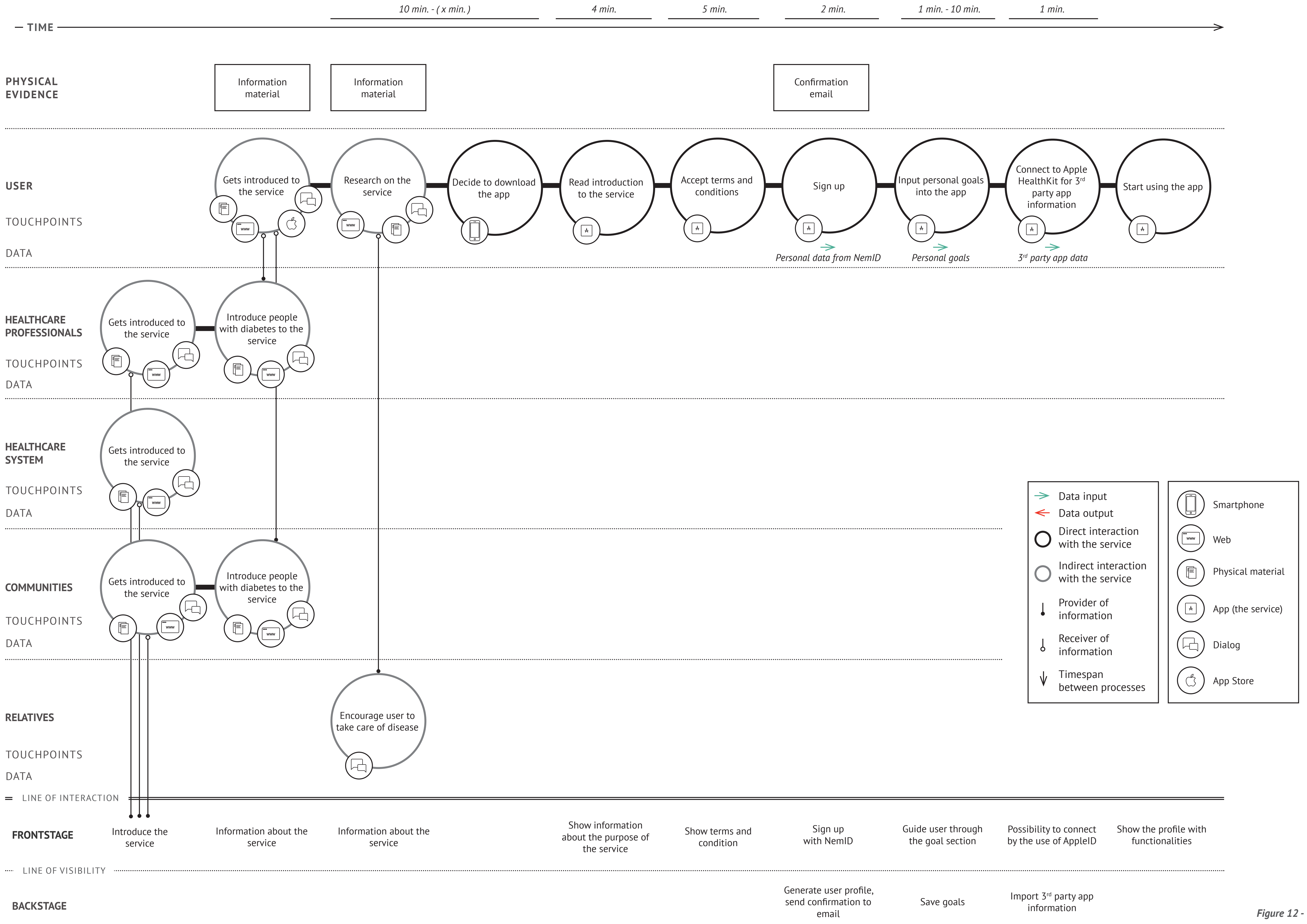
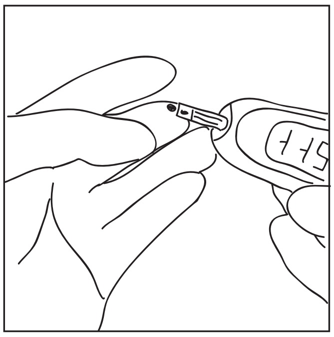


Figure 12 - Blueprint #1

BLUEPRINT #2

DATA & OVERVIEW

Is being reminded about measuring blood glucose



Performs measurements and inputs values into the system

Receives guidance about how to reach goals

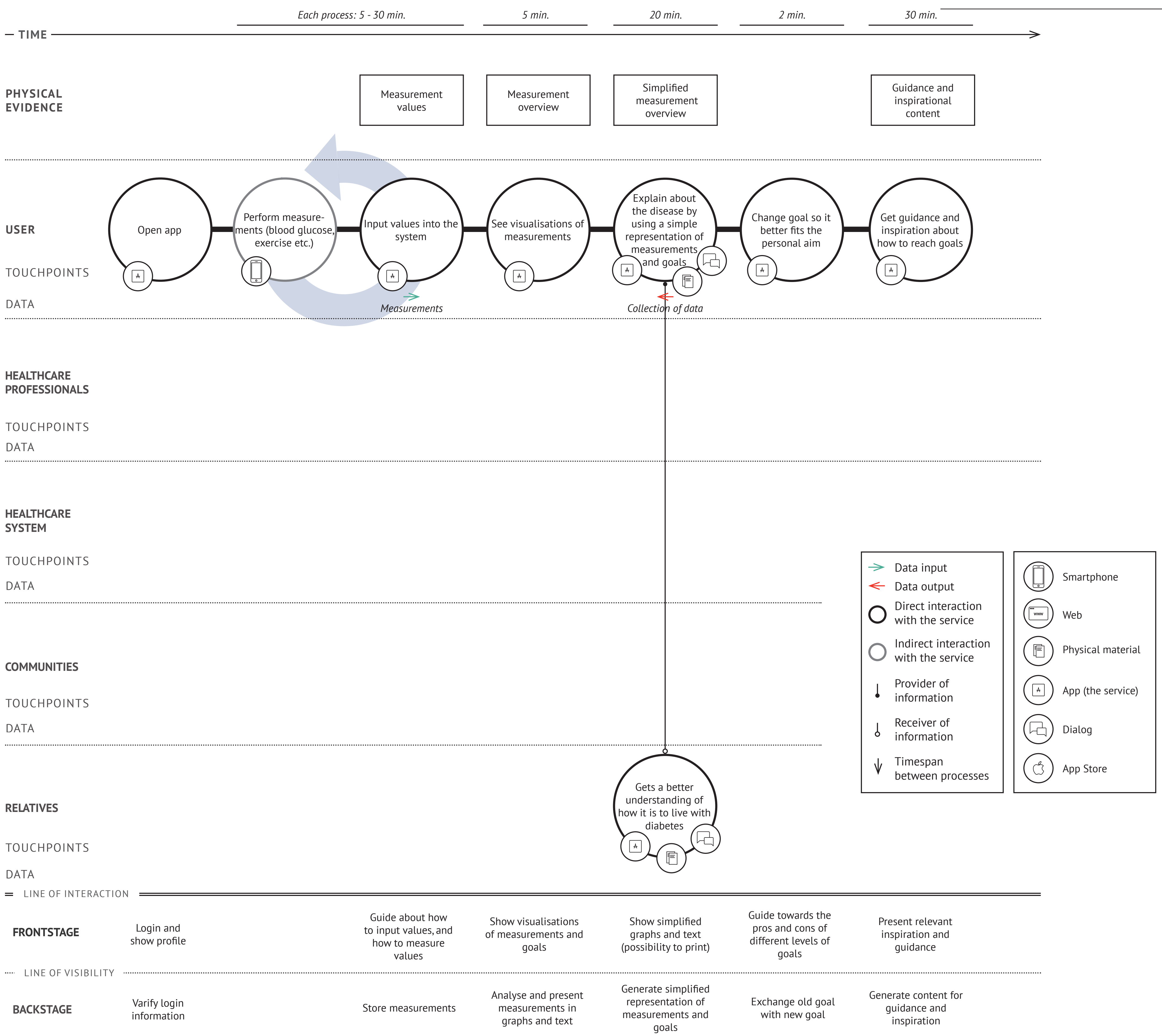


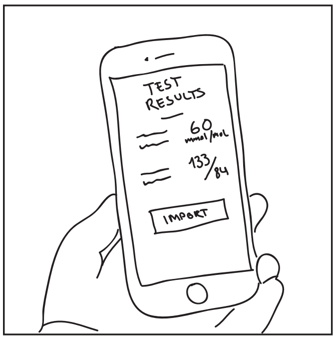
***Figure 13 -** Blueprint #2*

BLUEPRINT #3

GP CHECK-UP

Reminder about GP appointment and measurement before going to the consultation

Visits GP for check-up and tests. Shows GP own measurements in the app.



Recieves test results from GP and looks at the test results

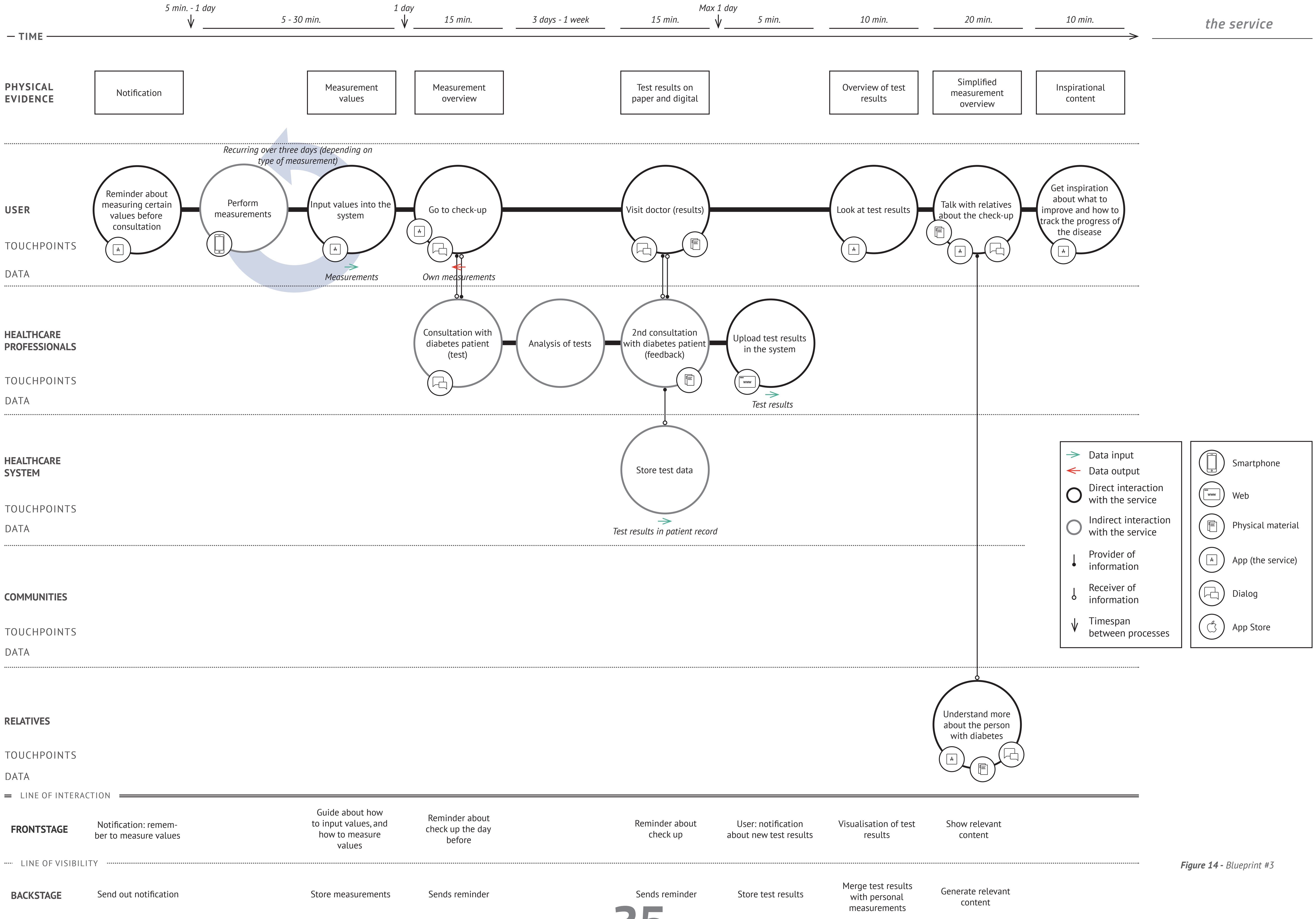


Figure 14 - *Blueprint #3*

// THE SYSTEM

The previous sections has described the service from the users' perspective through the user journey and blueprints. This section will look at the service from a more technical perspective, giving an overview and a visual representation of the more technical aspects of the service, by showing what is happening in the frontstage and backstage of the service and by visualising the flows of data (Figure 15). The map also shows where the data is stored, how the different actors are connected and what they provide each other and the service system. The suggested map only shows the part of the system that has been designed for this project. A larger system map would be needed in order to illustrate the whole eco-system surrounding the service.

Frontstage: Meant by frontstage, is all interactions that is directly affecting the service system, actions the user or actors within the system are aware of.

Backstage: Meant by backstage, is all actions that happens behind the scenes that the actors or users are not necessarily aware of.

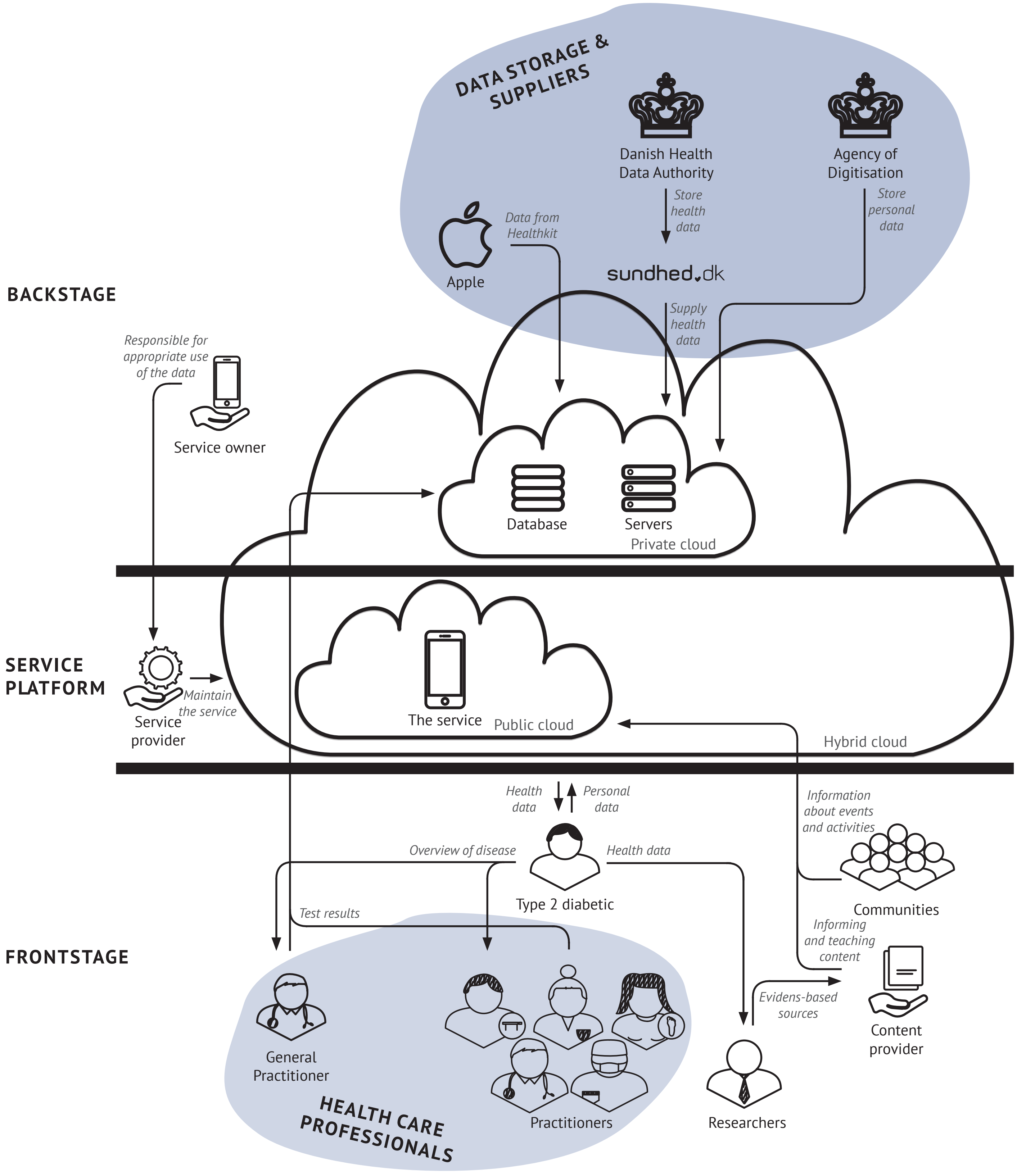


Figure 15 - System architecture

// SERVICE EVALUATION

To evaluate on the service created, its functionalities and their fulfillment of the users needs, a matrix giving an overview of the different needs and functionalities and to which extend the service fulfills these has been created, see (Figure 16). The needs and functionalities included in the matrix are deduced from the different interviews and workshops mentioned in the previous chapter (Key findings from design process p. 15). The needs included in the matrix are needs from the diabetes people and their needs towards the healthcare system. The functionalities included in the service system are based on the same research and are created to fulfill the needs.

The service evaluation scores the different needs and functionalities based on four parameters; direct fulfilment, indirect fulfilment, future fulfilment and no fulfilment. The scoring are rated as follows:

- Direct fulfilment gets 2 points
- Indirect fulfilment gets 1 point
- No fulfilment gets 0 point
- Future fulfilment gets 0 points

This way of rating the service means that the elements of the service which are the most fulfilled are the ones with the highest scores.

The most fulfilled needs by the service

- The need that are most fulfilled by the service is the need of an individual and customised tool to control and keep track of their disease.
- The secondly most fulfilled need is to have a place to gather all the existing and relevant health data from existing systems like *sundhed.dk, medicinkortet,* and *Min Sundhedsplatform*. This creates the option of getting an overview of both quantifiable self and other types of data related to their disease.
- The needs rated highest after the previous needs are the possibility:
    - to gather the numbers and notes from the general practitioner
    - to get inspiration and guidance about diet, exercise, and communities based on their profile
    - to get guidance after receiving their diagnosis about health offers
    - to have an better overview of all their measurements.

The most relevant and fulfilled functionalities by the service

- The functionality that is rated most fulfilled in the matrix is the gathering point for all their relevant data.
- The second highest rated functionality is a place to keep track of their disease
- The functionalities rated best, after the two previously mentioned functionalities are:
    - support in the decision-making and measurements consulted by Vibeke,
    - the service should be adjustable from user to user
    - should help the user to plan their consultations easier

The only need that is not fulfilled in the matrix is the need of better collaboration between healthcare professionals.

The needs and functionalities with the highest scores are the ones which should be considered the most important factors in the service system. If each of the functionalities are implemented and used as desired, it can be assumed that the service covers the primary needs of the people with diabetes and the healthcare system.

EVALUATION FACTORS

●	Direct fulfilment	2
○	Indirect fulfilment	1
	No fulfilment	0
☼	Future fulfilment	0

THE FUNCTIONALITIES	THE DIABETES PEOPLE											HEALTHCARE SYSTEM					
	Get an overview of consultations	Get an overview of measurements	Guidance after receiving diagnosis about disease	Guidance after receiving diagnosis about health offers	A helping hand to communicate the disease to relatives	A individualised and costomised tool	A place to gather all existing and relevant health data from existing systems	Gather measurements and notes from GP	Get inspiration and guidance about diet, exercise and communities related to diabetes	Better guidance from HCP	Better collaboration between HCP	Make the citizen take control of their own disease	More cost-efficient treatment	To figure out what citizens do next to the consultations, to improve advices in their treatment	To find correlations in healthcare data	To get more data to research about diabetes to exterminate the disease	TOTAL
Personal goal		●			○	●	●	●				○				○	11
Notes		Relation between goal and measurements				The user can choose what to measure	Data can help to choose goal	Data can help to choose goal				First step of empowerment				Shows what the citizens want their value to be	
Adjustable for each user	●	●		●	○	●	●	●	●								15
Notes	Able to choose how often	Able to choose how often			The possibility to show condition to relative	Add and deselect choices	Add and deselect choices	Add and deselect choices	Add and deselect choices								
Inspiration in the app				●	○	●			●								9
Notes					Find things to do together, cases and stories	Based on individual interest											
Keeping track of the disease	●	●			○	●	●	●		☼		○	○	●	●	●	19
Notes						User choose what to track, app can remind	The more measurement, the better overview	The more measurement, the better overview		Measurements could be used by HCP to improve advices		Could help the citizen to take control	The data could help users to act on swings		Long term possibility		
Ownership of own data						○	○	○				○					4
Notes						Can help to take ownership	Can choose to use the data or not	Can choose to use the data or not				Give the responsibility to the diabetics					
Gathering point for all relevant data	●	●		●	●	●	●	●	●	☼		○	○		●	●	22
Notes	Creates overview of all data	Creates overview of all data		Also a relevant data type	Show all data and overviews to underpin case	Possibility to choose what to gather	Relevant data	Relevant data	Relevant data	The overview of data could help to infer from context		Help to make overview to take control	Creates potential for changes in cost		Possibility to create correlations in data	Possibility to gather datasets	
Help to find communities and societies				●	○	●			●	○		●					10
Notes				Concrete offers	Communities could give advices to communicate disease	Add and deselect choices						Self-care					
Short cut to contacts related to the disease			●	○		●	●			●			○				10
Notes			Easier to contact HCP	HCP could help to suggest offers		Personal contacts to HCP are coded in	Gather contacts through NemID			Easier contact, easier to get advices			Avoid consultation - not if hypochondriac				
Easier planning	●	●		○		●	●	●				●					13
Notes				Easy to find in the app		Template to a wide range of users	See all reminders, schedules in one place	See all reminders, schedules in one place				Diabetic takes control of their own schedule					
Advices based on interest				●	○	●			●	○		○					9
Notes				Advice to health offers based on interest	Give advices to explain the disease				User can choose itself	Evidence-based advices		Unsure if the user will act on the advices					
Support in the decision-making and measurements		●	●			○	●	●	●			●	○		●		16
Notes		Gives overview to help take the decision	Gives information to support decision			Individualisation helpd to support right	Measurement and overview helps to support	Always available and notes of what to do	Personalised help/advices to support decision			Supports, but gives the control to the citizen	Could be, if citizen act on their own		Correlations can find patterns to support		
Choice of sharing data with HCP and scientific work						○								● (if user share)	● (if user share)	● (if user share)	7
Notes						The users choice of sharing								Daily patterns of measurements	Scientists can analyse the data	Possibility to have data for scientific work	
TOTAL	8	12	6	12	8	21	15	13	12	4		11	4	4	8	6	

Figure 16 - *Service evaluation matrix*

// SERVICE USAGE

To display how this service might affect the life of a person with diabetes, this section will through a few simple scenarios based on *the most fulfilled needs* from the previous section give examples of the service in use.

Some of the needs have already been described through scenarios and service blueprints earlier, these are:

- *Individual and customised tool to control and keep track of their disease*
- *Gathering all existing health data in one place*
- *Show test results and notes from the general practitioner*
- *Give an better overview of all the measurements*

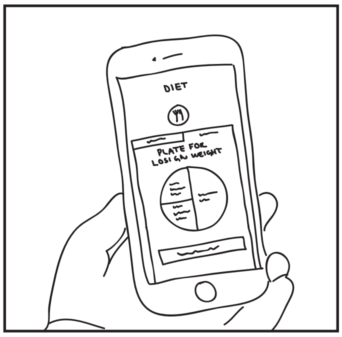
These will not be elaborated further upon in this section. Instead, two of the other most relevant needs will be described through a use case by a screen from the prototype. This will display how the service can assist a person in a real case and how a screen from the application might look.

The needs are the following:

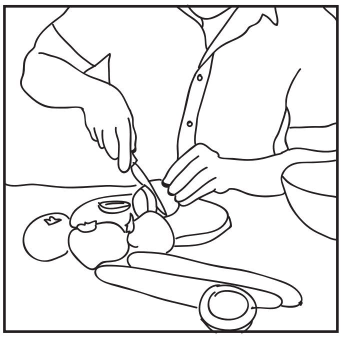
- Inspiration and guidance about diet, exercise, and communities
- Assist with guidance after receiving their diagnosis about health offers

Inspiration and guidance

Gets hungry and want to cook some food. Want to learn about how to cook healthy food.

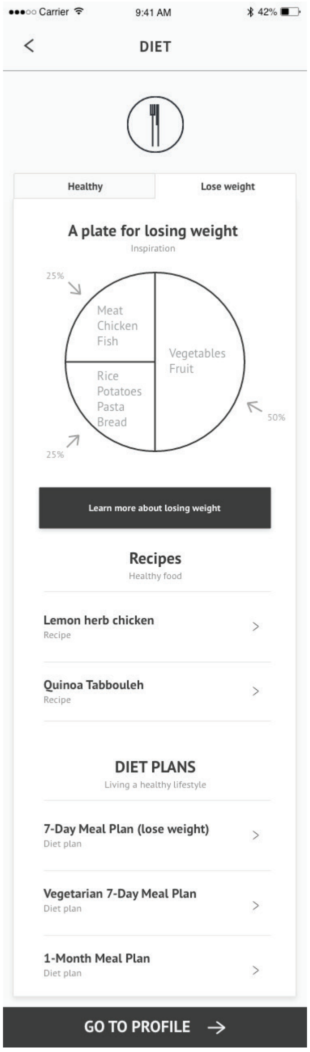


Opens the section about diet in the app, and choose to see information about loosing weight.



Cooks food based on what he just learned about a healthy diet

The scenario describes a situation where an element from the knowledge database could be relevant, in this case it is information about diet. The screen suggested to help a user in such a case consists of a visualisation of the amounts that the person should consume, recipes, and diet plans (Figure 17). This enables the user to easily build a meal that suits his requirement of losing weight.



A plate for losing weight
Inspiration

Recipes
Healthy food

Lemon herb chicken
Recipe

Quinoa Tabbouleh
Recipe

DIET PLANS
Living a healthy lifestyle

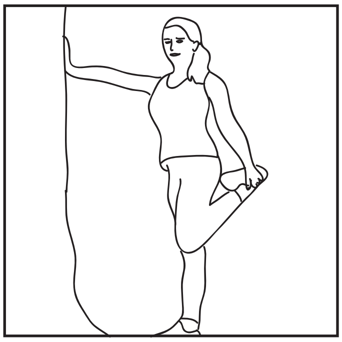
7-Day Meal Plan (lose weight)
Diet plan

Vegetarian 7-Day Meal Plan
Diet plan

1-Month Meal Plan
Diet plan

Figure 17 - *Prototype, inspiration and guidance*

Health offers

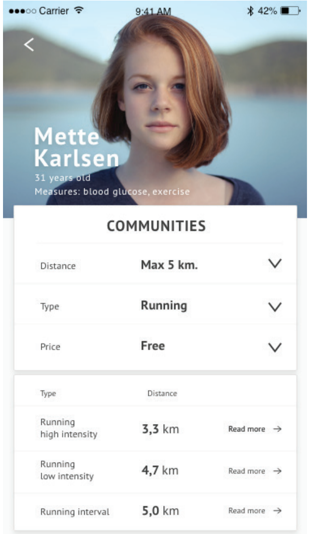


Tired of exercising alone. Wants to join a running community.

Chooses a running community that are close by, and signs up for a training the next day.

Joins the training and enjoy exercising together with other people.

This scenario describes a user who are interested in starting to workout with other people. To meet this need the communities function has been included in the application (Figure 18). This is meant as a collection of events, activities, and offers the user can join through the application. The function should allow for easy filtering of the activities e.g. according to age, type, activity level, price, and location relative to the users location. These filters enables the user to get quick access to the activities of interest.



Mette Karlsen
31 years old
Measures: blood glucose, exercise

COMMUNITIES

Distance	Max 5 km.
Type	Running
Price	Free

Type	Distance	
Running high intensity	3,3 km	Read more →
Running low intensity	4,7 km	Read more →
Running interval	5,0 km	Read more →

***Figure 18** - Prototype, health offers*

OUTCOME

The previous section described the service system created based on the finding in depth. Throughout the following section the motivation and roles of the actors connected to the service will be described.

// MOTIVATION IN THE SERVICE

A wide variety of actors are a part of the service, which often results in different expectations and agendas. The motivation matrix (Figure 19) are used to examine the actor cooperation and is an important tool when trying to understand what each actor brings to the system (Morelli, N., Tollestrup, C., 2007).

The blue boxes in the motivation matrix represent what the actors get out of being a part of the service. The grey boxes represent the cases where there are no direct cooperation between the actors in the service.

GIVES TO	USERS	HEALTHCARE PROFESSIONALS	HEALTHCARE SYSTEM	SERVICE OWNER	SERVICE PROVIDER	RESEARCHERS	RELATIVES	COMMUNITIES
USERS	- Overview of own disease - Easy management of disease related activities	- Information about overall health - Understanding patient motivation - What happens between consultations	- Quantified self data - Data for research purposes - Information about health	- Sensitive personal data	- Input about service performance	- Approval for use of data	- Better information about the life living with diabetes	- Support activities and events - A reason for continue arranging activities
HEALTHCARE PROFESSIONALS	- Precise treatment possibilities - Results from tests - Guidance and advices	- Improved patient treatment						
HEALTHCARE SYSTEM	- Possibility for improved treatment in the future	- New best practices of treatment	- Better treatment of diseases - Less patients at the hospitals - Lower cost	- Funding	- Guidance about disease management	- Health data		
SERVICE OWNER	- A secure system - Confidential storage of sensitive personal data - A service specified for people with type 2 diabetes	- Possibility to learn more about what the diabetes person does between consultations	- Data about diabetes people	- Improving the danish healthcare system	- Funding	- Provider of data for research projects with acceptance from the user		- Promotion possibilities
SERVICE PROVIDER	- An updated service - Help and guidance - New content - Support	- Visualisations of the diabetes people's personal data		- Well functioning system	- Happy users - The best system for people with diabetes		- A way of communicating how to live with diabetes	- More participants
RESEARCHERS	- Possibility for improved treatment in the future		- Evidence based articles and reports	- Evidence based articles and reports	- Evidence based articles and reports	- Provided with more patient data - Good research results - Acknowledgement for research		
RELATIVES	- Interest in supporting the person with type 2 diabetes						- Understanding the person with diabetes - Being able to help in a better way	
COMMUNITIES	- Events and activities - Motivation - Guidance	- Motivated citizens	- Motivated citizens	- Content (events & activities)	- Content (events & activities)		- Motivated person	- Promotion of events and activities - Helping people with diabetes

Figure 19 - *Motivation matrix*

// ROLE SCRIPTS

In connection to the implementation of the service, role scripts for each of the actors have been made. The role scripts are used to explain the intended roles of the actors in the service and will contain the primary tasks and a good advice for each actor.

Service owner

The primary tasks:

- Responsibility of data storage
- Securing the sensitive personal data

A good advice

“You have the responsibility for a secured data storage. Make sure to keep the database encrypted, and make sure the user decides what data should be shared.”

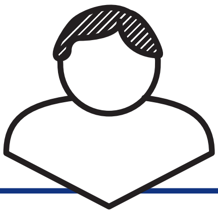
Service provider

The primary tasks:

- Responsibility for the frontstage of the service
- Responsibility for the backstage
- Taking care of the content in the service
- Supporting the users
- Responsible for the implementation of the application

A good advice

“It is important you make sure to keep the content updated and make regular user research to accommodate the developing needs of the users.”



The user

The primary tasks:
- Gather quantifiable data
- Manage own data
- Act according to the recommandations from the service

A good advice

“This is a service made for you. We advise you to fill in your goals towards your disease, for us to better create personalised content assisting you with your disease management. Go and explore the app!”

The healthcare professionals

The primary tasks:
- Enlighten the patient with the right knowledge about the disease
- Supporting the patient in the disease
- Inform the patient about the service

A good advice

“Make sure the patient feels enlightened about the disease and give them support so they know how to live with it. Inform the patient about this service, giving them a tool that can help them in between the consultations.”

The healthcare system

The primary tasks:

- Improve the process of how diseases are treated
- Set the overall framework for the provision of health

A good advice

“It is important that you use the data that are produced by the diabetes persons, to improve treatment and processes.”

Communities

The primary tasks:

- Keep the information about events and activities updated

A good advice

“It is important for people with diabetes to have communities to participate in, in order to be motivated. It is important to offer a variety of different events since people with diabetes are a very diverse group.”

// OWNERSHIP

The following section will describe a service model (Turner, N., 2015), showing the service in it's current state (Figure 20). The canvas is considering the future scenario where the service concept would be finished and ready for implementation.

The service model canvas has been used as a tool for discussion, this means that some sections might not be entirely elaborated, but is the current proposal to a service model.

The service model describes who the users around the service are, who delivers the service, the key activities in the service, the challenges and competitors as well as the performance of the service by considering the service as a business looking into KPI (Key performance index) and ROI (Return on investment).

USERS

Users

Primary target group:
- Type 2 diabetes people familiar with digital devices
- Especially newly diagnosed

Other potential users:
- Citizens with other chronic diseases
- Citizens with technical knowhow, interested in collecting private data and sharing data for research

Service proposition

Personal empowerment
- Overview
- Guidance
- Inspiration
- Ownership of own data
- Gathering point for all data

External
- Communication with relatives
- Help improving research conditions

Channels

- Mobile application (IOS, Android)
- Website

Usage

Regular usage (daily)
- Inputting measurements

Less frequent usage (A couple of times a week)
- Checking progress
- Accessing knowledge database

Rare usage
- Joining communities

Lifecycle
- Long user lifecycle, frequent usage equals a more meaningful system

SERVICE DELIVERY

Actors

- Sundhed.dk (Owner, providing a trustworthy name)
- Specialists e.g. dietician, doctors (Validating content)
- Journalists (Content creation)
- Community providers (adding activities)
- Development team (building and maintaining the service)
- Support team (assisting users)

Key activities

- Generating meaningful content (knowledge database)
- Providing guidance (preference based suggestions)
- Update website and app
- Promote the product
- Resolve support issues

RISKS

Challenges

- Providing users with supportive but not interventive feedback
- Creating a habit for users to use the service
- Gathering enough data for it to be relevant and to earn revenue
- Convincing communities to join into the idea
- Convince users that continuously gathering data can support their disease management

Competitors

- Google Fit
- Systems allowing for indvidual tracking (Kulhydrat, Endomondo)
- Dia+ (Diabetes foreningen)
- Bluestar

PERFORMANCE

ROI

Economic
- Income from healthcare sector (using data for research)
- Funding from research institutions (using data for projects)
- Infrastructure costs (servers etc.)
- Support, development, and content creation costs

Empowerment
- Users reducing medicine usage
- Increase in user well being
- Precise and effective care

KPI

- Number of active users based on frequency
- % of users actively contributing to data sets
- Increase in user wellbeing
- User satisfaction

Figure 20 - *Service model canvas*

CONCLUSION

The following section will describe some recommendations for the primary receiver of this report, sundhed.dk. Furthermore, the overall conclusion based on the problem statement and overall goal of the project will be presented.

// RECOMMANDATIONS TO FURTHER DEVELOPMENT

As this presentation report is presenting a not fully developed service, some recommendations for the further process of the project will be presented in the following section.

Create value in the service

When designing this service, it it is important to remember that the design can not be based purely on the intent of gathering data without considering the user's needs and creating value for the users. If the users do not see a value in using the service, no users will use the system, and no data will therefore be generated.

Find more users

Since the numbers of participants used to develop the service idea has been few, the further development of the service are in need of more users and actors to backup the empiric evidences.

The research until now shows a big diversity of possible user's of the system, which requires the system to focus on the individual user and the user's personal generated data. Therefore, working towards an algorithm-based service capable of accommodating feedback to the individual user is worth aiming for.

It is important to be aware of how diverse the target group is. The personas can for example be used to remember how different people can be.

Work towards a MVP

The features incorporated in the service at the current state are many, which is why a MVP (Minimum Viable Product) could be recommendable. The MVP could be used to launch the most important features in the service, and afterwards consider the other features in the pipeline parallel to the feedback from the initial users of the service.

The features recommended by the thesis group as the most important are a system to gather the personal quantifiable self data and compare them with the health data. Furthermore, to support the type 2 diabetes people to be empowered in their own disease by setting goals for their disease and by the gathered data.

Knowledge to take responsibility or to get the response ability

Research has shown that the diabetes person do not get enough information about the disease when being diagnosed. Knowledge about the disease is important for the diabetes people in order to take responsibility of their own health, that in the longer run will make the diabetes people get the ability to respond on their condition themselves.

// CONCLUSION

This section will conclude on the thesis based on the research conducted and design development throughout the thesis. However, due to the small amount of participants included in the process, it is not possible to make any definitive conclusions.

The purpose of this thesis has been to research the potential of data in applied service design. It was done through a case study of data used to empower citizens with type 2 diabetes.

Data shows huge potential in the field of service design. One possibility it provides is to create personalised and customised services, which the users demands. The methodological approach behind service design is useful when designing services that include data. Data has through service design methods become a valuable resource for the healthcare system (the companies who deliver the service) and to assist in meeting the user's needs (providing value to the user).

In order to answer the case study, the following problem statement was made:

> *"How can a service system utilising quantified self data, empower citizens with type 2 diabetes, to take responsibility for their disease by supporting them in their decision making?"*

The service system gives an example of how the citizens with type 2 diabetes can gather their quantifiable self data and connect it with data produced in the healthcare system. The mix of these two data streams help the citizens to get personal and customised guidance towards improving their health. Ultimately making the citizen take responsibility and making him aware of the effect of his decisions.

Empowerment can only happen when the person himself accepts his condition, takes responsibility for his own health, and is motivated towards doing something about it. Empowerment has been incorporated into the service through a section in the application, which informs the diabetes person about an area related to his disease (e.g. blood glucose, blood pressure). Afterwards he is allowed the chance of setting a personal goal related to the area, making an informed decision based on the information provided. Following, the system will be based on the decided goal advising the person in reaching his goal.

The support of the type 2 diabetes person is happening through the advices and guidance the system gives the person towards reaching his previously set goal.

The service development and tests conducted revealed that the target group, who would be interested in using the service, can be narrowed further. It has been suggested multiple times that the service could be especially useful for newly diagnosed people with type 2 diabetes and people who were not currently well regulated but were motivated towards doing something about the disease.

Based on the interviews and workshops conducted through this study, it was found that people with diabetes are in need of better guidance and support towards their disease – elements that are not fulfilled by other actors. It can not be concluded if the service system manages to empower the people with diabetes due to the type of tests completed. The tests conducted were focussing on evaluating the importance of different elements through usability tests and value mapping. In general the test participants were positive towards the service system. In various cases they stated that they would like to try using the system in their everyday life.

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