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Designing a Business Model for Remote Consultation focused on Medical Councils

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Chapter 1

Introduction

Business Models are an essential part of today's modern economic world. The rising number of publications on this topic prove this assumption to be right. (Osterwalder et al. 2005)

In this section a short introduction on the topic will be given. First of all the definition of a Business Model will be clarified and followed up by a summary of the main components of a Business Model and its role in the modern business world.

1.1 Definition of a Business Model

Since the Business Model Concept is a fairly new idea coming from different disciplines like eBusiness, technology, strategy and management it is not very well defined and has different interpretations. (Al-Debei & Avison 2010)

Osterwalder et al. (2005) came up with a definition that is sufficiently broad to fulfil the different interpretations of the Business Model Concept and wrote:

“ A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences. ”

1.2 The Business Model Concept

When talking about the Business Model Concept it is important to briefly describe the purpose of a Business Model. The Business Model is situated between a company's business strategy and business processes. It serves the purpose of linking these two worlds and to communicate the business strategy in an easy to understand fashion. In figure 1 the position of the Business Model is shown using the Business Logic Triangle. (Osterwalder & Pigneur 2002)

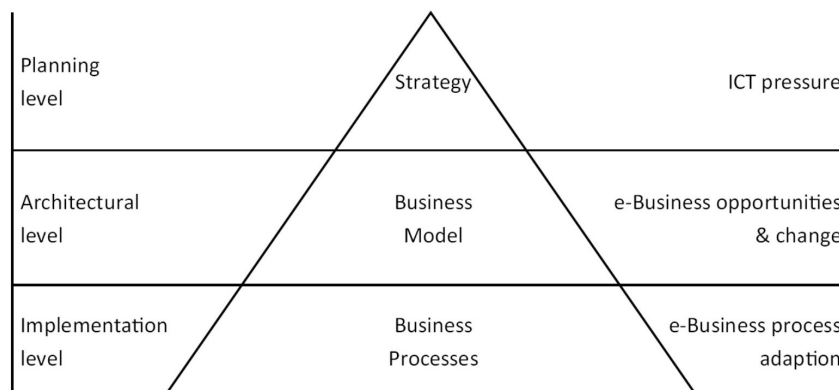


Figure 1: Business Logic Triangle (Osterwalder & Pigneur 2002)

Osterwalder & Pigneur (2002) identified 4 main components or pillars of a Business Model. These pillars are the essential components which are required to describe a business. Each pillar can be further decomposed in order to increase the level of detail and show the actions and measures that are needed for this specific pillar. Furthermore all pillars interact with each other and are somehow dependent on each other. In figure 2 the interaction between those pillars is shown. (Osterwalder & Pigneur 2002)

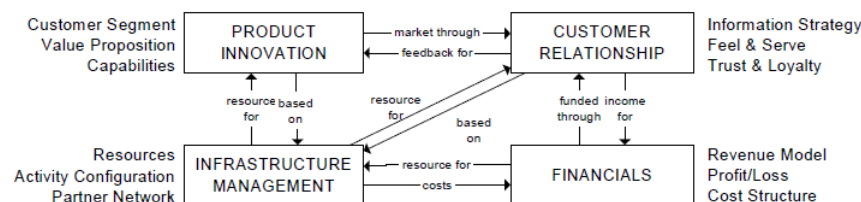


Figure 2: 4 pillars of a Business Model (Osterwalder & Pigneur 2002)

1.2.1 Product Innovation

The first cornerstone is named "Product innovation". Every company that wants to be successful on the market needs to offer a product or a service. It is not only about which product or service a company offers, it is also about how the company differentiates from its competitors. Taking a closer look at the Product Innovation pillar, three core elements can be found. (Osterwalder & Pigneur 2002)

According to Osterwalder & Pigneur (2002) these elements are:

- Value Proposition
This element describes the specific value a company offers to a specific customer segment or in other words how a company creates value for a specific customer segment.

- **Target Customer**
Since a company aims its products to a specific customer segment it is necessary to state who this group of customers are, which product segments are considered and where and where not to compete.
- **Capabilities**
In order to achieve value creation a company needs specific capabilities in order to create value. These capabilities can be understood as the basic actions necessary to produce and/or offer services and products to the market.

The results of Product Innovation are marketed through the Customer Relationship element, which provides customer feedback on the products at the same time. In order to create and or offer products to a market infrastructure is needed and therefore the Product Innovation element is based on the Infrastructure Management element. (Osterwalder & Pigneur 2002)

1.2.2 Customer Relationship

This element summarizes how the company deals with customers in general. It describes how the company interacts with customers to gather information about existing products or the general opinion about the company itself. This information is necessary in order to improve as a company and gain market shares. The customer relationship element consists of three core elements. (Osterwalder & Pigneur 2002)

According to Osterwalder & Pigneur (2002) these elements are:

- **Information Strategy**
This element is all about information gathering about the company's customers. It allows managers to analyse customer behaviour and gain insight to customers needs. Therefore this information can be used on order to improve products or services.
- **Feel and Serve**
This element describes how a company stays in touch with its customers. It is about which channels (direct or indirect) are used to communicate with the target market. The internet offers great opportunities in that regard, however it is also important to be aware of the fact that the wide range of channels increase the amount of management needed.
- **Trust and Loyalty**
Trust between business partners is essential and has to be established. Especially when thinking of virtual markets trust becomes even more important, especially considering that parties don't know each other on a physical basis. There are common practices that help building trust like verification, authorization, privacy policies or encryption standards. Loyalty is a result of customer trust and satisfaction.

The Customer Relationship element provides customer feedback, which can and

should be used for the Product Innovation element. It is based on the Infrastructure Management element and generates income for the Financial element. (Osterwalder & Pigneur 2002)

1.2.3 Infrastructure Management

The Infrastructure Management involves systems that are necessary in order to bring the company's offerings to the market. It also needs to provide infrastructure in order to take care of Customer Relationship. Three core elements can be identified. (Osterwalder & Pigneur 2002)

According to Osterwalder & Pigneur (2002) these elements are:

- **Activity Configuration**
A company creates value so that customers are willing to pay for that added value. In order to create value a company needs the corresponding infrastructure to support involved activities and processes.
- **Partner Network**
The Partner Network element describes which activities are distributed among the partners of a company and which partners are needed in order to provide or create the service or product.
- **Resources**
If a company wants to create value it needs Resources. These Resources can be tangible, intangible and human assets. Tangible Resources are Resources like cash reserves or equipment, while intangible Resources are patents, reputation, brands and alike. Human assets are the people working for a company which use tangible and intangible Resources in order to create value.

Infrastructure Management is providing the Resources needed for Product Innovation and Customer Relationship, while generating Costs which affect the Financial element. (Osterwalder & Pigneur 2002)

1.2.4 Financials

The Financial element brings insight to the financial plan of a company. It shows how the company's financial success is guaranteed on a long term basis. Three elements are essential. (Osterwalder & Pigneur 2002)

According to Osterwalder & Pigneur (2002) these elements are:

- **Revenue Model**
This element outlines how the company generates revenue from its products or services. The Revenue Model can be composed of different revenue streams and pricing models.
- **Cost Structure**
This item summarizes all occurring costs for a company in order to be able to create and deliver its products or services to the market.

- Profit Model

The Profit Model describes the outcome of the Revenue Model minus the Cost Structure.

Financial provide Resources (money) for the required Infrastructure Management, while generating income through Customer Relationship. (Osterwalder & Pigneur 2002)

Chapter 2

Business Models

2.1 Taxonomy of Business Models

Since this research focuses on remote consultation it is obviously involving and relying on the internet to provide a service. Therefore it makes sense to look at existing Business Models which are already known and are especially focused on using the internet to generate revenue with their products or services.

The following Business Models have been identified by Rappa (2004):

- **Brokerage Model**
Brokers are understood as market makers. Their goal is to sell products in the areas of business to business, business to consumer or consumer to consumer. Revenue is generated by charging fees on transactions.
- **Advertising Model**
The Advertising Model is a web-version of the classical media broadcaster model. A website provides some sort of content mixed with advertising banners. To be successful usually a high traffic volume is necessary in order to generate revenue.
- **Information-intermediary Model**
This model entirely relies on selling information about customers, markets or competitors. A significant amount of data about user behaviour is collected, carefully analysed and the sold. This information is highly valuable since it helps buyers to understand specific needs and markets.
- **Merchant Model**
This is basically understood as the web based version of classical mail-order business. There is a web-based catalogue listing the goods that can be purchased and are on purchase shipped to the customer.
- **Manufacturer Direct Model**
Thanks to the internet manufacturers are able to sell their products directly to the customer bypassing the distribution channel. Usually this model is used to improve efficiency, give a very good customer support experience and to improve knowledge about customer behaviour.

- **Affiliate Model**
The affiliate provides a link to a specific product at a merchant and gets paid usually a percentage of the purchases value at the merchants as a reward. However it is necessary that a purchase is made in order to generate income.
- **Community Model**
The goal is to create a community or interest group around a specific topic. This model entirely relies on donations made by consumers in order to provide the service or product. A popular example is Open Source Software. Usually software is available for free, developed by a community of developers which rely on voluntary donations made by the users of the software.
- **Subscription Model**
Users are charged periodical for using a service or product. The actual usage of the product or service is independent from the fees charged. It has become common to combine Advertising Models and Subscription Models, the service is available for free and displays ads of some sort while it is possible to consume the service ad-free when a user is willing to switch to a Subscription Model.
- **Metered Model**
The Metered Model charges users for the actual usage of a service. A user just pays the amount he or she has actually consumed. One example would be electricity, where a user is charged the amount of electricity that he or she has consumed.

After discussing Business Models specifically found on the internet a brief overview of Business Models regarding health care systems will be given.

Hwang & Christensen (2008) identified 3 main types of Business Models. Those Business Models are of course not exclusively found at health care institutions but are quite common for them. Those three types according to Hwang & Christensen (2008) are:

- **Solution Shops**
Solution Shops are highly specialized institutions with the goal to solve unstructured problems. Usually highly skilled experts are employed who are using their knowledge and problem solving skills in order to satisfy the customers needs. Since every customer is unique the solution for a specific customer also has to be unique, therefore the customer is willing to pay quite high prices. This Business Model is widely spread across general hospitals and physician practices since those businesses provide health care by highly skilled professionals.
- **Value-adding Process Businesses**
These businesses add value in some shape or form using a resource as input. Usually this processes of value adding can be repeated and therefore these businesses rely on highly developed and efficient processes for value creation. The success of such a business is more or less dependent on the

processes itself which defines the quality and costs of the outcome, which is a product or a service. A lot of Business Models using this idea are rising in the health care business as well. Usually organizational structures have to be defined in a way so that Solution Shops and Value-adding Process Businesses work together and are not separated. If those two worlds get separated a administrative overhead is created and therefore the gain through value adding process optimization is lost again. Examples incorporating Value-adding Process Businesses are MinuteClinic, Shouldice, etc.

- **Facilitated User Networks**
Facilitated User Networks are businesses where all participants sell and buy products from each other. In order to serve the participants needs some kind of quality and trust for the network itself has to established. Money is effectively made by company which is providing such a network and ensuring proper functionality of the network itself. A good, yet under-developed, example for health care would be the care of chronic disease. There are already similar solutions using this Business Model which are working just fine like Weight Watchers, Alcoholics Anonymous, dLife, etc.

In general it seems like there are no disruptive innovations for Business Models in the area of health care emerging. New technologies are not used for changing how things are done, they are much more used to improve the way it is done. (Hwang & Christensen 2008)

2.2 Business Model Frameworks

In this section an overview of Business Model Frameworks will be given. A Business Model Framework is a basic tool kit allowing to develop a Business Model.

2.2.1 STOF Framework

The STOF Framework consists of two main parts. First there is the STOF Model, which provides the basic building blocks to sketch a Business Model, but it also features a STOF Method which describes the process of designing a Business Model. The STOF Framework is specifically aimed at technology based businesses and should therefore be looked at. (Bouwman et al. 2008)

The STOF Model

The STOF Model is split into four main categories which are the Service Domain, Technology Domain, Organization Domain and Finance Domain. The Model derives its name from these domains as well. Figure 3 shows the main concept of the STOF Model. (Bouwman et al. 2008)

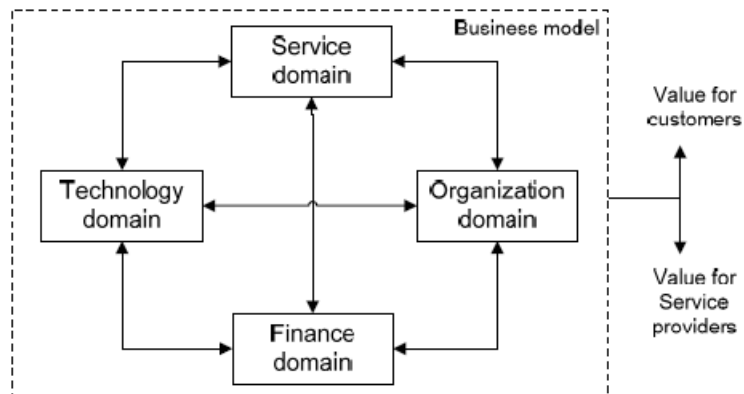


Figure 3: STOF Model (Bouwman et al. 2008)

- **Service Domain**
The Service Domain answers questions like what value gets delivered to the customer and gives information about target customers. In general it answers questions about the Service or Product itself. (Bouwman et al. 2008)
- **Technology Domain**
The Technology Domain deals with questions regarding the underlying technologic infrastructure like transmission or third party services. It should provide an overview about all technological factors relevant for the product or service itself. (Bouwman et al. 2008)
- **Organization Domain**
The Organization Domain deals with questions regarding all organizational aspects of the product or service itself. Questions like which agents are contributing to the service or product get answered. (Bouwman et al. 2008)
- **Finance Domain**
The Finance Domain answers questions about the financial aspects of the service or product. Revenue and costs are sketched in this domain. (Bouwman et al. 2008)

The Model also takes relationships into consideration by identifying Critical Design Variables which are necessary to sustain the Business Model itself. Furthermore these Critical Design Variables are also related to Critical Success Factors, which are of very high importance for the success of the Business Model Concept pursuit. (Bouwman et al. 2008)

The STOF Method

The STOF Method describes the process of developing a Business Model Concept. It is divided into four steps which are according to Bouwman et al. (2008) as follows:

1. Quick Scan

During this stage an initial version of the Business Model gets outlined. The structure of this initial version is split into the previously explained domains. The outcome is a first initial version of the intended Business Model which is conform with the STOF Model.
2. Evaluation of Critical Success Factors

After developing an initial version of the Business Model, Critical Success Factors are identified and evaluated. This evaluation can lead to three different results:

 - Business Model works as intended, go to Step 4.
 - Business Model needs reworking, go to Step 3.
 - Business Model cannot succeed, stop planning.
3. Identify Critical Design Issues

If Step 2 lead to the outcome that further improvements of the Business Model are needed, than this step ensures that these issues get addressed. Therefore a number of Critical Design Issues are identified. This identification serves the purpose of further improving the Business Model. After refining the Business Model and taking the design issues into account step 2 is reiterated. Step 2 and step 3 are iterated as long as necessary in order to get a final outcome if the Business Model will work or not.
4. Robustness Check

As a last step the Business Model is checked for robustness against external influences such as changing user requirements, new technologies, emerging markets, etcetera. This robustness check should ensure that the Business Model is sustainable over the long run.

Figure 4 shows a graphical representation of the four steps necessary to develop a Business Model using the STOF Method. (Bouwman et al. 2008)

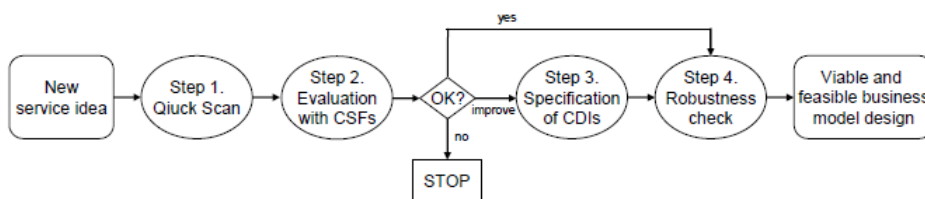


Figure 4: STOF Method (Bouwman et al. 2008)

2.2.2 The Entrepreneur's Model

The Entrepreneur's Model consists of six main components which are then divided into three levels. The six main components according to Morris et al. (2005) are:

1. Factors related to the offering

This component focus is on value creation and should sketch the way the company wants to create value for the customer.

2. Market factors
This component describes the market the company aims for.
3. Internal capability factors
The internal capabilities describe the source of competence of a company and should define where the company excels.
4. Competitive strategy factors
The competitive strategy factors describe how the company plans to separate itself from the competition and what gives them a competitive advantage.
5. Economic factors
The economic factors describe the financial aspects of the Business Model. They should outline how revenue is generated.
6. Personal / investor factors
This component defines which intentions are behind the Business Model. Especially it should clarify the time, scope and size ambitions.

These six components get further split into three different levels, where each level fulfils specific purposes, described by Morris et al. (2005) as:

1. Foundation Level
The Foundation Level is the starting point of the Business Model. It serves the purpose of defining the basic components of the model. Each component features some pre-defined options to pick from (see table 1 for more details). However the Foundation Level is pretty easy to copy for competitors.
2. Proprietary Level
At this level approaches for the components selected at the foundation level are formulated. In order to separate from the competition new and unique ways to implement the Business Model outlined at the Foundation Level are necessary. Those new innovations are formulated at the Proprietary Level.
3. Rules Level
The Rules Level should define a basic set of rules for each component in order to ensure that ongoing strategic decisions reflect the proprietary elements of the model itself.

Putting everything together one should get a suitable Business Model. The approach is focused on Entrepreneurs and therefore focuses on innovation and new ways to do business, which is reflected at the Proprietary Level. In order to ensure those innovative ways are easy to follow in the future the Rules Level has been added. A worksheet like representation is shown in table 1. (Morris et al. 2005)

Foundation Level	Proprietary Level	Rules
<p>Factors related to the offering <i>How do we create value?</i> (select from each set)</p> <ul style="list-style-type: none"> • primarily products / primarily services / heavy mix • standardized / some customization / high customization • broad line / medium breadth / narrow line • deep lines / medium depth / shallow lines • access to product / product itself / product bundled • internal manufacturing or service delivery / outsourcing / licensing / reselling / value added reselling • direct distribution / indirect distribution (single or multichannel) 		
<p>Market factors <i>Who do we create value for?</i> (select from each set)</p> <ul style="list-style-type: none"> • b2b / b2c / both • local / regional / national / international • upstream supplier / downstream supplier / government / institutional / wholesaler / retailer / service provider / final consumer • broad or general market / multiple segment / niche market • transactional / relational 		

<p>Internal capability factors <i>What is our source of competence?</i> (select one or more)</p> <ul style="list-style-type: none"> • production / operating systems • selling / marketing • information management / mining / packaging • technology / R&D / creative or innovative capability / intellectual • financial transactions / arbitrage • supply chain management • networking / resource leveraging 		
<p>Competitive strategy factors <i>How do we competitively position ourselves?</i> (select one or more)</p> <ul style="list-style-type: none"> • image of operational excellence / consistency / dependability / speed • product or service quality / selection / features / availability • innovation leadership • low cost / efficiency • intimate customer relationship / experience 		
<p>Economic factors <i>How we make money?</i> (select from each set)</p> <ul style="list-style-type: none"> • pricing and revenue sources: fixed / mixed / flexible • operating level: high / medium / low • volumes: high / medium / low • margins: high / medium / low 		

Personal / investor factors <i>What are our time, scope and size ambitions?</i> (select one) <ul style="list-style-type: none"> • subsistence model • income model • growth model • speculative model 		
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Table 1: The Entrepreneurs Business Model (Morris et al. 2005)

2.2.3 The Business Model Canvas

The Business Model Canvas is in contrast to the previously discussed Business Model Frameworks not aimed at a specific group of businesses or persons. It is much more a general approach which could be adaptable by companies throughout the different branches.

The Business Model Canvas consists of 9 segments, according to Osterwalder & Pigneur (2010) these segments are:

- Key Partners
Key Partners are essential partners for the purposed Business Model and are therefore very important for the company to be successful.
- Key Activities
Key Activities describe the activities that are necessary in order to provide a service or product to a customer. These activities include everything ranging from activities necessary for value creation up to activities necessary to operate Channels. Activities that are essential for customer satisfaction are also an important part of the Key Activities.
- Key Resources
Key Resources describe essential resources a company needs in order to provide their service or product. However Key Resources are not only resources that are related to the actual process of adding or generating value for customers, they are also resources needed in order to provide the required channels to interact with customers and resources to generate revenue.
- Value Propositions
This describes the actual value creation for the customer itself and therefore contains the products or services the Business Model wants to deliver. Value creation is specifically aimed for the targeted Customer Segments and therefore the Customer Segments have to be taken into account.
- Customer Relationships
Customer Relationships describe how the company plans on dealing with

their customers. It can be everything between personal interaction up to fully automated interaction systems.

- **Channels**
The Channels building block is related to the different Channels a company wants to use in order to interact with their customers. It includes communication, distribution and sales channels that a company plans to use in order to interact with their customers.
- **Customer Segments**
This segment describes the different groups or organizations a company aims to acquire as customers. It is very important to be aware of which group of customers a company actually aims for because this defines the basic customer needs that have to be satisfied with the outcome of the Business Model itself.
- **Cost Structure**
The Cost Structure gives information about all Costs relevant for the Business Model.
- **Revenue Streams**
Revenue Streams describe how the company plans on making money. It should illustrate how the company generates revenue from the different customer segments and how pricing for each customer segment works.

Figure 5 illustrates the graphical representation of the Business Model Canvas. (Osterwalder & Pigneur 2010)

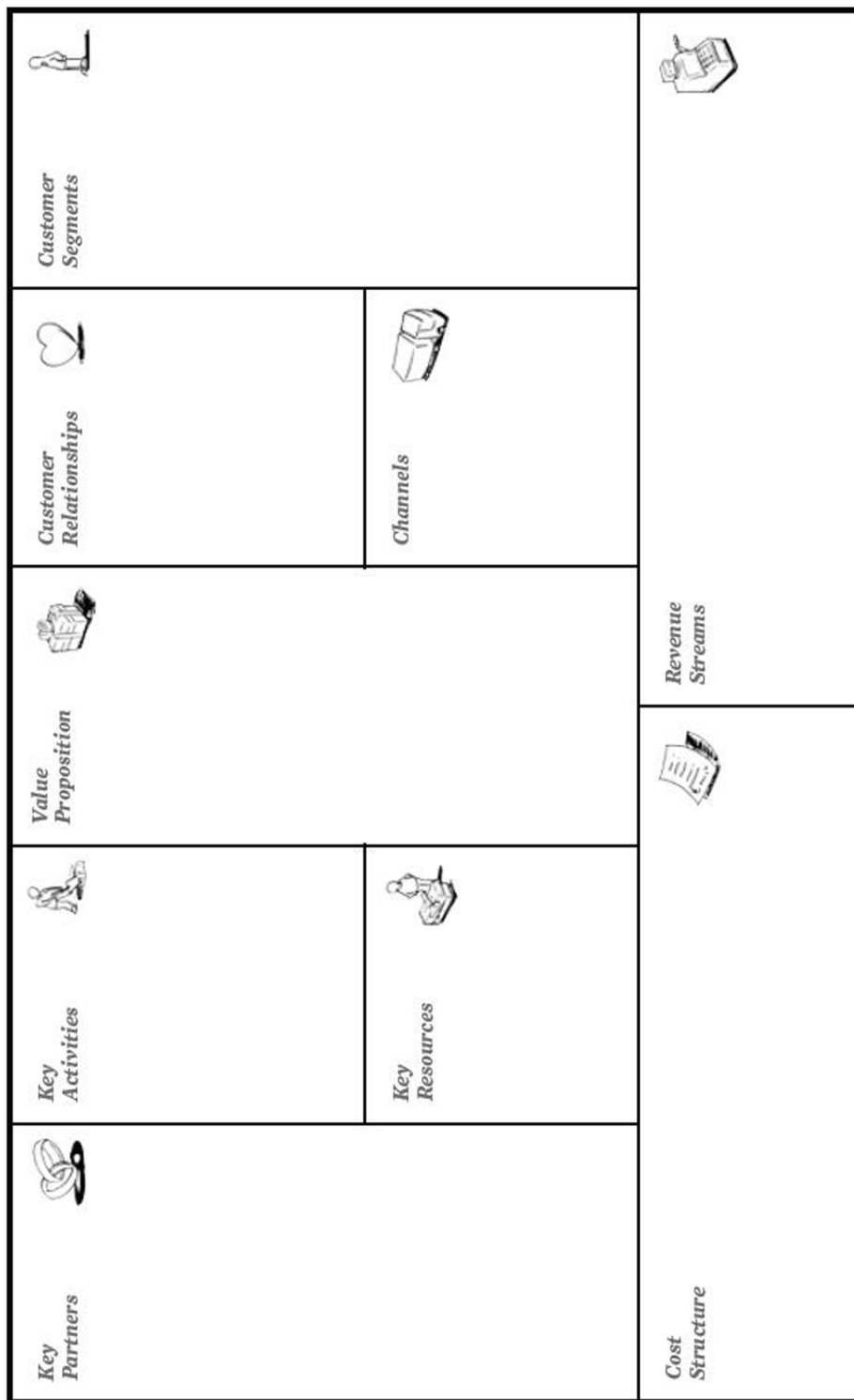


Figure 5: Business Model Canvas (Osterwalder & Pigneur 2010)

2.2.4 Business Model Starter Kit

The Business Model Starter Kit is based on the idea of the Business Model Canvas and is a game-like approach to help people develop new Business Models without the need to read a lot of literature. Therefore it should provide easy access to model new ideas for everyone. (Breuer & Ketabdar 2012)

At the core the Business Model Starter Kit is providing the following eight key components, according to Breuer & Ketabdar (2012):

- **Value Proposition**
This part should clarify which value is actually generated for the customer and also keep an eye on what the customer is willing to sacrifice to gain access to that generated value.
- **Stakeholder Segments**
Stakeholder Segments should clarify which groups of people are interested in gathering access to the companies offers.
- **Touchpoints**
Customer Touchpoints should help getting the customers perspective and ways how to investigate customer needs once a product is released. In other words: It describes methods on how to know what the customer wants from the company's product.
- **Distribution**
This segment should describe how the product gets distributed to the customer in the end.
- **Revenue Model**
This section describes the Revenue Model of the company and how the company plans to make money.
- **Capabilities**
Capabilities describe the organizational structure of the company and also resources and skills specific for the company.
- **Partners**
Describes the companies Partners with a specific focus on how win-win situations can be created so that Partners are performing to their best within the Partner Network.
- **Cost Structure**
The Cost Structure defines the expenses of the company.

Figure 6 shows the graphical representation of the Business Model Starter Kit. (Breuer & Ketabdar 2012)

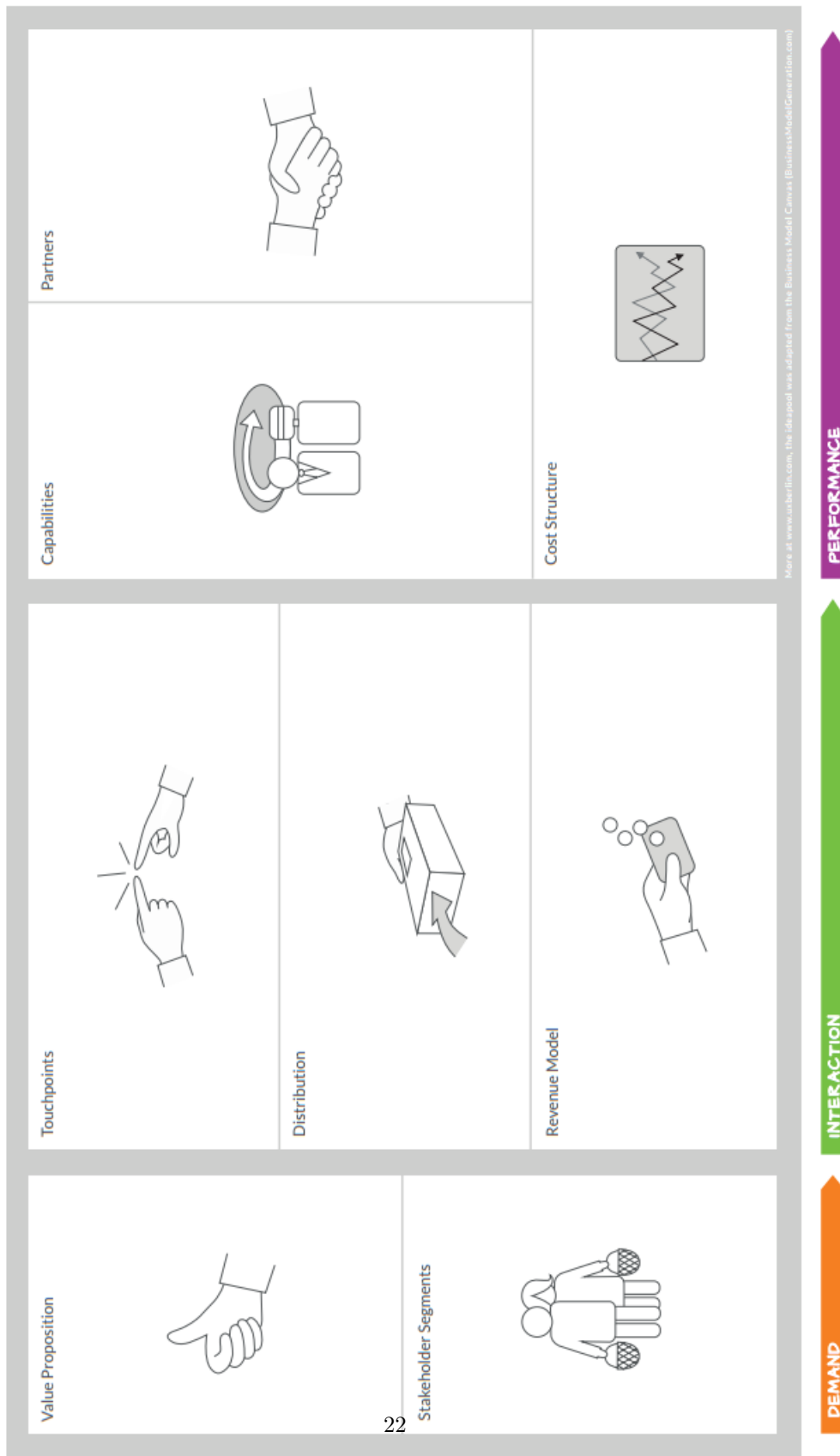


Figure 6: Business Model Starter Kit (UXBerlin 2013)

2.3 Conclusion on Business Model Frameworks

In section 2.2 three Business Model Frameworks have been introduced. Each of the presented Business Model Frameworks are considering the basic components of a Business Model Concept as discussed in section 1.2 and are therefore usable. In table 2.3 an overview is given.

Frame-works	Product Innovation	Cus-tomer Relationship	Infras-structure Man-agement	Finan-cials	Rela-tionships between Actors
STOF	x	x	x	x	
En-trepreneur's Model	x	x	x	x	
BMC	x	x	x	x	
BM Starter Kit	x	x	x	x	x

Table 2: Business Model Frameworks Overview

The STOF Framework is a Framework aimed for companies dealing with technology and is therefore quite useful for developing a Business Model for this specific business area. The STOF Framework goes even one step further by providing a method (The STOF Method) on how one should create a Business Model. One definite advantage of the STOF Framework is that it takes relationships in between the Business Model parts into account, however it is a very basic consideration.

The Entrepreneur's Model is aimed at entrepreneurs as the name suggests. It is a quite good toolbox to develop new ideas and formulate them as well. It is quite easy to use and provides a good playground to create new and innovative Business Models. The Entrepreneur's Business Model doesn't take relationships in between critical parts of a Business Model into account.

The Business Model Canvas is probably one of the best known Business Model Frameworks out there. It features a clear and intuitive graphical representation which should make it easy to use and support the development of new ideas. The Business Model Canvas seems to be the least limiting Framework and gives enough freedom to come up with creative new ideas for Business Models. The Business Model Canvas doesn't take important relationships between components into account, however it does identify the key assets of a Business Model which are necessary for the Business Model itself to be successful.

The Business Model Starter Kit is a game-like approach based on the Business Model Canvas. This is also the only Framework that takes value exchange into account. This is not directly shown in the Canvas itself, but the description explicitly states that the player should analyse value networks as well. Additionally the Business Model Starter Kit also provides challenge cards, that might address specific relationship problems and the player has to show that their developed Business Model can counter those problems.

2.4 Value Networks

2.4.1 The Value Mapping Tool

The Value Mapping Tool is focused around supporting companies to create value propositions and enabling them to model sustainable business. More specifically this tool aims to address the following aspects according to Bocken et al. (2013):

- Understanding positive and negative aspects of value proposition
- Recognizing conflicting values
- Identify opportunities to reduce negative outcomes for the stakeholders participating in the value network.

The representation was designed under the following aspects according to Bocken et al. (2013):

- Four different value representations should encourage to deeply explore the current situation and gain deep insights what areas need reworking or changing.
- Stakeholder segments should ensure that the range of possible value recipients is taken into account since traditional business model processes are rather customer value oriented.
- The network centric approach should ensure that all actors inside the network are identified and taken into account. (Bocken et al. 2013)

The Value Mapping Tool is shown in figure 7.

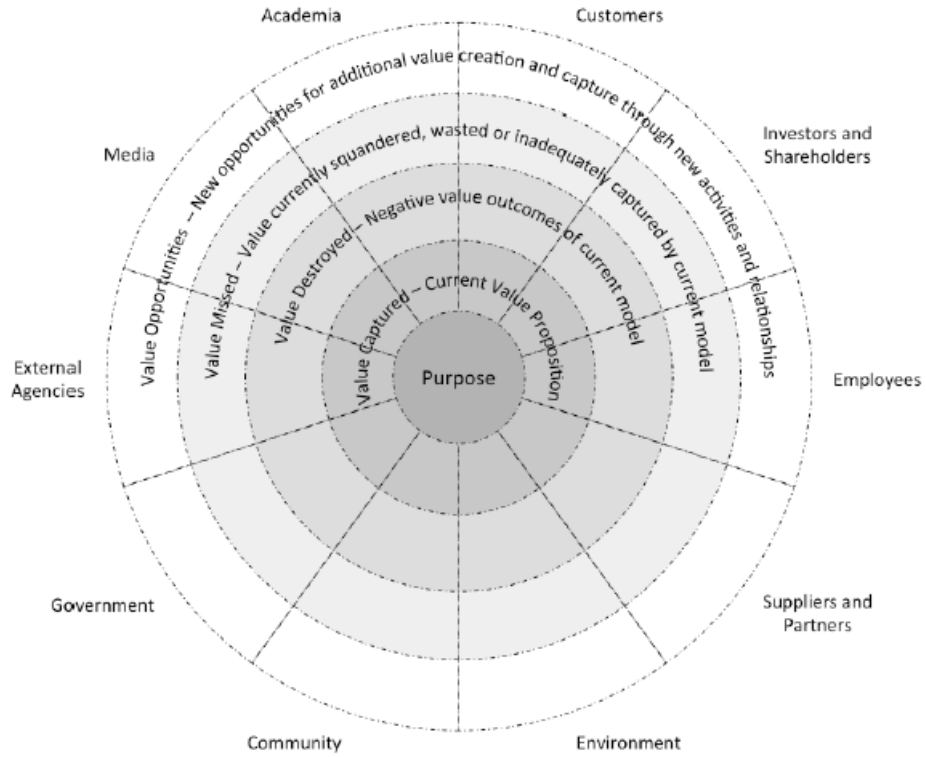


Figure 7: Value Mapping Tool (Bocken et al. 2013)

Since this version of the Value Mapping Tool is rather large, a simplified version of the tool has been developed. Therefore the stakeholders have been reduced to four groups and the different types of values have been reduced to three. It was found that value missed and value destroyed led to similar ideas and therefore have been merged together to one ring. The simplified version is shown in figure 8. (Bocken et al. 2013)

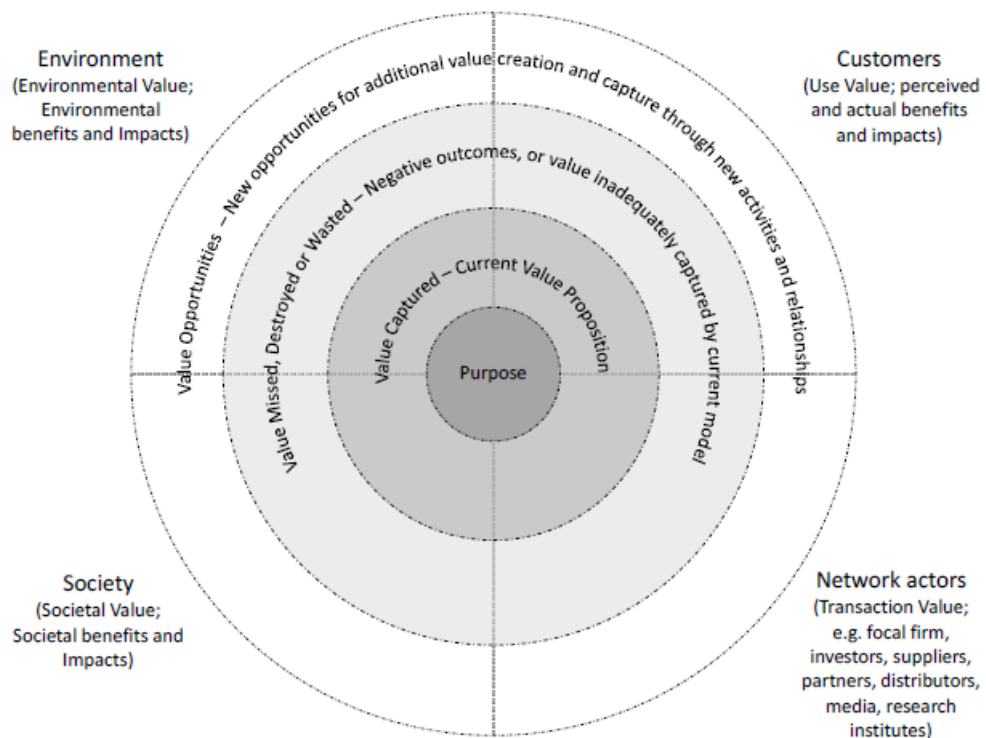


Figure 8: Simplified Value Mapping Tool (Bocken et al. 2013)

2.4.2 Net-Map

Net-Map is a tool that is based on interviews and visualizing influence and interactions between the different actors involved and should show the following information according to Schiffer (2007):

- Involved actors
- Links between actors
- Influence of the actors
- The actors goals

Influence is shown by the the height of a stack of discs for each actor, while links are drawn between the actors. The links between actors are dependent on the situation one wants to examine and have to be picked in a preparation phase. The Net-Map tool is a quite intuitive one, that should allow easy access for all different kinds of people to express their point of view. An example is shown in figure 9. (Schiffer 2007)

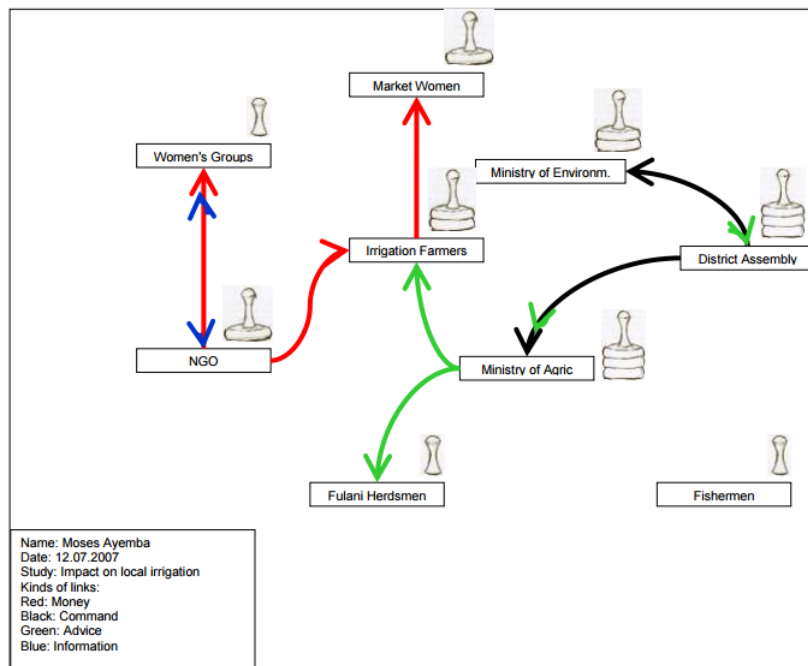


Figure 9: Net-map including actors, links and influence towers (Schiffer 2007)

2.4.3 The V^2 Value Network Notation

The basic building blocks of the V^2 Network Notation according to Vorraber (2012) are:

- Economic entity
 Can be understood as company or an individual, which is separated furthermore into three parts: Agent, Capabilities and Assets. Each economic entity features a Port which allows the entity to receive or provide transfer objects.
- Transfer objects
 Can be understood as the values exchanged between economic entities. 7 different transfer objects are introduced: Brand, Product, Information, Service, Coordination, Monetary value and Intangible value.
- Links
 Links are connected to the ports of an economic entity. Two different kinds of links are distinguished: provision link (providing a transfer object that supports customer value) and revenue link (providing a transfer object related to revenue).
- Endogenous motivation
 Describes the motivation of employees within an economic entity and can be separated into three areas:

- defensive
The agent provides value only if it is not conflicting with its own goals.
 - neutral
Task activity hasn't got highest priority, however value gets delivered in a timely manner.
 - active
Value creation tasks have a high priority and the agent is eager to provide value.
- Exogenous influence
Describes external factors that influence the network and are separated into three categories:
 - defensive
External force discourages value creation.
 - neutral
External force doesn't encourage or discourage value creation.
 - active
External force encourages value creation.

Figure 10 shows the graphical representation of the building blocks. In figure 11 a complete value network representation using the V^2 Value Network Notation is shown. (Vorraber 2012)



Figure 10: Building blocks of the V^2 Value Network Notation (Vorraber 2012)

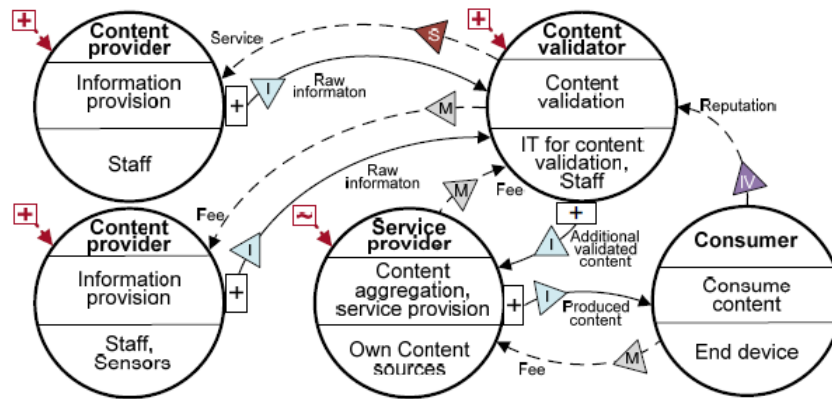


Figure 11: V^2 Value Network Notation example (Vorraber 2012)

Chapter 3

eHealth in the European Union

The European Union (EU) has formulated an eHealth Action Plan with the aim to establish a network across all member states for the purpose of sharing medical patient data across borders. Due to the use of Information and Communication Technologies (ICT) the efficiency and quality of health care can be enhanced and new markets and innovations in the health area are enabled through a policy across all member states. (European Commission 2012)

Public health is expanding rapidly throughout the member states. For example an expenditure of 5.9% on average has been observed in 1990, while an expenditure of 7.2% has been observed in 2010. There are forecasts that show that the expenditure may grow up to 8.5%. This increase is also reflected at the global telemedicine market, which has grown from \$9.8 billion in 2010 to \$11.6 billion in 2011 and is expected to reach \$27.3 billion in 2016. (European Commission 2012)

As promising as these numbers sound there are several barriers that prohibit a wider uptake of eHealth.(European Commission 2012)

Those barriers are according to European Commission (2012):

- Awareness and confidence are missing among patients, citizens and health-care professionals.
- Different eHealth solutions are not compatible.
- Limited knowledge about cost-effectiveness of eHealth.
- Legal regulations are unclear for applications and there is not much insight about what the collected data is used for.
- Setting up (standardized) eHealth systems is cost-intensive.
- Different systems and services across member states.

To overcome those barriers the European Commission (2012) has set up the following operational objectives within the Action Plan:

- Improve interoperability of eHealth services.
- Support research, development and innovation in eHealth to further improve availability of well-designed and user-friendly services.
- Support deployment of eHealth services.
- Promote international policy dialogues and cooperation on eHealth.

To achieve these objectives the EU is developing a general concept in cooperation with the member states known as the eHealth Network. (European Commission 2012)

3.1 The eHealth Network

The eHealth Network is a guideline that should help to develop and implement a network across all member states to achieve interoperability of different eHealth systems currently deployed. The outcomes of the research work done by the EU is set up by Directive 2011/24/EU. (European Commission 2012)

The aims of the eHealth Network concerning cross-border informations exchange are as follows, according to European Commission (2014):

- Access to safe and high quality healthcare.
- High level of trust and security.
- Enhance continuity of care for patients.

Those guidelines are not a legal obligation and therefore the member states are responsible for organisation and delivery of eHealth services. (European Commission 2014)

3.1.1 National Contact Points for eHealth

Since all member states have their own health care system in place, cross-border access can be tricky, since there is no commonly shared standard or interface between those member states. To overcome this issue the introduction of National Contact Points for eHealth (NCPeH) has been purposed. These NCPeH can be understood as a communication gateway and should guarantee a specific structure, behaviour and security policy of exchanged information. NCPeH act as an interface between national infrastructure and other member states. The NCPeH have also to ensure, on a technical level, that authorization, authentication and identification is done in a correct way. Furthermore the NCPeH are also responsible for logging international requests. (European Commission 2015)

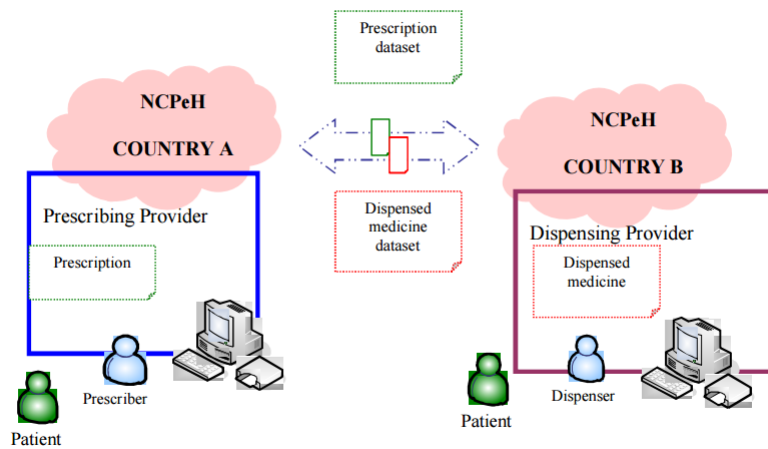


Figure 12: Example of ePrescription using NCPeH (European Commission 2014)

Figure 12 shows an example usage of NCPeH's for ePrescription.

3.2 eHealth in Austria

Austria is very actively implementing eHealth and therefore one of the leading member states of the European Union. (Bundesministerium für Gesundheit 2015)

Back in 2005 Austria introduced an electronic health insurance card (e-Card) and in 2012 Electronic Health Records (EHR) were introduced. The Austrian government also realized the importance and benefits of an electronic health systems and actively supports establishing more efficient services in that area. (Bundesministerium für Gesundheit 2015)

Austria also has a Commission for telemedicine in place which should help building up knowledge in the following areas according to the Bundesministerium für Gesundheit (2015):

- Medical eHealth Services
- Law regarding eHealth
- Technical aspects of eHealth
- Economy regarding eHealth

The commission was introduced in 2013 and should especially focus on eHealth services that would allow to treat especially age-related and chronic diseases. (Bundesministerium für Gesundheit 2015)

3.2.1 Results from the Telemedicine commission

The commission found that the infrastructure for telemedicine in Austria is already sufficient to deploy services. Austria already introduced EHR, which is a standardized exchange format for health records based on HL7 CDA / IHE. Therefore potential services in the eHealth area have to apply to these standards. (Bundesministerium für Gesundheit 2014)

However the commission also found that current billing schemas are not transferable to eHealth services and have to be reinvented to assure a proper fit for eHealth systems. It also has to be clarified under which circumstances social insurance comes to bare. (Bundesministerium für Gesundheit 2014)

Since the main task of the commission was to identify potential services for age-related and chronic diseases, two main use-cases were identified: Telemonitoring for Diabetes Mellitus and telemonitoring for heart-failure. (Bundesministerium für Gesundheit 2014)

Service assessment

The commission also came up with assessment criteria in order to judge services of interest and choose which service to deploy. These criteria are according to the Bundesministerium für Gesundheit (2014):

- Project quality overall
Project quality deals with cost-benefit definitions of concrete diseases. It is also necessary to think about a proper disease-management-process. The technical implementation of the service should be mature.
- EHR compatibility
The eHealth service should be EHR compatible, at least at the point of deployment. This means that services should be able to use the EHR infrastructure. When services want to submit data it is sufficient to provide a structured document as a first step, however this document should end up as a CDA record as a final outcome. Monitoring reports have to be structured in a way so that third parties can actually use the document as well.
- Roles of the involved
The patient has to have an active role and some form of communication has to be ensured between the patient and the physician. It is also important that these systems are patient-centric. Different health institutions should also be able to interact with each other and use the service, not only hospitals within the same group.
- Outcome and measurability
Parallel with service deployment an evaluation has to be done. It should ensure the economical and medical advantage of using that service and should also help to identify and solve problems with the service. The criteria for outcome and measurability are:
 - Minimal drop outs

- Compliance
 - Scientific studies have to prove advantages of the service
 - Clinical patient safety
 - Patient privacy (Data protection and security)
 - Quality improvements
 - Transferability (transparent interfaces, etc.)
- Costs for deployment
 - Deployment, acceptance and time frame

In the next sections two studies for heart-failure and diabetes will be shown.

3.2.2 Heart Failure telemonitoring

Scheer et al. (2009) conducted a study that should show the benefits of tele-monitoring patients with chronic heart failure.

The equipment consisted of 3 components, which are commercially available, according to Scheer et al. (2009) these components are:

- Mobile phone
- Weight scale
- Sphygmomanometer

As preparation the patients who were using the telemonitoring method were trained at measuring blood pressure and weight and were instructed by a technician on how to use the mobile phone given to them. The patients then had to measure their blood pressure, heart rate and body weight each day and enter the results using the mobile phone's internet browser. Furthermore they should also enter their dosage of heart failure medicine. This data was sent to a monitoring center and reviewed by a physician. If there was something wrong with the patients data, the physician was able to contact the patient using the mobile phone given to the patient. (Scheer et al. 2009)

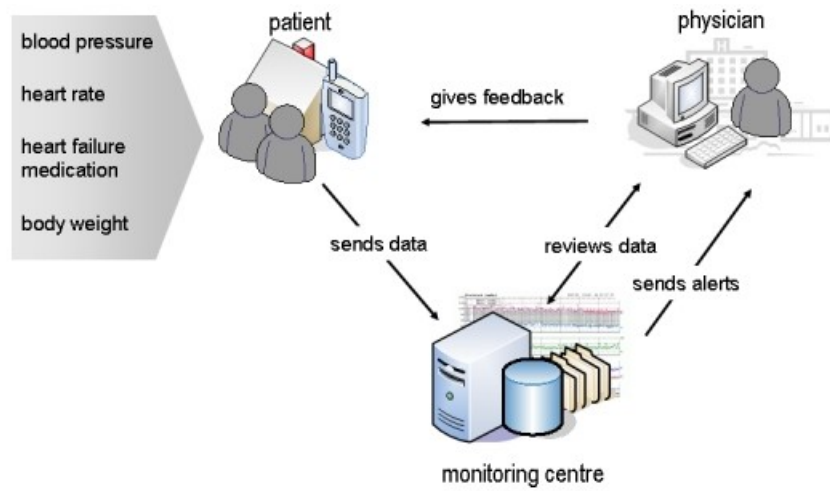


Figure 13: Telemonitoring service principle (Scheer et al. 2009)

Figure 13 illustrates the architecture of the service.

Results

The patients were split into a telemonitoring group, consisting of 66 randomly selected patients, and a control group of 54 randomly selected patients. In total 120 patients took part at the study. (Scheer et al. 2009)

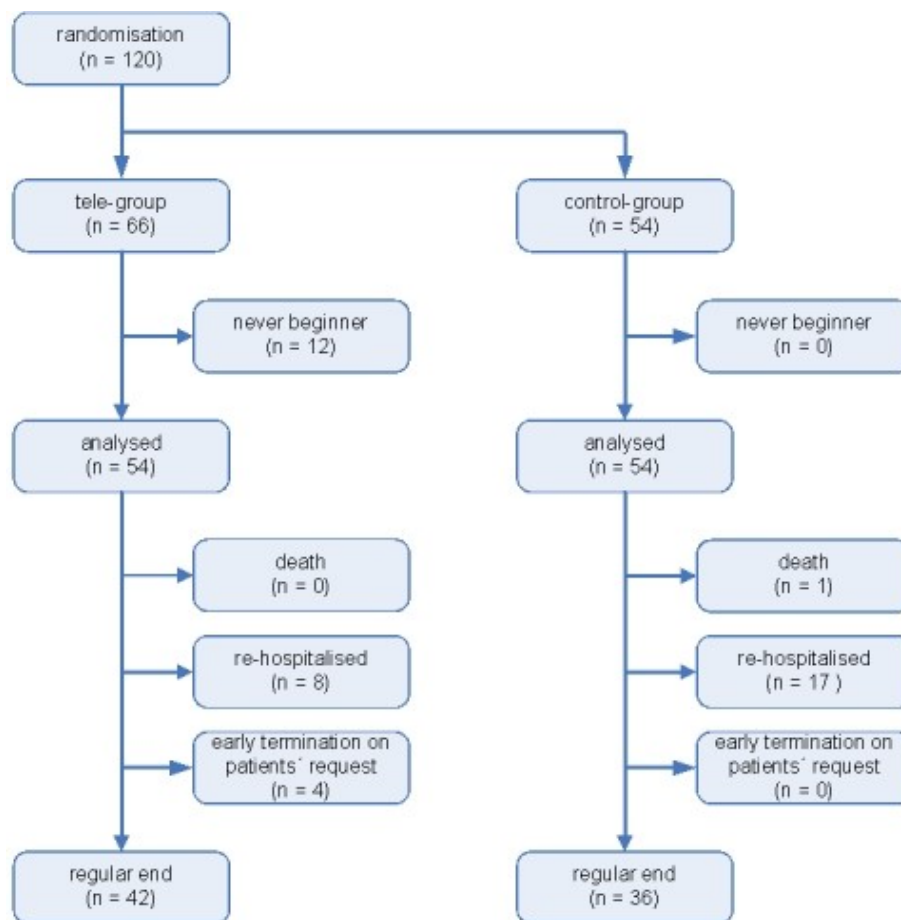


Figure 14: Study results (Scheer et al. 2009)

Figure 14 shows the outcome of the study. Inside the telemonitoring group 12 people were unable to initiate data transmission and were therefore classified as never beginners. Overall it could be shown that the outcome of chronic heart failure patients can be improved using telemonitoring and reduce frequency and duration of hospitalizations. However there are still some challenges left like designing a proper user-interface for elderly people or to further ease the use of such telemonitoring tools utilizing new technologies. (Scheer et al. 2009)

3.2.3 Diabetes telemonitoring

Kollmann et al. (2007) conducted a study on the feasibility and user acceptance of patients with Type 1 Diabetes Mellitus using telemonitoring utilizing a mobile phone.

An application called Diab-Memory has been developed which assists patients entering relevant data to a database at a monitoring center. The data got processed and relevant statistics and trends were provided to the physician

and the patient. Ten patients were asked to participate in the study using a mobile-phone. (Kollmann et al. 2007)

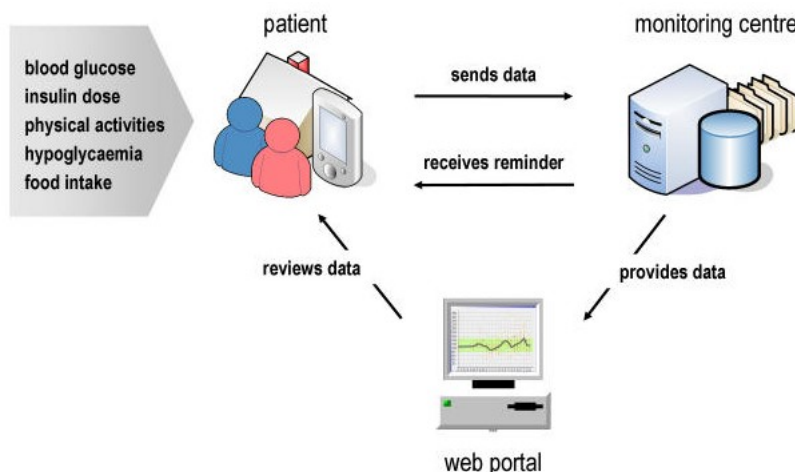


Figure 15: Telemonitoring principle (Kollmann et al. 2007)

Figure 15 shows the principle architecture of the system. The system consists of 4 parts, which were defined by Kollmann et al. (2007) as:

- Patient terminal
The mobile phone used to enter and transmit the data.
- Monitoring server
A server system used to receive and process data, while also ensuring data security and user management with distinctive access levels.
- Graphical data representation and reminders
An automated process, which analysed incoming data and presented the data in a graphical fashion. Furthermore the process also generated reminder text messages if the incoming data required any actions.
- Web portal
Provides access to the processed data for physicians and patients using a web browser.

Results

It could be shown that patients found the up-to-date statistics very helpful. Although patients also had the option to use a website for entering their data, 90% of the received values were entered using the mobile phone. (Kollmann et al. 2007)

	Before the Study	After the Study	<i>P</i> Value
HbA _{1c} , mean (SD)	7.9% (1.1%)	7.5% (0.9%)	.02
	First 2 Weeks of Study	Last 2 Weeks of Study	
Blood glucose, mean (SD)	141.8 mg/dL (22.5 mg/dL)	141.2 mg/dL (23.1 mg/dL)	.69
Number of reported hypoglycemia values, mean (SD)	4 (5.9)	3 (3.9)	
Total number of blood glucose measurements transmitted (%)	725 (100%)	595 (100%)	
Above 150 mg/dL threshold	289 (39.9%)	224 (37.7%)	.07
In normal range (80-150 mg/dL)	313 (43.1%)	250 (42.0%)	.13
Below 80 mg/dL threshold	123 (17.0%)	121 (20.3%)	.82

Figure 16: Comparing first and last 2 weeks of the study (Kollmann et al. 2007)

It could be shown that such a system is feasible and also accepted and appreciated by patients. Figure 16 shows that telemonitoring assisted the patients pretty good in dealing with their disease. (Kollmann et al. 2007)

3.2.4 Legal Regulation

The Federal Chancellery (2014) defined the Federal Act on Data Security Measures when using personal electronic Health Data (Health Telematics Act 2012 – GTelG 2012) which regulates the way how sensible electronic patient data has to be handled.

In this section a summary of important legal information for the purpose of building a remote consultation Business Model will be given.

Since this act deals mostly with Electronic Health Records not all information is relevant for remote consultation, because there is dedicated software to access Electronic Health Records. However it has to be ensured that no information is leaked in any shape or form violating this legal regulation.

Roles and access rights

The Federal Chancellery (2014) defined that roles of health care providers have to be proven and verified. This can be achieved by using using electronic signatures that are traceable to qualified certificates and contain sector specific personal identifiers, or matching identification data with the data of the eHealth Directory Service, or by matching identification data with the Healthcare Provider Index. (Federal Chancellery 2014)

If the proof or verification is not achievable, in particular if the required technical infrastructure is missing, roles can be confirmed according to the Federal

Chancellery (2014) by:

- personal contact
- contact by telephone
- contractual provisions
- queries of electronic directories
 - of the Austrian Medical Association
 - of the Austrian Dental Association
 - of the Austrian Midwives Board
 - of the Austrian Chamber of Pharmacists
 - of the Main Association
 - of the Federal Ministry of Health

The Federal Chancellery (2014) also defines different access rights for different healthcare providers which are:

- Members of the medical profession have access to all health data
- Members of the dental profession have access to medical documents and medication data
- Pharmacies have access to medication data regarding prescription as well as non-prescription drugs
- Hospitals other than independent outpatient clinics have access to all health data
- Nursing institutions whose operation is subject to a notification or permission requirement according to federal or state laws as well as governmental supervision control have access to all health data
- Legal or authorized representatives have access to all health data for the protection of the participants rights pursuant.
- employees of the EHR-Ombudsman have access to all health data

Data security

The Federal Chancellery (2014) also defined guidelines for security measures that have to be taken into account when dealing with health data.

In terms of confidentiality regarding the electronic transfer of health data across networks that are secured against unauthorized intrusion using state of the art security measures it has to be ensured according to the Federal Chancellery (2014) that:

- Data transfer is protected by cryptographic or physical measures
- Only closed or definable group of users have access to the network

- Authentication of users is possible

When using protocols and other methods for forwarding health data the Federal Chancellery (2014) defines:

- Full encryption of health data has to be provided
- Cryptographic algorithms have to be used, which grant the identification of healthcare providers' role and a proper format and structure of the submitted health data. The chosen algorithms also have to be confirmed by an authority defined by section 19 of the Federal Electronic Signature Law by the Federal Chancellery (2013). This means that the Federal Chancellery (2013) intended to provide an authority that has to verify to correctness of used cryptographic methods.

In terms of integrity the Federal Chancellery (2014) defines that proof and verification of the integrity of health data has to be done using a proper signature schema, which is defined by the Federal Chancellery (2013) as follows:

- The signature is uniquely linked to the signatory
- The signature is able of identifying the signatory
- The signature is created using means that the signatory can maintain and control
- The signature is linked to the data in a manner that subsequent changes to the data can be identified.

Furthermore the Federal Chancellery (2014) also defines that the above measures are not necessary when exchanging health data between health care providers using a secured network where access to this secure network is just granted to health care providers known in advance.

IT-Security concept

Healthcare providers are also asked to provide a document that describes all security measures that are taken in order to provide a sufficient level of security. This document should give evidence that data is treated according to the law and that it is not possible for unauthorized persons to access the data. The Federal Minister of Health can also request this document to be submitted. (Federal Chancellery 2014)

Data security is defined by the Federal Chancellery (2015) as the protection against accidental or intentional loss or destruction of data as well as prohibiting unauthorized persons of accessing this data.

Furthermore the Federal Chancellery (2015) defines the following measures to be taken insofar the technical possibilities and economic justifiability is appropriate:

- The distribution of functions between organisational units and operatives regarding use of the data shall be laid down

- Data shall be used only if there are valid orders of authorized organisational units or operatives
- Every employee is to be instructed about his duties and the according federal acts as well as internal data protection regulations
- The right of access to the premises of the data controller or processor is to be regulated
- The right of access to data and programs is to be regulated as well as the protection of storage media against access and use by unauthorised persons
- The right to operate the data processing equipment is to be laid down and every device is to be secured against unauthorized operation by taking precautions for the machines and programs used
- Logs shall be kept for three years, unless provided otherwise by law in order that the processing steps that were actually performed, in particular modifications, consultations and transmissions can be traced to the extent necessary with regard to their permissibility
- A documentation shall be kept on the measures taken pursuant to subparas. 1 to 7 to facilitate control and conservation of evidence

Whenever Electronic Health Records are accessed it has to be logged, the minimal information that has to be logged is defined by the Federal Chancellery (2014) as follows:

- Date and time of use
- Unique log-transaction number
- Usage type
- Unique electronic identity of the healthcare provider or EHR-Ombudsman
- Name of the natural person that accessed the Electronic Health Record
- The unique identifier of the used Electronic Health Record
- Query criteria
- Error messages for failed queries

Chapter 4

Available Technologies

In this chapter available technologies will be shown that might be relevant for practical implementations for Remote Consultation. Different approaches will be discussed according to features and security as well as Business Models. Furthermore target audiences of these Business Models will be analysed and shown.

4.1 Skype using HoloNotes

Microsoft is currently working on a new virtual reality glasses called Microsoft HoloLens. Microsoft HoloLens is the first device to date that actually allows people to interact and experience high definition holograms. This device can be seen as a fully functional and connected holographic computer that provides communication and interaction interfaces. Figure 17 showcases Microsoft virtual reality glasses. (Microsoft 2016)



Figure 17: Microsoft HoloLens glasses (Microsoft 2016)

Microsoft also showcased how HoloLens would extend the possibilities of voice over IP calls using HoloNotes. HoloNotes provides the possibility to see ones

environment and actually draw a hologram into this environment. This allows people to point out exactly what they mean and more detailed instructions can be given. HoloNotes seems to be an extension for Skype, which is a voice over IP software solution developed by Microsoft. Figure 18 shows how a Skype call looks like when using HoloNotes for the caller and the callee. (Microsoft 2016)



Figure 18: Skype call using HoloNotes (Microsoft 2016)

4.1.1 Security measures

Since HoloNotes seem to be a feature mainly aimed for Skype calls it makes sense to look at the current security measures Skype offers in order to protect calls. However, it can not be said if these exact same protection mechanisms will be used in the future for Skype calls utilizing HoloNotes.

Currently all Skype-to-Skype calls, videos and file transmissions are encrypted. Skype also provides a service for calling PSTN devices (traditional telephones) where the part over the PSTN network is not encrypted. For encryption Skype uses 256-bit AES (Advanced Encryption Standard) encryption and 1536-bit or 2048-bit RSA (Rivest-Shamir-Adleman cryptosystem) certificates which are certified by the Skype server. (Microsoft and/or Skype 2016)

It is sufficient to use 168 or 256 bit for symmetric encryption, like AES, for secure systems. AES is also considered as a secure algorithm to use. For asymmetric encryption schemas, like RSA, key sizes of 1536-bit are consider acceptable for most secure applications. Key sizes of 2048-bit are considered for highly protected applications. (OWASP Foundation 2016)

Assuming Skype is using these encryption mechanisms for HoloNotes as well it can be considered sufficient in terms of legal regulations in Austria, as men-

tioned in section 3.2.4.

4.1.2 Business Model Canvas

The Skype Business Model has evolved over time and is providing additional services, that are not part of the core concept of a Video VoIP service. Skype doesn't only provide communication with devices connected to the internet, through the usage of gateways also common telephone networks can be reached. Calling devices on telephone networks is charged, therefore the customer can buy Skype credits in order to do so. Additionally Skype offers hardware vendors the opportunity to get their devices tested by Skype, thus ensuring that the devices are working properly with Skype services. In return the hardware vendors are getting certified which is ensuring their customers product quality and functionality. For companies Skype is offering a dedicated Business solution in order to give the best experience possible. Figure 19 illustrates the Skype Business Model.

<u>Key Partners</u> <ul style="list-style-type: none"> • Microsoft • Telecom providers • Hardware manufacturers • Payment providers 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Complaint management 	<u>Value Propositions</u> <ul style="list-style-type: none"> • Skype with HoloNotes • Skype out • Messages • Attachments • Skype Calls • Skype ID • Hardware Licenses 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Skype credits • Subscriptions • Software download • Support agents 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Home users • Skype out users • Companies • Hardware manufacturers
<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Complaint management • Partner fees • Telecom costs • Overhead 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • Credits • Subscriptions • Skype Hardware • Basic service free 			

Figure 19: Skype Business Model Canvas

4.2 Sightcall

SightCall is a voice over IP video call software providing an API for developers creating their own applications, using pre-made modules from that API. The infrastructure for managing calls is provided by the company. There are also some suggested use-cases and pre-made applications available that showcase the possibilities of the SightCall platform. The most interesting features are the visual support features and teleconsultation for healthcare features. (SightCall 2016)

A more detailed list of features according to SightCall (2016):

- Callers can share the back camera of their device with the callee
- Callee can point, draw and annotate
- It is possible to record video calls
- E-prescription integrated
- Remote smart devices can interact and share information with the callee

Figure 20 is showing a client getting visual support by the callee.



Figure 20: Callee instructing client (SightCall 2016)

Figure 21 is showing the callee receiving data from remote smart devices.



Figure 21: Callee getting remote data (SightCall 2016)

4.2.1 Security measures

Sightcall uses DTLS-SRTP (Datagram Transport Layer Security, Secure Real-time Transport Protocol) to secure communication using AES with a key size of 256 bit. All Sightcall platforms are sound with webRTC standards and guarantee therefore secure communication. (SightCall 2016)

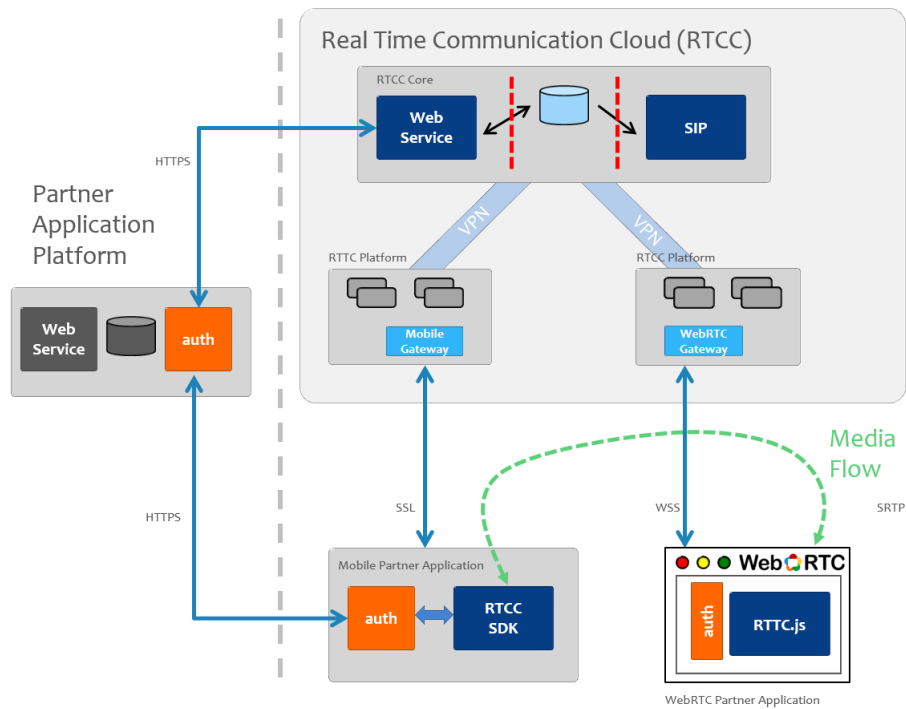


Figure 22: Sightcall security principle (SightCall 2016)

4.2.2 Business Model Canvas

Sightcall provides basic Video VoIP communication using devices connected to the internet. Video calls also feature annotations, which allow users to draw on videos. Sightcall is also providing a Salesforce plugin, which is available at the Salesforce Store. To ensure that customers get the best customization possible, Sightcall also offers an API which allows companies to develop solutions exactly fitting their needs. Figure 23 illustrates the Business Model Canvas.

<u>Key Partners</u> <ul style="list-style-type: none"> • Cloud computing providers • Telecom providers • Hardware manufacturers • Payment providers • Salesforce 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Support management 	<u>Value Propositions</u> <ul style="list-style-type: none"> • API based VoIP Service • Messages • Attachments • Video Calls • Annotations • API 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Software download • Support agents 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Companies • Developers
<u>Key Resources</u> <ul style="list-style-type: none"> • Developers • Software 	<u>Channels</u> <ul style="list-style-type: none"> • Website • Demos • Social media 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • no information available 	<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Support management • Partner fees • Telecom costs • Overhead 	

Figure 23: Sightcall Business Model Canvas

4.3 Xpert Eye

Xpert Eye is utilizing smart glasses like Google glass for voice calls, image sharing, text messages and annotations. Supported smart glasses are hooked up to a notebook, which provides a proper screen for smart glasses, since they have very limited display sizes. The caller uses smart glasses to provide his or her point of view to the callee, while the callee can give instructions for the caller. (AMA 2016)

Figure 24 shows a nurse using smart glasses to aid a patient assisted by a physician, in the background the notebook can be spotted.



Figure 24: Nurse using Xpert Eye for remote assistance (AMA 2016)

4.3.1 Security measures

Currently there is no detailed description of security measures available and therefore it cannot be said if this technology would satisfy legal regulations.

4.3.2 Business Model Canvas

Xpert Eye is utilizing Smartglasses to provide remote assistance, therefore it is important that Smartglass manufacturers provide the ability to create applications for their product. Due to the limitations of display sizes of Smartglasses it is necessary to use a portable computer to display information and write messages. The service is aimed at companies that are looking for a way to provide remote assistance to people that have to use their hands, therefore Smartglasses are a viable choice. Figure 25 provides a detailed Business Model Canvas.

<u>Key Partners</u> <ul style="list-style-type: none"> • Cloud computing providers • Telecom providers • Hardware manufacturers • Payment providers • Smartglass manufacturers 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Support management 	<u>Value Propositions</u> <ul style="list-style-type: none"> • Smartglass based consultation • Messages • Picture capture • Video Calls • Annotations 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Software download 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Companies
<u>Key Resources</u> <ul style="list-style-type: none"> • Developers • Software • Smartglasses 	<u>Channels</u> <ul style="list-style-type: none"> • Website • Social media 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • no information available 		
<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Support management • Partner fees • Telecom costs • Overhead 				

Figure 25: Xpert Eye Business Model Canvas

4.4 Vimed Teledoc

The Vimed Teledoc system is a mobile workstation to communicate with patients or other physicians. Since the device itself is a whole workstation additional features like card readers or media drives can also be used to transfer data. The workstation used by the remote device is controllable via software and allows the callee to move his or her vision around and even use several zoom levels. The workstation also comes with a microphone, speakers, touch screen, keyboard and mouse to provide a variety of input options. To ensure mobility the Vimed Teledoc comes equipped with a battery that lasts up to 10 hours. (Vimed 2016)



Figure 26: Mobile workstation (Vimed 2016)

4.4.1 Security measures

There is no specific information about connection security given, the device operates via WLAN. However Vimed (2016) also offers network access for medical networks named medMnet which is a protected network using VPN technology to ensure nobody from an external network has access to the transmitted data. Furthermore this network is also monitored to ensure there are no failures. (Vimed 2016)

4.4.2 Business Model Canvas

The Vimed Teledoc is a device for virtual presence, allowing Video VoIP calls. Since this product is aimed at hospitals additional Systems like card readers have been integrated into the device, ensuring efficiency and stability for clinical applications. The device also comes with a CD burner allowing to store information. Figure 27 shows the Business Model Canvas.

<u>Key Partners</u> <ul style="list-style-type: none"> • Telecom providers • Hardware manufacturers • Payment providers 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Hardware development • Support management 	<u>Value Propositions</u> <p>Virtual Presence Device</p> <ul style="list-style-type: none"> • Video Calls • runs on battery • CD burner • remote controlled 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Support agents • On-Site care • Software download 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Hospitals
<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Support management • Hardware costs • Telecom costs • Overhead 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • no information available 			

Figure 27: Vimed Teledoc Business Model Canvas

4.5 PädExpert

PädExpert is a web-based service providing medical councils for paediatrics. PädExpert is currently being tested in Germany and first results have shown that the system provides several advantages. (PädExpert 2016)

The advantages found by PädExpert (2016) are:

- Better diagnosis, especially for uncommon disease
- Quicker diagnosis
- Better treatment quality
- Paediatricians gained new skills
- Several improvements for patients (shorter waiting times, shorter travel times)
- Specialized care at the paediatrician they know and trust
- Cost reduction

4.5.1 Security measures

PädExpert is using the Data-Split method to store and transmit data over the internet. The data transmitted gets separated into three parts according to PädExpert (2016):

- Personal data
- Medical data
- Attachments

Medical data is completely anonymous and is tagged with a reference code, which is stored in a local database. Personal data is getting encrypted and stored in a separate database. Attachments, which could include personal or medical information, are also encrypted and stored in a third database. For encryption an asymmetric encryption system is used, which provides a public key, that is accessible for all participants, and a private key, which is only accessible by a specific user. Therefore it can be ensured who is actually able to decrypt which information. The Data-Split method was certified as secure by the Bavarian State Office for Data Protection. (PädExpert 2016)

Figure 28 shows the principle of the Data-Split method.

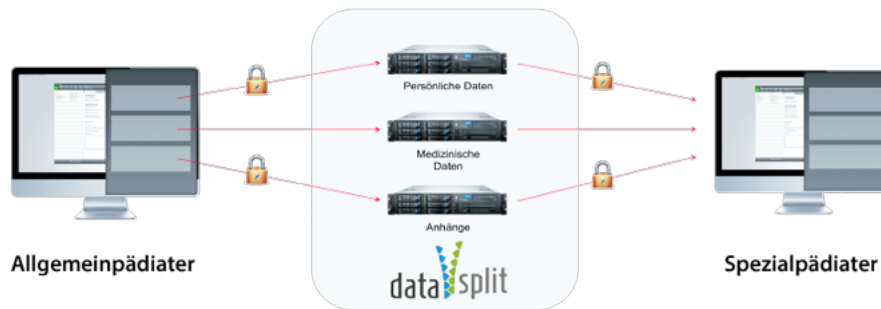


Figure 28: Data-Split method (PädExpert 2016)

4.5.2 Business Model Canvas

In contrast to the previous Business Models, PädExpert is using a different approach to create value for the customer. Instead of using real-time communication PädExpert is relying on asynchronous communication, therefore the service is based on a web-platform that allows to do that. Instead of using annotations to outline the problem, PädExpert is using input masks to provide a detailed, fact based symptom description, which is then reviewed by a specialist who is providing a diagnose. In terms of revenues there is also a different approach. PädExpert relies on governmental funding, therefore making use of subsidies to fund operational activities. The Business Model Canvas is shown in figure 29.

<u>Key Partners</u> <ul style="list-style-type: none"> • Cloud computing providers • Telecom providers • Government • Pediatricians 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Support management 	<u>Value Propositions</u> <p>Consultation Portal</p> <ul style="list-style-type: none"> • Symptom descriptions • Attachements • Diagnosis 	<u>Key Resources</u> <ul style="list-style-type: none"> • Developers • Software 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Registration • Support agents 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Pediatricians
<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Support management • Partner fees • Telecom costs • Overhead 				<u>Channels</u> <ul style="list-style-type: none"> • Website • Press • Social media • Governmental support 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • Subsidies

Figure 29: PädExpert Business Model Canvas

4.6 Conclusion

At table 4.6 an overview of existing technologies is given. The following aspects are taken into consideration:

- Meets legal requirements
Answers the question if the technology satisfies legal requirements based on the information given by the provider without taking any further steps to satisfy legal requirements.
- Hands free
Tells if the technology can be used without the need of constantly interacting with hands by the person seeking help.
- Real-time
Gives information if it is real-time communication or not.
- B2B
The product is aimed for business to business markets.
- B2C
The product is aimed for business to consumer markets.
- Special hardware
Special hardware defines if this technology actually uses some kind of specific hardware that is not commonly available. For example, smart glasse can be considered as special hardware since they are not commonly found at hospitals, while smart phones and tablets are not considered as special hardware, since they are commonly used in those institutions.

Technology	Meets legal requirements	Hands free	Real-time	B2B	B2C	Special hardware
HoloNotes	yes	yes	yes	yes	yes	yes
Sightcall	yes	no	yes	yes	no	no
Xpert Eye	no	yes	yes	yes	no	yes
Vimed Tele-doc	no	yes	yes	yes	no	yes
PädExpert	yes	no	no	yes	no	no

Table 3: Technology comparison

Comparing these technologies for their intended use cases also has shown some interesting facts. Most video-conferencing tools that enable the user to use annotations are intended for an expert to non-expert scenario, like a nurse receiving remote assistance and detailed instructions for patient care from a physician. The only system that was intended for an expert to expert consultation, PädExpert, didn't use video nor annotations at all, although the possibility to attach data, like pictures, was given.

Comparing the Business Models from these technologies, it can be said that there are a lot of similarities between them. Therefore it makes sense to look at these similarities and and derive a basic Business Model, which is commonly shared between those Models and use the result as a foundation for further improvement.

4.6.1 Derived Business Model Canvas

Looking at the different Business Models, we were able to identify the following commonly shared parts of the Business Model, which we've then tailored towards a remote consultation system. The Business Model Canvas shown in figure 30.

<u>Key Partners</u> <ul style="list-style-type: none"> • Cloud computing providers • Telecom providers 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Support management 	<u>Value Propositions</u> <ul style="list-style-type: none"> • VoIP Video calls • Attachements • Messages 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Website • Support agents 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Medical institutions
<u>Key Resources</u> <ul style="list-style-type: none"> • Developers • Software 	<u>Channels</u> <ul style="list-style-type: none"> • Website • Social media 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • Subscriptions 		
<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Support management • Partner fees • Overhead 				

Figure 30: Derived Business Model Canvas

The different segments were derived as follows:

- **Key Partners**
Every service needs computational resources, therefore a Partner to provide these resources is needed. Most likely a Cloud Computing provider is chosen to take care of hosting or provide some sort of server infrastructure. It is also necessary to ensure a proper connection to the internet, which is provided by Telecom providers. Those Telecom providers have to ensure the service is reachable and also make sure that there is enough bandwidth available to give customers the best possible experience.
- **Key Activities**
The Service itself has to be developed and further improved to satisfy customer needs, therefore software development is an important activity. Furthermore customer complaints and questions have to be dealt with, which is done by providing a proper support.
- **Key Resources**
Since the service needs development, well qualified software developers are very important to be successful. Secondly a proper development environment and a platform to run the service on is needed, referred to as software.
- **Value Proposition**
Most services rely on real-time video communication, while also offering attachments and direct messages, however it would also be possible to exchange video calls for proper input masks to describe the problem. In order to provide the best value for customers, an expert interview will be conducted and evaluated to answer this question.
- **Customer Relationship**
Usually a website in addition with a software download is used. Additionally the investigated services also provide some sort of Call Center with Support Agents.
- **Channels**
Since all investigated services are web-based it is quite straight forward to also use the web as a Channel - most commonly this is done by providing a website and also being active on social media.
- **Customer Segments**
Usually investigated services were targeted at other companies, or at a specific group of companies. In our case it makes sense to target medical institutions.
- **Cost Structure**
Software development and support management is necessary, but it is also creating costs. In order to acquire new customers marketing has to be done. Costs for using the services of Key Partners have to be taken into account as well.
- **Revenue Streams**
It is quite common to offer Subscriptions for services and it is also widely

accepted by customers, therefore it makes sense to consider this type of billing as an viable option. Taking political developments into account, governmental subsidies are probably also an option to provide such a service, if a service full fills the criteria mentioned in section 3.2.1.

Chapter 5

Refining the Business Model

In the previous section a fundamental Business Model was derived. In this chapter the aim is to refine important sections to further increase value for customers. In order to do so, we have decided to conduct an expert interview to gather a deeper understanding of what is important for users of such a system.

5.1 Creating an interview guide

In order to conduct an expert interview it is a necessary to think of proper questions for the questionnaire first. It is important to think of what information you actually want to collect before trying to formulate the questions itself. One possible way to structure your questions is to use a Mind-map and make sure all the topics you are looking for are covered and then proceed to formulate the actual questions. When conducting a questionnaire one should start off with a short introduction, which should contain information about the person conducting the interview, the reasons why this interview is necessary, pointing out that there are no wrong answers and thanking the person for participating. There should also be an option for having a non disclosure agreement and to ask the interview partner if he or she wants to stay anonymous. (Pilshofer & Prensberger 2001)

5.1.1 Question classes

There are two distinct classes of questions, namely closed and open questions. Closed questions are questions that are answered with yes or no, or questions that have options to choose from through ticking them. Closed questions are easy to evaluate since there is a scale that is equal for everyone answering them. It is also important to note that scales should have an equal distance between each option to choose. For example it is not very useful to use school grading systems, since the distance between failing a class and barely passing a class is interpreted much bigger than the distance from the best grade to the second best grade. (Pilshofer & Prensberger 2001)

Open questions are questions that can be answered individually, without having to choose from a predefined set of options. Open questions are especially helpful when it comes to discovering new options and to gain a better understanding of the topic. However, open questions are also harder to evaluate since there is no common scale. (Pilshofer & Preamsberger 2001)

Of course it is also possible to mix both classes by providing options to tick and one option to answer a question with own words. (Pilshofer & Preamsberger 2001)

5.1.2 Formulating questions

When formulating questions it is important to take a couple of points into account, according to Pilshofer & Preamsberger (2001) these points are:

- Questions should be simple to understand.
- Formulate questions as exact as possible.
- Make sure that all people involved understand the terminology.
- Questions shouldn't be suggestive, i.e. do not steer people towards an answer.
- There shouldn't be too much content in one question, i.e. do not try to ask too much in one question, rather split up in order to keep it simple.
- Formulate questions as neutral as possible.
- Try to avoid questions that produce socially expected answers, i.e. people feel forced to answer what is commonly expected by the general public.

It is also a common practice to include control questions into a questionnaire, however the problem with control questions is that they are usually quite obvious and easy to spot. (Pilshofer & Preamsberger 2001)

5.2 The interview guide

We have decided to split the questions into three dimensions, which are: Process Dimension, Information Dimension and User Acceptance Dimension. These dimensions should help to further sketch and optimize the Business Model derived in section 30.

The Process Dimension should help us understand how the process of of consultation works and what would be advantageous for users at consultations.

The Information Dimension should help to understand which kind of information is actually important and necessary for a council.

The User Acceptance Dimension helps to understand if such a service would be appreciated and is considered as a viable option by the user.

We have also decided to use open questions because they provide a very detailed description what users want from the system and open questions also help us to gather a deeper understanding about what actually is important for users, especially in terms of value.

Process Dimension

These are the questions related to Process Dimension, which should help us to understand the process that lies behind consultation. This dimension should help to increase understanding of several organizational parts of the Business Model.

- Would it be beneficial in your daily job routine to get a council ?
- How long does it currently take to get a council ?
- How long should it take to get a council ?
- How many councils do you require per month ?
- How many councils are you giving per month ?
- Are there any major drawbacks with consultation currently ?
 - What are those drawbacks in detail ?
- Are there situations where instant feedback would be an advantage ?
- How does a council work step by step ?

Information Dimension

These are the questions related to Information Dimension, which should help to understand which Information has to be provided when using consultation. It should help to sketch technological requirements for the Business Model itself, thus guaranteeing that all required information can be shared between the participants without issues.

- What information has to be provided for the consultant and for the physician requesting the council ?
- Would it help to sketch a problem in a graphical way ?
 - Would you prefer videos or pictures ?

User Acceptance Dimension

These are the questions related to the User Acceptance Domain, which should help to understand the users needs and if such a service would be considered as an option by users. It should also show if such a service would be beneficial in practical scenarios and if the technological advantages could be used in practice. Finally it should also give an idea if such a service would be used by physicians at all.

- Do you prefer consulting physicians from the same hospital group ?

- Why are you preferring that ?
- Would you consult someone you have no experience with ?
 - Would you rather consider consulting a unknown person if there where ratings ?
- Is physical presence important during consultation ?
- Would you rather have real-time communication (phone calls) or asymmetric communication (Email, letters) ?
- Would you consider participating at virtual consultation services ?

The final interview guide

We have ordered the questions for the interview the following way:

- Would it be beneficial in your daily job routine to get a council ?
- How long does it currently take to get a council ?
- How long should it take to get a council ?
- How many councils do you require per month ?
- How many councils are you giving per month ?
- Are there any major drawbacks with consultation currently ?
 - What are those drawbacks in detail ?
- Are there situations where instant feedback would be an advantage ?
- How does a council work step by step ?
- What information has to be provided for the consultant and for the physician requesting the council ?
- Would it help to sketch a problem in a graphical way ?
 - Would you prefer videos or pictures ?
- Do you prefer consulting physicians from the same hospital group ?
 - Why are you preferring that ?
- Would you consult someone you have no experience with ?
 - Would you rather consider consulting a unknown person if there where ratings ?
- Is physical presence important during consultation ?
- Would you rather have real-time communication (phone calls) or asymmetric communication (Email, letters) ?
- Would you consider participating at virtual consultation services ?

5.2.1 Interviews

In this Section the held interviews will be summarized. We've been taking notes while interviewing the experts and summarized their answers.

Interview with a medical superintendent

The first interview has been conducted with a medical superintendent.

- Would it be beneficial in your daily job routine to get a council ?
Yes it would be beneficial. Without medical councils it would be nearly impossible to deliver proper patient care. Medical councils are currently the only way to get specialized knowledge from different special departments.
- How long does it currently take to get a council ?
It is dependent if the council is held with an special department on site, or if the required special department is not on site. On-site consultation can be achieved within the same day. One to two times a week external councils are held, these days are defined before hand and are scheduled.
- How long should it take to get a council ?
It would be sufficient to get a council within 8 hours, respectively until the next medical round.
- How many councils do you require per month ?
There are about 10 councils per day held in between the different special departments.
- How many councils are you giving per month ?
There are about 10 councils per day held between special departments on site, physicians working at a hospital usually do not offer consultation to physicians that are not working for the same hospital group.
- Are there any major drawbacks with consultation currently ?
Councils with in-house special departments work really well. Councils with specialist that are not in-house have some drawbacks.
 - What are those drawbacks in detail ?
External consultation is very dependent on appointments. Since appointments are fixed before head long waiting times can occur, which could be improved.
- Are there situations where instant feedback would be an advantage ?
Usually it is sufficient to get feedback within a day, to be more precise until the next medical round. It is also dependent on the patients status, for example instant feedback would be very beneficial if the patient is critical.
- How does a council work step by step ?
We are using an electronic management system. If a council is required a order for a council has to be entered using that system. Within that order, the issue is described. The consultant is using this system to see if there are any requests for a council and responds to requests given by the list. The consultant has an account for the management system, which allows him

or her to see all digital information about the patient beforehand. Finally the consultant visits the patient and examines the patient. In very rare cases (< 10% of all cases) it is sufficient to just use digital information in order to identify the issue and give a therapy recommendation.

- What information has to be provided for the consultant and for the physician requesting the council ?

Usually the consultant has full access to all electronic health data available about the patient. Additionally the consultant needs a description of the issue. It is also important to get the latest data, like vital signs, fibre curves, current medication and so on, which is available at the ward and not necessarily updated or entered at the patient management system. To get this data it is important to go and see the patient and get the most actual data possible by the consultant.

For the physician requesting the council it is important to get the clinical report and a therapy recommendation from the consultant.

- Would it help to sketch a problem in a graphical way ?

It isn't necessary to showcase the problem, most of the time it is sufficient to describe the problem with one or two sentences. Graphical information from previous examinations is usually stored within the clinical information system and the consultant can review this information, annotations to those materials are not required.

- Would you prefer videos or pictures ?

Not required.

- Do you prefer consulting physicians from the same hospital group ?

If the special department is available on site, it makes sense to consult that department. Consultants from the same hospital group are not always the best choice, since the geographic distance is more important. E.g. it doesn't make sense to consult someone from the same hospital group if that specific physician is geographically far away. In this cases external experts are consulted, which are located nearer to the hospital.

- Why are you preferring that ?

On-site special department consultation is preferred, since the required expert opinion is already near by and doesn't need to be bought in addition. It is also much faster to consult a physician that is already working at the same hospital.

- Would you consult someone you have no experience with ?

Usually not, since consultant partners are always selected on experience and qualification. Therefore each external consultant gets interviewed before hiring.

- Would you rather consider consulting a unknown person if there where ratings ?

If those ratings reflect the quality of the consultant and are based on experience then yes. However it has to be made sure that this rating is given by experts, like other physicians or hospitals.

- Is physical presence important during consultation ?
In 90% of the cases it is important for the consultant to be physically present. The presence of the consultant is required since he or she has to examine the patient on a personal level in order to make sure everything is done the right way and to mitigate mistakes and ensure a maximal degree of patient safety.
- Would you rather have real-time communication (phone calls) or asymmetric communication (Email, letters) ?
If someone wants to get a medical council he or she has to write a proper order for a council, therefore always a order in a written manner is required. The outcome of a council is a clinical report that has to be archived. Due to this process asymmetric communication is sufficient, since the consultant has to be physically present in most cases to examine the patient.
- Would you consider participating at virtual consultation services ?
Yes, but only for about < 10% of the cases, since the majority requires the consultant to personally examine the patient. For some special fields (like radiology or dermatology) where one could safely diagnose disease without examining the patient personally it would be a possibility.

Interview summary

Councils are an important part in the medical world. On-site consultation is working fine at the moment, external partners are usually harder to manage, since they are not available all the time. In an ideal world a council should be acquired within 8 hours. There is no strong preference for consulting physicians from the same hospital group, the important factor is the geographic location.

A council serves the purpose of getting an expert opinion on a disease, where the physician requesting the council has not much to none experience with. Therefore it is very important for the consultant to be physically present and being able to interact with the patient, in order to guarantee a sufficient level of patient safety and the most accurate diagnosis possible.

Looking at medical councils in general only a very small amount, < 10% of councils, could be held in a virtual setting. For those special fields that would allow exclusive virtual consultation it would be appreciated. For such a virtual service, asymmetric communication would be the method of choice. No additional videos or pictures with annotations would be required, since the problem can be described with one or two sentences in a sufficient way. The starting point of each council as a written request and the outcome is also a medical report and therapy recommendation from the consultant.

Interview with an oncologist

The second interview has been conducted with an oncologist.

- Would it be beneficial in your daily job routine to get a council ?
Yes, there are always situations where expert opinions from a different medical specialization are needed.

- How long does it currently take to get a council ?
You have to distinguish between consultants that are already on site, and consultants that are from an external source. Currently councils with consultants on site are rather simple to get and it takes about one to two days. However consultants from external sources are not that easy to get on site and it can take up to a week.
- How long should it take to get a council ?
It should take about one working day to get a council done, 48 hours might be acceptable as well.
- How many councils do you require per month ?
I'm roughly needing one council per day.
- How many councils are you giving per month ?
Roughly one to two councils per day.
- Are there any major drawbacks with consultation currently ?
Yes, there are currently some issues with consultation that are mainly caused in how they are organized.
 - What are those drawbacks in detail ?
Currently requests forms for a council have to be written by hand, which is not optimal. Additionally a lot of required documents are not directly entered into the electronic management system. This leads to unnecessary delays in the whole process, since secretaries have to enter clinical reports given by consulted experts into the electronic management system and share that reports with the physician who requested the council using the electronic management system. This whole process is very time consuming and waiting times of up to 48 hours for a clinical report and therapy recommendation can occur.
- Are there situations where instant feedback would be an advantage ?
Yes, it can happen that patients get released before a council has taken place. E.g. the patient gets released on Friday, while the council has been required on Thursday, due to too long waiting times the clinical report and therapy recommendation from such a council arrives on Monday. Additionally it would make life easier, since on weekends there is basically nothing happening, so if one would need a council on Friday it is quite common to get the results not earlier than Monday.
- How does a council work step by step ?
First a request form has to be filled out by hand. Then this request form is passed on to the secretary, who arranges the council and enters the request into the electronic management system. This request form gets submitted to the consultant required. The consultant is requiring the patient to visit his or her office, or is coming to see the patient on site. It is dependent which council is required: In some cases there are fixed days per week, where the consultant examines the patients and there are also cases where appointments are made on demand, which leads to unpredictable waiting times for external consultation. For internal consultation it is easier to

set up an appointment. At the last step the consultant submits a clinical report and therapy recommendation, which has to be entered and shared within the electronic management system by administrative staff.

- What information has to be provided for the consultant and for the physician requesting the council ?

For the consultant is important to get the question about a specific case. Additionally the patient record is important, which includes all important medical information. When a patient gets send to a consultant, the patient is bringing his patient record with him or her.

For the physician requesting the council, the clinical report with the findings and a therapy recommendation from the consultant are important.

- Would it help to sketch a problem in a graphical way ?

There is no need to sketch things in a graphical way. Graphical information, like cardiograms, is part of the patient record and is attached. Additional annotations to such diagnostic tools are not required, since the issue can be described in a textual way.

- Would you prefer videos or pictures ?
Not required.

- Do you prefer consulting physicians from the same hospital group ?

If the required special department is available at our hospital group then yes.

- Why are you preferring that ?
We can do this because our hospital groups sites are geographically close to each other and they are rather easy to reach. However if they would be split widely across the land then we would have to pick specialists geographically closer to the site where the council is required. Additionally organization of councils within the same hospital group is easier and faster.

- Would you consult someone you have no experience with ?

No, we need to make sure that the consultant is qualified and provides the quality of patient care we expect. I would just consult a unknown person if there is really no other option available and the patient is very critical, given there is no other person I already know available.

- Would you rather consider consulting a unknown person if there where ratings ?
These ratings have to be given by professionals, otherwise I wouldn't trust them. E.g. if those ratings where like hotel ratings, where everyone can rate, it would not provide the quality of information needed to judge the physician. If those ratings where given by other hospitals or physicians and are based on practical experience with the consultant then yes.

- Is physical presence important during consultation ?

No, in the field of oncology therapy recommendations can be given by the consultant without being physically present. We are already using teleconferences and they are working quite well. However not everything can

be judged without seeing the patient and in other fields, like orthopaedics, it is important to be physically present and examine the patient as a consultant.

- Would you rather have real-time communication (phone calls) or asymmetric communication (Email, letters) ?

Real-time communication would be a preferable choice, since it enables one to ask details or follow-up questions immediately. It also helps to clarify several aspects that probably haven't been discussed in detail by the consultant. Since we are using teleconferences already, I find it very useful.

- Would you consider participating at virtual consultation services ?

Yes I would participate at such a service. However not every case can be discussed virtually and might require patient examination.

Interview summary

Councils are very much needed for physicians. Internal consultation is comparable easy to organize and quick to get, while external consultation is not that smooth. It would be sufficient to get a council done within one or two days. The important factor for selecting a medical consultant is the geographic location, in this specific case the sites of the hospital groups are geographically close to each other, which allows doing as much consultation within the same hospital group as possible.

In the field of oncology it is possible to state diagnosis without physically examining the patient, which allows virtual consultation. However it cannot be ensured that there is absolutely never the requirement to examine the patient, but most of the time there would not be the need to. Additional annotations to pictures or videos are not required, since all information can be usually found at the patient record.

Virtual consultation would be an option for the field of oncology, in fact councils are already done virtually by using teleconferences and this method has been found very good. Live communication would be quite useful, because follow-up questions can be asked while consultation in order to clarify therapy recommendations or get a more detailed explanation of several aspects. The starting point is a request form for council and the outcome of each council is a diagnosis and a therapy recommendation.

Chapter 6

Results

6.1 Medical councils

In general it can be said that medical councils usually take place between two special departments, which are specialized in different branches of medicine. For example surgery is consulting internal medicine. Since each special department is highly specialized in their specific operational field, it cannot be assumed that a surgeon is able to perform examinations specific for internal medicine.

A general virtual approach for medical councils is not possible in practice, since physical examination can be necessary for the medical consultant in order to provide a therapy recommendation. However virtual councils are still an option to enhance and speed up medical consultations where no physical patient examination is needed.

6.1.1 The process of medical consultation

The general process of medical consultation is sketched in figure 31.

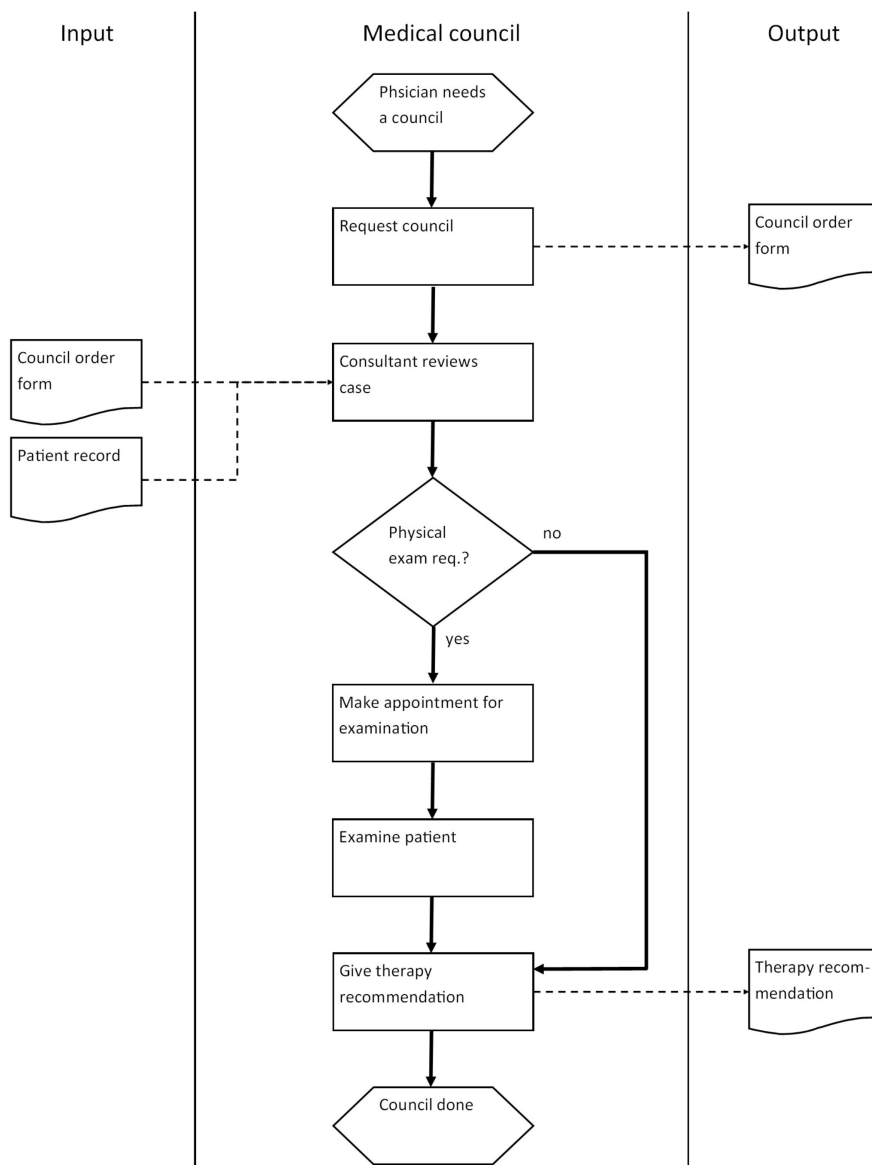


Figure 31: Medical consultation process

A more detailed description of the process steps:

1. Physician needs a council
First of all the need for council has to be there. For example a surgeon couldn't clearly identify the issue and assumes that internal medicine could solve the issue and provide a diagnosis and therapy.
2. Request council
The physician requests a council by filling out a request form. This request form is required for each and every council. The request form includes a description of the problem itself and is in fact the order of a council.

3. Consultant reviews case
The consultant receives the council order form and starts investigating the case. The consultant additionally needs the patient record including all relevant medical information about the patient.
4. Physical examination required ?
The consultant then decides if a physical examination of the patient is needed. If no physical examination is needed, go to step 7.
5. Make appointment for examination
If the consultant needs to physically examine the patient he proceeds to make an appointment in order to do so.
6. Examine patient
The consultant physically examines the patient.
7. Give therapy recommendation
When the consultant collected all relevant information about the issue, he proceeds to recommend a therapy to the physician initially requesting the council. The therapy recommendation has to be delivered as a document for documentation purposes. This document is essential and has to be provided for each and every council to the physician requesting the council. Another important thing is that the consultant just recommends a therapy. If the therapy is actually applied is judged by the physician initially asking for the council.
8. Council done
After receiving the therapy recommendation the council is done.

Required documents for the process of consultation:

- Council order form
The council order form is the official request for a council and has to be sent to the consultant. This document also includes the problem description for the consultant. This document could be provided in a digital or physical way.
- Patient record
The patient record is needed by the consultant to get all prior medical incidents and the patients history. Additionally it delivers core data about the patient.
- Therapy recommendation
The therapy recommendation is the official answer from the consultant to the request. This document explains the findings of the consultant and suggests how to treat the issue. This document is essential for every medical council.

6.2 Virtual medical councils

Due to the fact that the majority of medical councils involve physically examining the patient by the consultant, virtual consultation is not a tool that can

be used for all medical councils. However virtual consultation can be used at specific medical branches and could optimize the process for this specific cases.

Documents and patient information can be provided in a digital fashion, therefore the required documents can also be delivered by using virtual consultation tools. Since Austria has introduced Electronic Health Records, it is also possible to share medical patient data in an electronic way.

The interviews lead to the conclusion that video or pictures would not be needed for virtual consultation, and a web-service that offers the ability to state the problem description and share relevant patient information, especially electronic health records, would be sufficient. Although it would be beneficial to have some sort of service that allows follow-up questions in case some parts of a therapy recommendation need further explanation.

After gathering information how the medical consultation process works, which was shown in figure 31, we were able to sketch a business process for virtual medical consultation as well. We have kept in mind that, in order for virtual medical consultation to work, no patient examination has to be required. Additionally we have also taken into account that follow up questions would be advantageous.

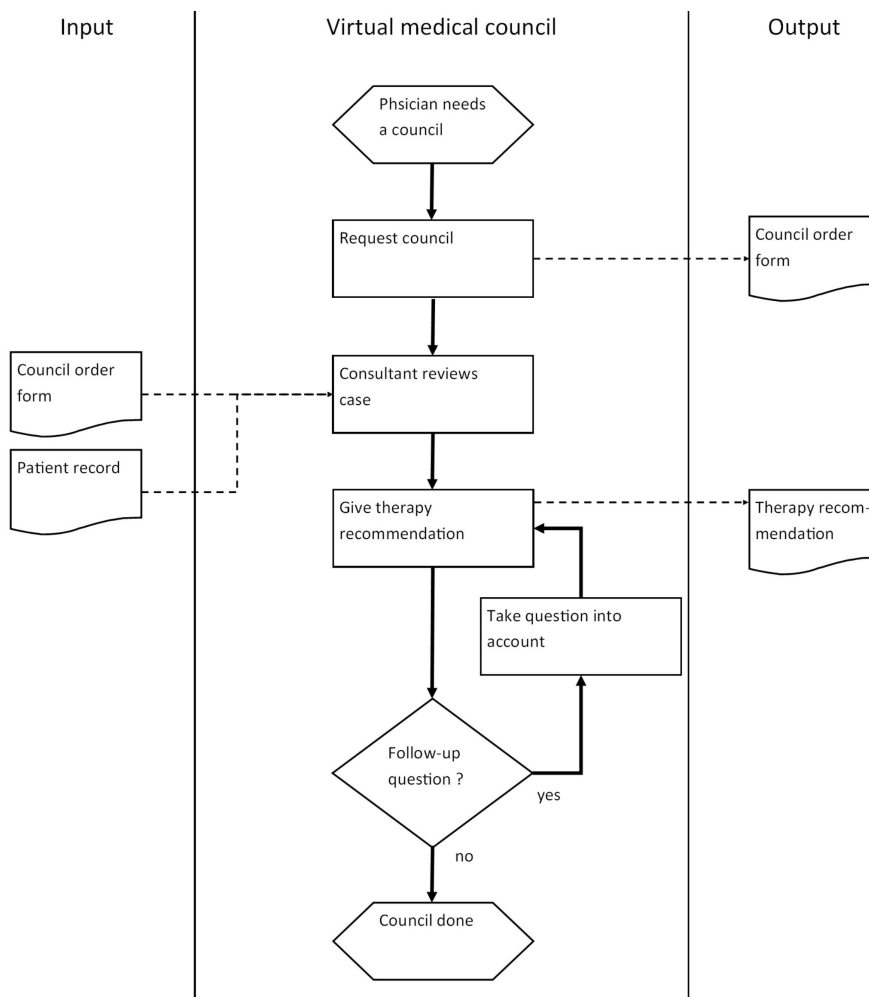


Figure 32: Virtual medical consultation process

A more detailed description of the process steps:

1. Physician needs a council
First of all the need for council has to be there. At this point it has to be clear that no patient interaction is needed for the consultant, hence this process is only suitable at specific medical branches
2. Request council
The physician requests a council by filling out a request form. This request form is required for each and every council. The request form includes a description of the problem itself and is in fact the order of a council, which can be digitally signed by the physician requesting the council
3. Consultant reviews case
The consultant receives the council order form and starts investigating the case. The consultant additionally needs the patient record including all relevant medical information about the patient.

4. Give therapy recommendation
When the consultant has reviewed all relevant information about the issue, he proceeds to recommend a therapy to the physician initially requesting the council. The therapy recommendation has to be delivered as a document for documentation purposes. This document is essential and has to be provided for each and every council to the physician requesting a council. Another important thing is that the consultant just recommends a therapy. If the therapy is actually applied is judged by the physician initially asking for the council. The therapy recommendation document is digitally signed by the consultant.
5. Follow-up question?
If the physician initially requesting the council has a follow-up question to the therapy recommendation of the consultant he can post this question to the consultant, if not proceed to step 7.
6. Take question into account
The consultant reviews the question from the physician requesting the council and proceeds to refine the therapy recommendation according to the question. He then creates an altered therapy recommendation at step 4.
7. Council done
If there are no more follow up questions the council is done.

Required documents for the process of virtual medical consultation:

- Council order form
The council order form is the official request for a council and has to be sent to the consultant. Modern digital signing algorithms can be used in order to create such a document.
- Patient record
The patient record is needed by the consultant to get all prior medical incidents and the patients history. Additionally it delivers core data about the patient. Thanks to the introduction of electronic health records this information should be available in a digital fashion already.
- Therapy recommendation
The therapy recommendation is the official answer from the consultant to the request. This document explains the findings of the consultant and suggests how to treat the issue. This document is essential for every medical council. Digital signing algorithms can be applied to the document to ensure authenticity and integrity.

6.2.1 Suggested use cases by others

Schaffernak (2015) sketched a use case for virtual consultation, shown in table 4.

Name	Virtual Consultation
Short Description	The use case describes the process of a remote consultation where two or more entities which are spatially separated communicate interactively with each other using the camera and microphone of the near-eye display device. This involves video as well as audio transmission in real-time.
Actors	Doctor (advisee); One or more medical specialists (advisors); Patient (passive)
Preconditions	Network between endpoints is established. Required server applications are running. Near-eye display device is ready for use.
Trigger	During a medical process the doctor is confronted with a situation where the support from a medical specialist is needed.
Typical Process	<p>Arranging an appointment for a Virtual Consultation, for instance via telephone. At the beginning of the appointment:</p> <ul style="list-style-type: none"> • Start required application on near-eye display device. • Doctor (advisee) wears the near-eye display device. • Consultant starts client application to establish the connection to the remote endpoint. • Bidirectional audio connection and one directional video connection (advisee to advisor) is used to discuss medical issues. <ul style="list-style-type: none"> – The advisee is using the near-eye display device to capture the video from first-person perspective. • Pictures can be taken if needed from both parties. <ul style="list-style-type: none"> – Save pictures to local hard drive or save it in the HIS. • When everything is settled, disconnect the client(s) and the near-eye display device until the next time the Virtual Consultation is needed.
Additional Constraints	The connection outside of the hospital IT infrastructure should fulfill security constraints, such as confidentiality, integrity, non-repudiation and authenticity.

Table 4: Virtual Consultation use case proposed by Schaffernak (2015)

At first glance it looks like that this use case is suited for medical councils as well. In this thesis several flaws of the concept of pure virtual consultation have been revealed.

In most cases medical councils appear between two medical professionals with a different field of expertise. Therefore the advisee has little to no experience at consultants field of expertise. In most cases, considering patient safety, it would not be sufficient to instruct the advisee in a remote fashion how to perform examinations, as purposed by Schaffernak (2015) at the virtual consultation process.

In this thesis it could be clarified that virtual medical councils just make sense when no patient interaction is needed, therefore leading to the conclusion that the patient is not an Actor at the process of virtual consultation. The patient might be important before and after consultation, but not at the process of virtual councils.

Additionally we were able to find out that picture and video communication is not needed nor advantageous for medical councils. Therefore resources for establishing real-time video conferencing are not necessary. All relevant information about the patient, that are needed for virtual medical councils, are stored at the patient record, which can be stored and exchanged in a digital form, the electronic health record.

Another use case was purposed by Sachs (2014), which is focused on surgery. The use case is shown in table 5.

Name	Virtual consultations
Short Description	This use case describes how a Near-Eye Display Device along with a built-in camera, microphone and speaker may be used to perform real time consultations without the need for the consulting person to be locally present (and therefore being able to perform such consultations more quickly and efficiently).
Actors	Patient, Surgeon, Consulting Surgeon
Prerequisites	Network, head-mounted device (such as Google Glass), server (PC running inside of the network with started server application), Thin-Client for the consulting surgeon (providing video and audio in- and output)

Trigger	The surgeon sees himself confronted with a situation which he does not want to risk judging solely by himself. Therefore a consultation is conducted with a fellow surgeon (ideally with special experience on the specific matter).
Typical Process	<ul style="list-style-type: none"> • Operating room is prepared. <ul style="list-style-type: none"> – Network is prepared. – Near-Eye Display Device is started and connected to the network. – Server-PC is started, connected to the network and server-application is launched. – Screen (or monitoring thin client device) is started and connected to the server (either directly, or over the network). • Surgeon wears Near-Eye Display Device and therefore provides his viewpoint along with additional data (sound / speech) to the server via the built-in sensors. • The Surgeon may trigger a consultation to any person outfitted with either a thin client that is connected to the server as well or the possibility to watch the process on the server application itself. • After the operation, the server application and the Near- Eye Display Device are disconnected and may be switched off until further application.
Remarks	For consultations it should be possible to provide at least video-out, high-quality photo-out and audio-in / -out. Video- and Photo- In are of added benefit but may have to be used sparsely because of data transfer limitations (the more data is transferred simultaneously, the bigger is the challenge of providing adequate performance).

Table 5: Virtual Consultation use case purposed by Sachs (2014)

Looking at the Actors it is easily identifiable that both, the consultant and the physician needing advice, are surgeons. Considering that medical councils usually take place between different fields of expertise, a medical council could be

required between a surgeon specialized on thoracic surgery needing advice from a surgeon specialized on neurosurgery.

The consultant would still be required to enter the operating room and examine the patient in order to give a therapy recommendation. The thoracic surgeon would not be able to judge a neurosurgery case by just getting a virtual council, because he or she is not trained for this. Thinking about patient safety such an approach would be rather careless.

Conclusion

Two use cases have been discussed, which have something to do with consultation, but actually do not hold in case of medical councils.

Schaffernak (2015) also states that such a service would help inexperienced surgeons to get help rather fast if they need any.

In fact both use cases are not suitable for medical councils, these use cases describe much more a form of virtual assistance for trainees. For example students could be taught more efficiently when using such systems.

6.2.2 A Business Model for virtual medical councils

After researching the practical needs of physicians for consultation we were able to develop the following Business Model, shown in figure 33.

<u>Key Partners</u> <ul style="list-style-type: none"> • Cloud computing providers • Telecom providers 	<u>Key Activities</u> <ul style="list-style-type: none"> • Software development • Support management 	<u>Value Propositions</u> <p>Consultation Portal</p> <ul style="list-style-type: none"> • Symptom descriptions • Attachements • Electronic health records • Follow up questions • Diagnosis • signed Documents 	<u>Customer Rel.</u> <ul style="list-style-type: none"> • Website • Support agents 	<u>Customer Segments</u> <ul style="list-style-type: none"> • Selected medical departments
<u>Key Resources</u> <ul style="list-style-type: none"> • Developers • Software 	<u>Channels</u> <ul style="list-style-type: none"> • Website • Social media 	<u>Revenue Streams</u> <ul style="list-style-type: none"> • multiple options 	<u>Cost Structure</u> <ul style="list-style-type: none"> • Software Development • Marketing • Support management • Partner fees • Overhead 	

Figure 33: Business Model Canvas for virtual medical councils

The final parts of the Business Model are:

- **Key Partners**
Every service needs computational resources, therefore a Partner to provide these resources is needed. Most likely a Cloud Computing provider is chosen to take care of hosting or provide some sort of server infrastructure. It is also necessary to ensure a proper connection to the internet, which is provided by Telecom providers. Those Telecom providers have to ensure the service is reachable and also make sure that there is enough bandwidth available to give customers the best possible experience.
- **Key Activities**
The Service itself has to be developed and further improved to satisfy customer needs, therefore software development is an important activity. Furthermore customer complaints and questions have to be dealt with, which is done by providing a proper support.
- **Key Resources**
Since the service needs development, well qualified software developers are very important to be successful. Secondly a proper development environment and a platform to run the service on is needed, referred to as software.
- **Value Proposition**
A web-service is needed that allows consultants to access patient records. The physician needing help should be able to describe the issue and if needed add follow up questions on the specific case. Since documents are required, digital signatures can be used to create official documents that ensure authenticity and integrity. Additionally a rating by persons who have experience with the consultant and are from the medical profession could help choosing a consultant within the virtual consultation system.
- **Customer Relationship**
A website is used, additionally support agents are required that help customers in case any issues arise.
- **Channels**
Social media activity and a website are a must-have in nowadays world.
- **Customer Segments**
Since virtual medical councils are not applicable for all cases of medical councils, one has to select specific fields of the medical profession where such a service is actually applicable.
- **Cost Structure**
Software development and support management is necessary, but it is also creating costs. In order to acquire new customers marketing has to be done. Costs for using the services of Key Partners have to be taken into account as well.
- **Revenue Streams**
Since there are multiple ways to establish and fund such a system, see section 6.2.3 for more details.

6.2.3 Variation possibilities

We've been able to identify 3 possibilities to implement such a service, which will be described in this section.

1. Virtual consultation software

The first obvious way of offering such a service would be to sell a piece of software that enables hospitals to conduct virtual consultation. This could be a stand-alone version or an extension module for current hospital management systems. It could be distributed by a software download and be purchased with a licence. When offering an extension module for hospital management systems it should be rather easy to use information from these systems, like electronic health records. When offering a stand-alone version one has to ensure that access to electronic health records can be provided, most likely by using interfaces from the hospital management system in place.

2. Virtual consultation through subsidies

Another way would be that the government makes such a service available. There could also be legal regulations that require each hospital to offer a specific amount of virtual councils on selected fields each month. Thus making it easy to guarantee participation at the service. The costs of running the service could be covered by the subsidies, while participating hospitals would have a new source of revenue.

3. Virtual consultation

Since virtual consultation is only an option if no patient interaction is required, one could employ experts on those fields and offer a virtual consultation service. Therefore not only the required infrastructure is provided by the company, also the specialized medical personnel is provided by the company. This might be an option for research institutes, that have a lot of specific knowledge in certain areas and want to generate additional income. This highly specialized knowledge might also be of high value to hospitals, since otherwise it would not be that easy to get to that knowledge.

6.3 Discussion

Medical councils are not that easy to port to the virtual world. In most cases it has to be ensured that the consultant has physical access to the patient in order to do a proper examination. This is also in the interest of patient safety and to ensure that the diagnosis is as accurate as possible.

Medical councils usually happen between different branches of the medical profession, therefore making it hard to examine a patient by instructing the physician who initially requested the council. However there are also branches of the medical profession where no patient interaction is necessary and those branches would benefit from a service like virtual consultation. During the expert interviews the fields of radiology, oncology and dermatology were mentioned by the experts as an example for branches where virtual medical councils could be possible.

When thinking of the service itself and what physicians actually want, our results clearly show that videos or pictures with annotations are of minor interest in cases where remote consultation would be possible. Even instant feedback is not that important, much more a way of asking follow up questions on the therapy recommendation would be beneficial. According to our information it is also sufficient to get a therapy recommendation within 24 hours.

On selected fields that don't require patient examination by the consultant such a service would work and could be an improvement to the process of consultation.

The required information and documents are available and providable in a digital fashion, so the technical possibilities of such a service are given. There are also legal regulations that ensure a proper protection of sensible data. The most important documents at virtual consultation are the initial consultation request form, the therapy recommendation and the electronic patient record. The first two documents have to be signed, which can be done in a digital way, and are used for documentation purposes. Electronic health records are under legal regulation and have been introduced by the government already. Therefore all information can be delivered and obtained in a digital way.

6.4 Future work

This thesis showed that a general approach to transferring medical councils to an virtual environment is not working. However, this thesis also showed that there are specific medical branches where virtual consultation is possible.

It would make sense to conduct a detailed study on medical branches to figure out which branches are actually capable of doing councils in a virtual way, since our sample of experts was small with just two experts asked. The experts suggested that virtual consultation could be possible in the fields of oncology, dermatology and radiology. It would be a good start to investigate these branches of the medical profession in more detail in order to get more sophisticated results.

This Business Model and the purposed service can serve as a starting point to further investigate if the service is fulfilling the needs for those identified special medical branches that are capable for virtual consultation and if needed slight adjustments can be made.

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