Introducing eHealth Business Modelling Instruments for Implementing eHealth Technologies Based on an Integrated Approach with Human-Centered Design

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Abstract- **Many eHealth technologies struggle with their implementation. Too often a well-designed eHealth technology fails to be successful in practice. One way to assess the implementation early in the development of an eHealth technology is by eHealth Business Modelling. This paper introduces the use for business modelling in eHealth and what business models are. Followed by a brief description of the ceHRes roadmap, which is our development approach for eHealth technologies that connects Human-Centered Design with eHealth Business Modelling. We then focus on the business modelling part of this roadmap and describe the instruments we currently use for eHealth Business Modelling to work towards a sustainable implementation for an eHealth technology. With the resulting business model, the potential implementation of the eHealth technology can be assessed a priori with its relevant stakeholders and strategic choices for an optimal value co-creation can be made and operationalized.**

Keywords- business model; co-creation; collaboration; eHealth; evaluation; implementation; roadmap; stakeholder; value creation

I. INTRODUCTION

eHealth technologies are advancing towards a better fit with user needs and user behavior through User-/Human-Centered Design, however the implementation of the technology often remains poorly prepared and executed. This results in a well-designed eHealth technology that still fails to be successful in practice [1]. Often the implementation is evaluated ex post, so after the eHealth technology is fully developed and already deployed in its environment or market. The lack of stakeholder involvement, lack of cost-effectiveness analysis and uncertain sustainability leads to a suboptimal or even failing implementation.

eHealth Business Modelling is a promising way to evaluate the implementation of an eHealth technology a priori – so already during its development - by co-creating a business model for the technology with the relevant stakeholders and with the goal of collaborative value (co-)creation [2]. By involving the stakeholders in the implementation processes, the eventual implementation will better match with practice. It can be implemented in a way that matches their needs best. Besides, if stakeholders cannot cooperate already in thinking about a fitting implementation it is unlikely the value co-creation will go smooth either.

User-/Human-Centered Design are good for improving the eHealth technology itself, to make the technology reflect the needs of its users [3, 4]. But, users are only one subset of the entire ecosystem around an eHealth technology; there are many more stakeholders that will influence the technology. Maybe not in defining the specifics of the technology per se, but its implementation will depend on collaboration and co-creation of multiple stakeholders. Developing eHealth technologies is a multidisciplinary venture [5] where multiple stakeholders with multiple disciplines need to collaborate in the development of the technology but also in determining its implementation so it will 'survive' in practice. Basically anyone or any organization that affects or gets affected by the technology can be considered a stakeholder [6]. An eHealth technology faces many multidisciplinary stakeholders: policymakers, vendors, insurers, care organizations and care providers, home care, employers and patients [7]. These stakeholders all influence the implementation of the eHealth technology and thus influence the value of the entire technology.

Value in eHealth can be diverse; it can be monetary value (e.g., revenues, cost reductions), quantitative value (e.g., treatment time, number of patients, etc) or benefits [8]. The benefits from eHealth technologies are often complex to address, especially when these benefits are on a social level. Such social benefits are difficult (or perhaps even impossible) to quantize or monetize towards the eHealth technology directly. For example, if an eHealth technology speeds up a certain treatment, healthcare professionals can treat more patients; these treatments can become cheaper for healthcare organizations or the insurers; patients get home quicker, they consume less time and resources from the healthcare system, employers can benefit as patients get back to work faster, etc. eHealth technologies that offer such social benefits are hard to finance as the benefits are too obscure or indirect for the stakeholders that are supposed to finance the technology. In other words, it is imperative to assess what benefits are possible and thus what value an eHealth technology can offer to its entire ecosystem of stakeholders and more importantly, what this value means to each stakeholder. All stakeholders need to be inspired to collaborate and co-create value for themselves and each other and need to discover how this co-created value can be properly divided among the stakeholders. This is important for the implementation as the eventual value co-creation

determines whether the eHealth technology is considered sustainable and cost-effective.

How this value co-creation is ultimately done can be described in a business model as it is geared to describe the total value creation with multiple stakeholders [9]. A business model can transcend just one focal organization and looks at how value can be co-created and shared with other stakeholders [9]. This makes it suitable for guiding an implementation for an eHealth technology.
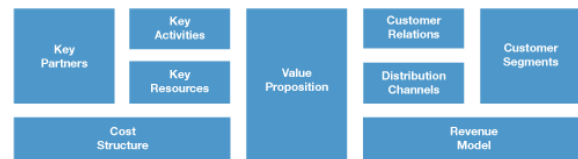
II. BUSINESS MODELS

Attention for business models grew in the last decade when the methods of doing business became more complex and more networked due to globalization and the rise of the Web 2.0 that made a whole new range of value creating opportunities appear in the form of Internet-based products and services [10]. Prime examples of successful Internet companies are e.g., Google, eBay and Facebook that totally rely on making money through Internet services. These companies experimented with totally new business models that fitted these new opportunities that Web 2.0 brought [11].

Known as eHealth [12], the Internet is seen as a promising venture to reorganize current healthcare services. Healthcare services currently are under a lot of stress when it comes to their affordability, accessibility and quality [13]. Grossman even states that with the current organization of the healthcare system in the USA about 30 to 40% of the healthcare costs are spent on inefficiency [14]. In many cases the "business" of business models in eHealth lays not directly in making profit, but the real profit lays in reducing costs at other stakeholders. However new ideas to improve healthcare - and that captures these cost reductions at the right stakeholders - require attention for new business models that fit eHealth in order to successfully implement these new ideas [14].

A business model is defined as the rationale of how an organization creates, delivers and captures value [15]. As mentioned earlier, value is determined by the stakeholders as they want to benefit from the eHealth technology, then they consider the technology valuable. A business model contains a strategic and bird's eye description of how stakeholders cooperate and co-create value, how the eHealth technology reaches its users and how the value can be offered in a sustainable and cost-effective way. Figure 1 shows the Business Model Canvas by Osterwalder, a currently popular business model 'blueprint' containing nine core concepts that constitute the whole rationale of value creation. Through market analysis, stakeholder needs assessments and various other instruments this canvas can be filled up with strategic choices that determine the rationale of value creation. The left side (key partners, key activities, key resources and the costs they generate) describes the organizational aspects of the value proposition, the right side (customer segments, customer relations, distribution channels and the revenues they generate) the customer/market side.

Figure 1. Business Model Canvas

For example, a business model can describe how a tele-dermatology website can reduce time at dermatologists by letting patients upload photos of their skin problems. They do not have to visit and the dermatologist can perform his diagnosis on the uploaded photo. This saves healthcare insurance companies and employers a lot of time and money. In this example the healthcare insurance companies have to pay a fraction of the original fee for dermatologists and, because of this optimization, benefit financially. Other benefits are that the dermatologists can diagnose more patients a day, patients can 'see' the doctor when it fits their schedule and there are even possibilities for social benefits that might interest health insurance companies, government and employers. This example shows that as long as all these stakeholders enjoy benefits from this tele-dermatology website they are willing to cooperate and collaborate. Here are opportunities for an eHealth technology. It is the challenge in defining a business model to find this ideal 'fit' for the stakeholders. The better this 'fit', the more value the business model yields and the implementation is more cost-effective and sustainable.

The market and technological possibilities evolve rapidly and these uncontrollable changes have consequences for the eHealth technology: The technology has to be kept up-to-date technically and that it still meets the user needs, but also the implementation needs to be dynamic as the business model needs to be kept up-to-date too [16, 17]. That is why eHealth Business Modelling is a continuous process that carries on even after the eHealth technology is deployed. Stakeholders can come and go, their value needs can change over time, all these things need to be dealt with when business modelling. A good business model needs to be a continuous rediscovery by constantly evaluating and improving earlier made assumptions [16].

Despite the fact that every organization operates with an underlying business model (even if the organization never explicitly made one they still operate with certain strategic objectives that can be seen as a business model) and the currently growing attention for business models in popular literature [18], research into business modelling is still a novel phenomenon and in the eHealth context even more so. eHealth development requires methods how eHealth business models can be defined, what eHealth business models are possible, what these business models exactly mean to the implementation of different types of eHealth technologies, etc.

III. CEHRES ROADMAP

We developed the ceHRes Roadmap (Figure 2) that combines the principles of Human-Centered Design and eHealth Business Modelling in a holistic and interwoven approach.

In each of these concepts both Human-Centered Design and eHealth Business Modelling have a set of instruments that can be used to develop and implement the eHealth technology. This combination of Human-Centered Design, eHealth Business Modelling and the technical development is similar to the idea behind Yusof's HOT-fit framework [19], who states that eHealth technologies need to be evaluated on the Human, Organization and Technology dimensions. Our roadmap takes it further than evaluation but guides the entire development of an eHealth technology on the same dimensions.

Figure 2. CeHRes Roadmap
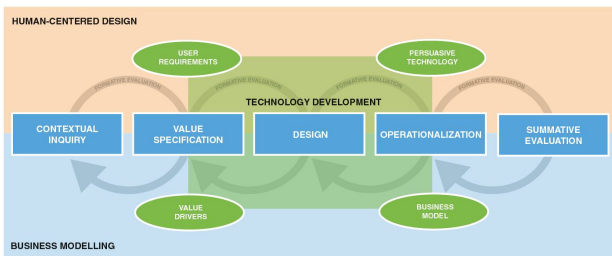
The whole development of an eHealth technology goes through five concepts:
- contextual inquiry,
- value specification,
- design,
- operationalization,
- summative evaluation.

Every step in between the concepts is also evaluated; hence the iteration loops in the figure. This evaluation is formative as it improves earlier findings and assumptions with new insights.

The approach described by the roadmap allows the developed eHealth technology to be persuasive and sense-making so that it meets its users' needs and behavior and at the same time the attention for the business model makes the development of the eHealth technology value-driven by involving the relevant stakeholders. This way the implementation gets prepared during the whole development and is an important part of development. Developing a good eHealth technology but with a poor implementation forfeit a lot of potential value.

IV. EHEALTH BUSINESS MODELLING INSTRUMENTS

In this article we focus on the bottom part (Figure 3) of the roadmap, the eHealth Business Modelling part, and we will introduce the current lineup of eHealth Business Modelling instruments per each of the aforementioned five concepts.

Figure 3. eHealth Business Modelling Instruments
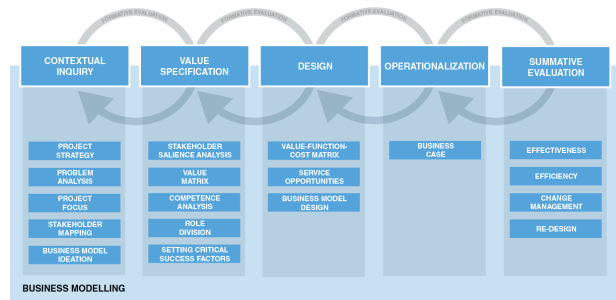
A. Contextual Inquiry

In this stadium it is important to prepare and plan the project as well as finding out whether what the exact problem is and if an eHealth technology is the right solution to this problem.

First the project strategy needs to be determined. There will be certain predetermined goals, conditions and constraints (finances, time, etc) that will influence the project straight from the start and these have to be well documented and communicated in a project strategy.

The next step is to analyze the problem. An eHealth technology is a solution for a certain problem. For example, by improving an inefficient process, by fixing inefficient information sharing, or by creating a new tool. It is dangerous to leap too quickly towards a solution as in those cases the technology might not properly solve the problem as the exact problem is more complex than assumed. The development of eHealth technologies is often too technology-driven, resulting in great state-of-the-art technologies but with problematic implementations. In order to take the proper action, the problem needs to be carefully assessed [20].

When the problem is understood it is possible to choose a focus on what problems the eHealth technology shall deal with and what solutions can be offered, obviously this focus needs to fit within the project strategy.

Also while analyzing the problem, the persons or organizations that experience the problem become apparent. These people are all stakeholders [6] and influence the implementation. In a relationship diagram these stakeholders can be mapped (Figure 4).

Before starting with the actual development of the technology its implementation can already be explored in the 'ideation'-phase [15]. Obviously these ideated business models contain a lot of assumptions but the opportunities of the technology can be assessed and communicated with the stakeholders already to assess whether or not the eHealth technology can be made sustainable.

B. Value Specification

The eHealth technology will face different type of stakeholders each with their own value needs. How can these value needs be input for the implementation? What value can the technology offer?

First, the salience of the stakeholders to the project can be ranked [21]. Obviously the value needs of important stakeholders will have more effect on the technology and the implementation than the value needs of less important stakeholders. In Figure 4 we gave the stakeholders from the tele-dermatology example a salience number in between 1 to 5.

Figure 4. Stakeholder relational diagram
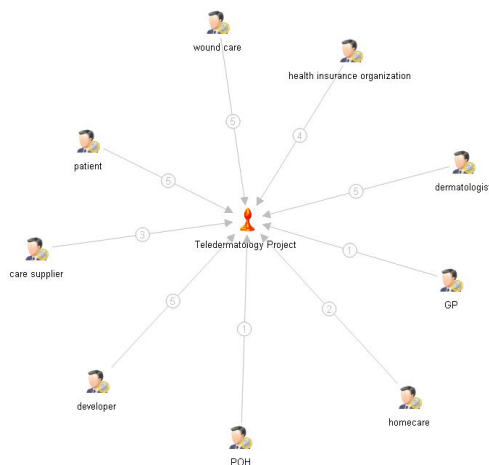
The same ranking can be applied on all the value needs that stakeholders specify. Some value needs are considered more important than others. These rankings can be put in a value matrix that calculates weighted rankings taking the importance of stakeholders and the importance of value needs in account. This helps in comparing and accumulating value for the design phase.

In the competence analysis the organizational consequences for offering these values can be surfaced by analyzing the necessary activities and resources.

The next step is to find the optimal distribution of these competences. eHealth technologies need to deal with multidisciplinary stakeholders so some activities can best be performed by specific organizations. This will result in partnerships and possibly even in an open or networked business model [22, 23] where organizations depend their value creation on each other. For co-creation of value,

willingness for continuous cooperation and collaboration among stakeholders is very important. Cooperation can lead for individual organizations to reach their goals more fully [23]. This continuous cooperation will determine the sustainability of the eHealth technology.

Some value needs are vital for the success of the technology and its implementation (they will score very high in the value matrix). In management these elements are often referred to as Critical Success Factors. In order to monitor these factors later on in the evaluation, they have to be set first.

C. Design

After completing most of the analyses to understand the environment, stakeholders and value of the eHealth technology, this phase deals with synthesizing the actual business model.

First, the value-function-cost matrix allows comparing value with estimated costs. With User-/Human-Centered Design the value can be specified into functional design conform the needs of the users. The development costs per value can be estimated. Functionalities that cost a lot of money but add little extra value to the technology and its implementation should be less interesting. Besides that, functionalities that score high in the value matrix should be prioritized to be developed first.

Not all value can be captured with the technology itself, some value derives from offering services next to the eHealth technology. These service opportunities are part of the business model as they improve the overall value of the eHealth technology and implementation.

The final stage of the design is to actually combine all insights from previous instruments together in a business model. There are various existing business model templates (Figure 1 for example) that can be filled up with the strategic choices that will yield the most optimal sustainability and cost-effectiveness for the eHealth technology.

D. Operationalization

The business model is a strategic tool; it still needs to be operationalized so that it can be put to practice. This can be done by specifying a business case based on the business model. A business case contains financial calculations, scenarios and is much more concrete in describing the activities, resources and planning necessary for the eHealth technology and its operationalization.

E. Summative Evaluation

Once the business model is operationalized and the eHealth technology deployed in practice, it is imperative to monitor the sustainability and cost-effectiveness. This can be done by monitoring the previously set Critical Success Factors and through technical monitoring tools that keep track of usage parameters.

When it starts to show that the sustainability and cost-effectiveness are becoming weaker, it is time to take action. A business model is a dynamic object and thus if it really shows necessary, changes have to be planned and made to the implementation of the eHealth technology and maybe also the eHealth technology itself.

When small changes seem not enough anymore to keep the implementation sustainable, a big overhaul in the form of a total re-design is an option to improve or redo the eHealth technology and its implementation. This may sound drastic but technologies come and go, so a re-design is only a matter of time.

V. FUTURE RESEARCH

We are testing the eHealth Business Modelling instruments in various eHealth research projects. We see the eHealth Business Modelling as an opportunity to improve the sustainability and cost-effectiveness of the implementation of eHealth technologies. It is imperative that the current instruments fit multiple eHealth projects, add the right input in the implementation process, and can deal with the multidisciplinary nature of eHealth.

Our current piloting projects are in various phases of the roadmap. Future publications will further specify the instruments one concept at a time, and our learning experiences from how they were applied on said pilot projects.

Figure 5. Current state of instruments in the ceHRes roadmap
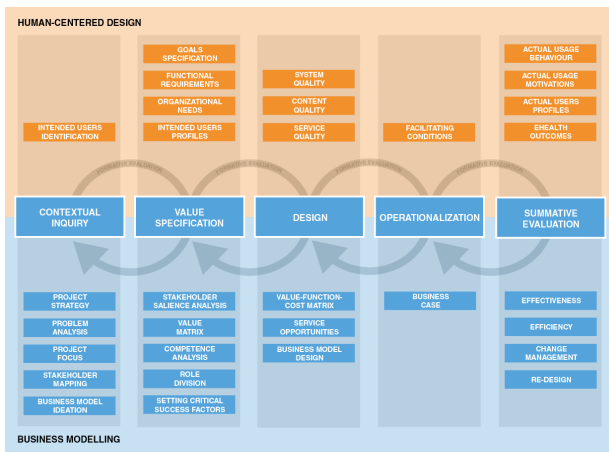
Also we will continue our research in the combination (Figure 5) of Human-Centered Design, and eHealth Business Modelling to improve our ceHRes Roadmap into a holistic, interwoven approach for successfully developing eHealth technologies.

VI. CONCLUSION

Attention for the implementation of eHealth technologies should not happen ex post of the development, but a priori and during the development. The development and implementation are strongly interwoven with one other and interdependent. Developing a technology that cannot be implemented is obviously not helpful and not really a worthwhile venture. Our roadmap combines eHealth development techniques and eHealth Business Modelling as implementation-approach to avoid such problems by making the development of the eHealth technology a value-driven process instead of the currently common technology-driven processes.

We hope that with the instruments introduced in this article, the development and implementation of eHealth technologies can advance and that this implementation through business modelling improves the sustainability and cost-effectiveness.

We are aware that a big challenge (and maybe even the biggest) in defining business models for eHealth technologies lays in finding an optimal 'fit' for all stakeholders. The goals and general need for eHealth technologies may be mutually accepted without much effort, but getting the stakeholders discuss their different needs and value perceptions and finding the right combination and right 'fit' for the eHealth technology and its implementation is a complex and lengthy task.

eHealth Business Modelling offers instruments that help finding these needs and how these needs can be transformed into value and eventually into a fitting business model that helps deploying the eHealth technology in its practice.

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