

Supporting the Viability of E-Health Services with Pattern-Based Business Model Design

The Case of an E-Mental Health App for Maternal Depression

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Abstract. Designing viable business models for e-health services is not trivial as people in charge of business model design often lack the respective knowledge and experience. E-health business model design patterns should support inexperienced business model designers as they document existing business model logics of the e-health domain for reuse. This paper aims at understanding how exactly a pattern-based business model design supports the viability of e-health business models by applying the e-health business model design patterns to a specific e-health service – an e-mental health app for maternal depression. A focus group workshop reveals that these design patterns sensitize the participants to the viability aspects of the business model and thereby help to enhance its viability.

Keywords: Business model design · Design patterns · E-health · Maternal depression · Viability

1 Introduction

Thanks to technological advances, patients and health-conscious people are entering the digital world and use e-health services to share their health-related experiences, to schedule appointments with their doctors, or to get medical advice and treatment [1]. However, many of these e-health services are not sustainable and result in economical failure as they lack a viable business model that defines how the service creates, delivers, and captures sufficient value for all stakeholders involved [2, 3]. This lack of business model considerations does not only lead to discontinued e-health services: Some of these services do not even make it to the market at all and end as successful prototypes [4].

To support the business model design for e-health services, so called e-health business model design patterns have been developed that document business model logics of existing e-health services and make them available for reuse [5]. The aim of this paper is to understand how exactly these patterns support the design of viable business models for e-health services. In order to do so, we conduct a focus group workshop for analyzing a pattern-based business model design by means of a concrete case - an e-mental health app for maternal depression. We deem this e-health service as

suitable for our purpose as extant research shows that such an app would be technically feasible and appreciated by potential end-users [6, 7]. While existing pregnancy related apps focus on physical aspects and neglect the diagnosis and treatment of mental conditions [8], our case requires a distinct and viable business model that has yet to be designed.

2 Background

2.1 E-Mental Health App for Maternal Depression

Maternal depression encompasses depression during pregnancy and within the first year after delivery [9]. Analogously to other depressive conditions, affected women feel hopeless and might be overwhelmed with their role of being a mother [10], which also affects the cognitive and emotional development of the child [11]. Even though 38 % of pregnant women [12] and up to 16 % of women after giving birth [13] are affected, maternal depression often remains undetected because in the majority of cases health professionals do not notice this condition during routine clinical practice [14, 15]. One of the main reasons for not detecting maternal depression is that women are often hesitant when it comes to talking about their emotional distress [6]. Moreover, women after delivery are busy with their baby and live according to the baby's napping and feeding schedules [16]. This makes it even harder for them to actually go to a health appointment. One possible solution would be to offer an e-health service in form of an e-mental health app that supports women in detecting maternal depression and that refers them to a health professional if needed. The aforementioned barriers of detecting maternal depression could be reduced by the app: On the one hand, women would be less inhibited to use such an app as they could reveal their emotional distress in an anonymous way; on the other hand, the app would provide a high level of flexibility as the women could use the app wherever they are whenever they have time [6, 16]. By offering an e-mental health app for maternal depression, the condition could be detected at an early stage and long-term consequences for the women and their babies as well as treatment costs could be significantly reduced [11, 15]. Since apps regarding other mental health conditions already proofed to be useful for detection and treatment purposes [17–20], it is surprising that there is not any app on the market that supports the diagnosis and treatment of maternal depression [6]. A review performed by Osma et al. [8] discovered many pregnancy related apps, however, they were rather focused on physiological aspects than on emotional ones. With the lack of e-mental health apps for maternal depression, a viable business model for this e-health service has yet to be found. This paper develops such a business model of an e-mental health app regarding maternal depression by applying a pattern-based business model design. In order to do so, business model related questions like “Which stakeholders should be involved?”, “How is value created and delivered?”, and “How will this app be financed?” will be answered.

2.2 Viable Business Model Design for E-Health Services

A business model illustrates how value is created, delivered, and captured by a business [2]. To be viable, the business model has to be designed in such a way that the business creates and delivers value to the relevant customers while at the same time appropriates sufficient value for itself [21]. Designing such a viable business model is not trivial as, in reality, the people in charge of designing a business model for their product or service are rather focused on other topics in their daily life and therefore lack the knowledge and experience regarding business model design [2]. For e-health services, this inexperience often leads to a failure of the business as relevant business model aspects are not considered [22].

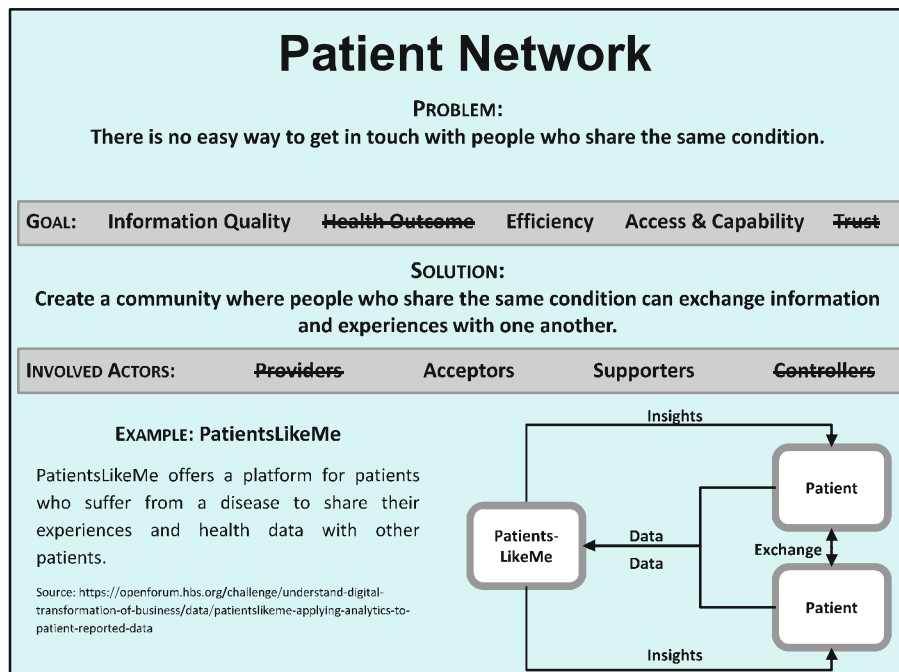
To overcome the inexperience, so called business model design patterns can be applied. These design patterns have their origins in the area of architecture where they match recurring problems with suitable architectural design solutions [23]. Even designers with a lack of the respective knowledge can (re-)use the documented solutions from these design patterns whenever they have to solve similar problems. Analogously to design patterns in architecture, business model design patterns document common business model logics that might be reused by other business model designers in similar contexts [2, 24–26]. Since 90 % of business model innovations are recombinations of extant business model patterns, the reuse of existing business model logics seems to be a valid approach to business model design [27].

However, general business model design patterns present business model logics on a rather abstract level [28]. As a consequence, the business model designer would have to transfer this high-level solution to his own specific industry and case. To facilitate this transfer, so called e-health business model design patterns have been introduced that are specific to the e-health domain and focus on the problems, goals, and stakeholders relevant for e-health [5]. Overall, 37 e-health business model design patterns have been developed (cf. Table 1) that are presented in a consistent structure: Each pattern states a problem relevant to the e-health domain and proposes goals that might be pursued while solving this problem, then the pattern is presented as a solution. In order to facilitate understanding, the involved stakeholder groups are highlighted. These stakeholders are subdivided according to Mantzana [29] into providers (e.g. doctors), supporters (e.g. IT providers), receivers (e.g. patients), and controllers (e.g. health authorities). Moreover, an example from the e-health domain that already instantiated the pattern is presented. An illustration of the example clarifies the value flows between the involved actors. Figure 1 presents the exemplary e-health business model design pattern “patient network”. This pattern refers to the problem that it is rather difficult for patients to find people with a similar health condition. The proposed solution is a community that connects patients sharing the same condition so that they can exchange their experiences. Thereby, patients get fast and efficient access to one another to enhance their level of information on the specific condition. The platform PatientsLikeMe [30] already implemented this pattern.

The idea of these e-health specific patterns is that unexperienced business model designers can relate to the presented problems, stakeholders, and examples and thus can rather easily transfer the presented solution to their own e-health case. As the example

Table 1. E-health business model design patterns [5]

01 24/7 Telehealth	14 Franchising	27 Partnership for trust
02 Access to healthcare abroad	15 Freemium	28 Patient engagement system
03 Automation	16 Full healthcare service provider	29 Patient network
04 Collective intelligence	17 Gamification	30 Pay-per-use
05 Commission-based revenue	18 Health wearables	31 Razor and blade
06 Crowdsourcing	19 Healthcare bartering	32 Reverse auction
07 Data-based customization	20 Healthcare crowdfunding	33 Secure platform
08 Data-based pricing	21 Healthcare data selling	34 Subscription-based revenue
09 Data for trust	22 Digital connectivity	35 Targeting new segments
10 Direct-to-consumer tests	23 Lock-in	36 Third-party channels
11 Expert platform	24 Marketplace for clinical data	37 Verified cost transparency
12 Fee for health	25 Open healthcare ecosystem	
13 Flatrate for health	26 Partnership for customization	

**Fig. 1.** The e-health business model design pattern “patient network”

shows that the presented solution proofed to be viable in a similar context, each pattern is supposed to support viable business model design.

3 Method

This paper aims at understanding how exactly e-health business model design patterns support the design of viable business models for e-health services by analyzing the pattern-based business model design for an e-mental health app regarding maternal depression. For this purpose a confirmatory focus group was judged to be a suitable method [31]. By conducting a focus group we could get rich data regarding the deployment of the e-health business model design patterns and the consequences for viable business model design [32]. We followed Tremblay et al.'s [31] suggestion to recruit focus group participants that are familiar with the application environment and would be potential users of the e-health business model design patterns. We therefore performed the focus group with employees from a software company that were in charge of designing an app for maternal depression and were in need of a corresponding viable business model.

The focus group was conducted in form of a workshop that followed the steps of a pattern-based business model design as illustrated in Fig. 2 [33].

First, the participants of the focus group were asked to document their current idea of the business model for the e-mental health app in a formalized way as a baseline. Here, they decided to apply the business model canvas [2] to define their business model baseline, because they were already familiar with it. Afterwards they got the task to define the challenges regarding the viability of their current business model idea. For example, if they had the feeling that the business model would not create enough value for one of the relevant stakeholder groups, they were asked to list that as a viability challenge. As a third step, the focus group participants were provided with the e-health business model design patterns, whereas each pattern was printed on a card and each participant got his own set consisting of all 37 e-health business model design patterns. The whole group got a short introduction to the e-health business model design patterns regarding their purpose and structure. Then, the participants were asked to go through the design patterns to come up with ideas how they might solve the viability challenges of their business model baseline by adapting its current design. Each participant wrote his ideas on sticky notes which he afterwards presented to the whole group. After the

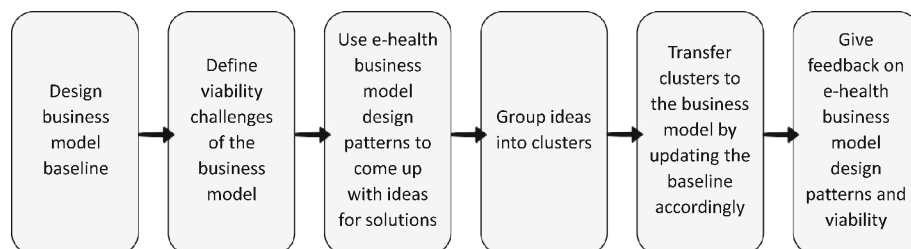


Fig. 2. Structure of a pattern-based business model design

presentation they were asked to group similar ideas into clusters. These clusters were then transferred to the business model by correspondingly updating the baseline. At the end, the focus group participants gave feedback if and how the e-health business model design patterns helped them to address the viability challenges of the baseline and to come up with a more viable business model for their e-mental health app. Here, they were also asked to articulate the assumptions the updated business model is based on and to indicate how realistic these assumptions are [34].

The focus group was conducted by two researchers, whereas one researcher moderated the session and the other one took notes. Here, it was of special interest how the participants applied the patterns, e.g. which patterns they judged to be useful to increase the business model's viability, which ideas they came up with based on those patterns, and how they transferred the idea clusters to their business model.

4 Findings and Discussion

4.1 Business Model Baseline and Its Viability Challenges

The first step of the focus group session was to capture the current idea of the e-mental health app for maternal depression as a business model baseline. Even though it can be described in different ways, the focus group participants opted for the business model canvas [2] to illustrate their business model baseline as they were familiar with this concept. This canvas shows how a business creates value (the value proposition as well as the therefore needed key activities, key resources, and partners), how value is delivered (customers as well as the respective relationships and channels), and how value is captured for the business itself (revenues and costs).

The focus group participants outlined the business model baseline as follows: Regarding the customer group of pregnant women/new mothers the main value proposition lies in offering a way to prevent and detect maternal depression via an easy to use, self-testing tool that protects the women's data. The app provider has an indirect relationship with the women via the health professionals that should use and recommend the app to them. The women can then download the app in a self-service manner via the app store for a one-time fee. With regard to the second customer group, the health professionals, using and recommending the app should enhance the image of an innovation driven health provider as well as support clinical studies focusing on maternal depression. Medical associations should help to create awareness for the app and the app provider could foster the relationship by being present on medical congresses. As the focus group participants did not expect the health professionals to be willing to pay, there are no revenues to be expected from this customer group. However, the focus group judged advertisement to be a potential source of revenue. In order to offer the value propositions, the app provider leverages his medical expert knowledge and app designer to design and create awareness for the app. The app development itself is outsourced to a technology partner. The resulting costs can be divided in one-time costs (for content preparation, app development, app design, and marketing for app launch) and recurring costs (for content maintenance and backend provision). Figure 3 illustrates the business model baseline.

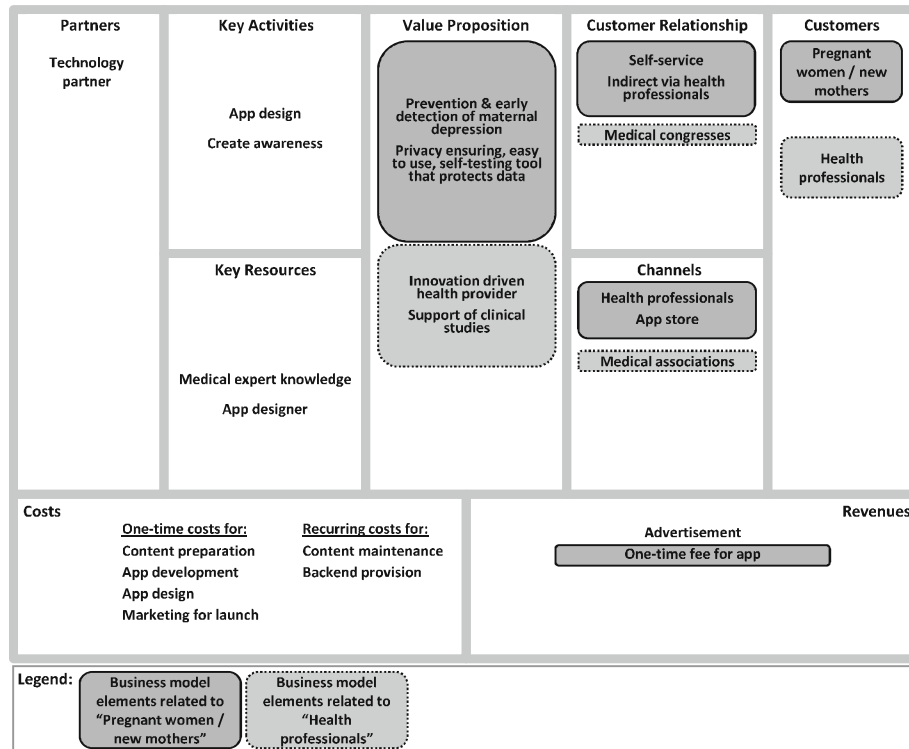


Fig. 3. Business model baseline in form of the business model canvas [2]

After designing the business model baseline, the participants were asked to formulate challenges that might compromise the viability of the e-mental health app. These challenges could refer to the lack of value creation for the different stakeholders (i.e. the value proposition is not compelling); the lack of value delivery (i.e. the value is not provided to (enough) stakeholders), or the lack of value capture (i.e. the app provider cannot appropriate enough of the generated value for himself). Regarding value creation, the focus group doubted that the current value propositions for both the health professionals and the pregnant women/new mothers were convincing enough to attract high numbers within both customer groups. Additionally, the focus group participants were skeptical with regard to the value delivery for the women. Here, the health professionals were designed as a channel as they should use and recommend the app to women during their consultations. However, as health professionals might not be convinced of the value creation, they might not act as a good channel to women, leading to a low adoption rate in the women customer segment. A low adoption from women would lead to a challenge in value capture: With only few women buying the app, the one-time fee as well as the advertising would probably not lead to high enough revenues to cover all costs. Hence, the participants formulated the following viability challenges:

Viability challenge 1 (value creation): *The value propositions for both customer segments (women and health professionals) are not compelling enough to attract a high number of customers.*

Viability challenge 2 (value delivery): *Health professionals as a channel to women do not deliver the app to enough customers.*

Viability challenge 3 (value capture): *The one-time fee paid by the women and the advertising do not lead to enough revenues.*

4.2 Supporting Viability Through Pattern-Based Business Model Design

In a next step the focus group participants received the e-health business model design patterns in order to come up with ideas how to tackle the aforementioned viability challenges by adapting the design of their business model baseline. These ideas were afterwards grouped into clusters. Table 2 gives an overview of all e-health business model design patterns the participants found relevant for their own case, the ideas they developed based on the design patterns, as well as the clusters they grouped their ideas into. This is the core of the pattern-based business model design process as it lays the groundwork for transferring the design patterns to a specific business model.

The feedback of the focus group participants revealed that they appreciated the pattern-based business model design as the patterns helped to sensitize them to the viability aspects of the business model and as a consequence to tackle all three viability challenges. The design patterns fostered ideas how to address the viability challenges which the participants would otherwise not have come up with. This was also enforced by the fact that the design patterns are based on innovative e-health cases and therefore triggered creative, out-of-the box ideas that already proofed to be suitable within one's own industry. The participants were convinced that they improved the viability of their business model during the focus group workshop. The following sections elaborate on how the pattern-based design addresses the three viability challenges and explain the related consequences for the business model. At the end, the adapted version of the business model is presented (cf. Fig. 4).

Tackling Viability Challenge 1 to Ensure Value Creation. The first viability challenge of the business model baseline is due to the fact that the value propositions for both customer groups, i.e. pregnant women/new mothers and health professionals, are not compelling enough to attract sufficient customers.

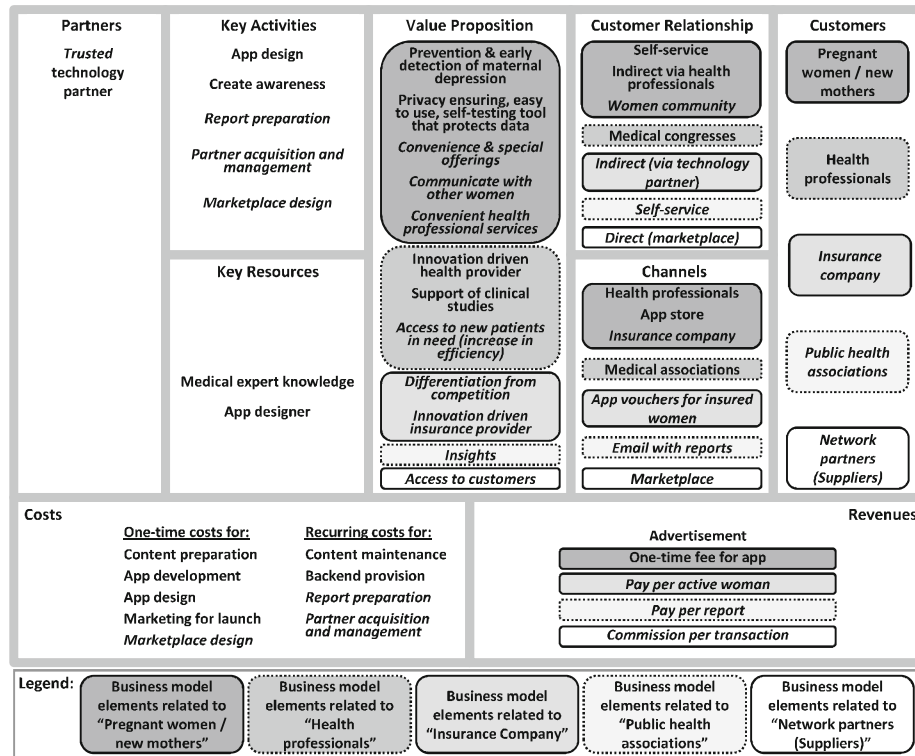
Regarding the first customer group (pregnant women/new mothers), the e-health business model design patterns “crowdsourcing” and “patient network” inspired the focus group to come up with the “women community” cluster that contains the ideas of integrating a community function within the app where women can exchange their pregnancy related knowledge and experience. This entails an extension of the value proposition (“communicate with other women”) and of the customer relationship (“women community”) for the pregnant women/new mothers segment (cf. Fig. 4). Additionally, the cluster “partner network” was built on the ideas of including pregnancy related partner offerings (e.g. from franchise companies) into the app that could be offered to the women. The ideas were developed based on the e-health business

Table 2. Relevant e-health business model design patterns, generated ideas, and their clusters

E-health business model design pattern	Idea	Cluster
Third party channel	Work with insurance companies	Go-to-market partner
Partnership for trust	Partner up with trusted insurance as well as with trusted technology company (to ensure data safety)	Go-to-market partner
Pay-per-use	Provide services on a usage basis	Go-to-market partner/Monetization of data
Secure platform	Raise confidence with trusted technology partner	Monetization of data
Healthcare data selling	Data selling to «good» parties (e.g. public health associations)	Monetization of data
Open ecosystem	Open app to partners offering pregnancy related products or services	Partner network
Franchising	Work with franchises to enlarge offering (e.g. sport franchises)	Partner network
Commission-based revenue	Expand offerings via partners for a commission per transaction	Partner network
Crowdsourcing	Provide access to the experience and knowledge of the «crowd»	Women community
Patient network	Pregnant women/new mothers community to raise attractiveness	Women community
Automation	Direct access to health professional appointments	Extended health professional services
24/7 telehealth	Offer remote consultation service	Extended health professional services

model design patterns “open ecosystem” and “franchising”. This leads to an adaption of the canvas (cf. Fig. 4): The network partners (i.e. suppliers of additional offerings) are a new customer group that is provided with access to potential customers via the app. They can offer their products and services via an app-integrated marketplace. The women’s value proposition is thereby extended as they can conveniently shop pregnancy related products and services and might profit from special offerings from the network partners. The app provider has the partner acquisition and management as well as the initial marketplace design as new key activities. Moreover, the business model has to reflect the corresponding costs.

The cluster “extended health professional services” not only addresses the value creation for pregnant women/new mothers but also for health professionals. Based on the e-health business model design patterns “automation” and “24/7 telehealth” the idea is to extend the offering of health professionals via the app by giving the women the opportunity to directly book an appointment with a health professional in their area or even offering them a remote consultation service. The focus group participants adapted



Note: Adaptions with regard to the business model baseline are in *italic*

Fig. 4. Updated business model based on e-health business model design patterns in form of the business model canvas [2]

the canvas accordingly (cf. Fig. 4): On the one hand, the value proposition of the pregnant women/new mothers segment is extended as the app offers additional services and as a consequence more value to this customer group. On the other hand, the value proposition for the health professionals is adapted as the app provides them with access to new potential customers by recommending them within the app. Since the app only refers the women to the health professionals in case they are at risk of maternal depression, the efficiency of the health professionals' offerings is increased. Thereby they can focus on the women in need of a health professional and provide them with their expertise regarding the diagnosis and treatment of maternal depression.

By enhancing the value propositions for pregnant women/new mothers as well as for health professionals, the viability challenge regarding value creation is addressed.

Addressing Viability Challenge 2 to Enhance Value Delivery. The second viability challenge for the business model baseline roots in the channel to the pregnant women/new mothers as health professionals will probably not suffice to win enough women as customers.

The “go-to-market partner” cluster includes the idea to work with a trusted insurance company. Here, the focus group judged the partnership with a trusted technology provider as a prerequisite of convincing an insurance company to provide the app to their female customers. The participants came up with their ideas based on the e-health business model design patterns “third party channel” and “partnership for trust”. Integrating these ideas into the business model baseline leads to the following changes in the canvas (cf. Fig. 4): The insurance company is an additional customer group which is offered the value proposition to appear as an innovation driven company to differentiate itself from the competition. The insurance company can provide the app to its female customers by handing out “app-vouchers”. Since the envisioned technology partner already has established relationships with all big insurance companies, the app provider will only have an indirect relationship (via the technology provider) with the insurance company.

The cluster tackles the viability challenge regarding value delivery as the insurance company is an additional channel to the women.

Acting on Viability Challenge 3 to Improve Value Capture. The last challenge with regard to the business model baseline is that advertising and the one-time fee for the app will not generate enough revenues for the app provider.

The above mentioned clusters “partner network” and “go-to-market partner” not only tackle the viability challenges 1 and 2, but also address viability challenge 3 that focuses on value capture. The “partner network” cluster includes the idea of opening the app to suppliers who can offer their products and services via an app-integrated marketplace and pay in turn a commission per transaction once a pregnant women/new mother buys one of their products or services. This idea is based on the e-health business model design pattern “commission-based revenue”. The “go-to-market partner” cluster contains the concept of an insurance company that provides the app to their female customers whereas the insurance company pays the app provider depending on the number of insured women using the app. This thought was triggered by the e-health business model design pattern “pay-per-use”. The two clusters lead to the inclusion of the two new revenue streams “commission per transaction” and “pay per active woman” (cf. Fig. 4).

In addition to the aforementioned clusters, the “monetization of data” cluster also aims at tackling viability challenge 3. Based on the e-health business model design patterns “pay-per-use”, “secure platform”, and “healthcare data selling”, the focus group participants came up with the idea to sell the generated data to “good” (i.e. non-commercial) parties on a usage basis. Again, a trusted technology partner is a prerequisite as he signals trustworthiness by ensuring data safety. As a consequence, the canvas is updated in the following way (cf. Fig. 4): Public health associations (as non-commercial parties) are a new customer group that can buy insights regarding maternal depression in form of reports. These reports can be ordered via the app and are send out to the associations via email after a fee per report is received. Hence, an additional key activity is the report preparation which also leads to additional costs.

Overall, the network partners, the insurance company, as well as the public health associations are new revenue sources for the app provider and, under the assumption that the involved costs are lower than the respective revenues, tackle the viability challenge regarding value capture.

5 Conclusion

The goal of this paper was to understand how exactly e-health business model design patterns support the design of viable business models for e-health services. For this purpose, a focus group workshop was conducted that dealt with the business model design for a specific e-health service – an e-mental health app for maternal depression. When comparing the pattern-based business model design with their original business model idea for the e-mental health app, the focus group participants did not only appreciate the pattern-based business model design in general, but were also convinced that the viability of their business model could be enhanced in several ways:

First, regarding value creation for the different customer segments, the updated business model provides a more compelling value proposition for both women and health professionals. Thereby the probability that these customer segments are convinced of the app's value is increased which in turn leads to an increase in the related viability.

Second, by including an insurance company as an additional channel, the value can be delivered to more women compared to before where the app provider would have been solely dependent on health professionals recommending the app to their patients.

Third, the value capture could be significantly improved by having more revenue sources than before. By having the insurance company, health associations, and the network partners generating revenues, the viability could be enhanced. Moreover, since more women are convinced of the app due to a better value creation, the revenue mechanisms from the baseline (advertising and one-time fee for app) are leading to more revenues as well.

Overall, the focus group workshop revealed that the e-health business model design patterns helped to sensitize the participants to the viability aspects of the business model and to focus on the value creation, delivery, and capture for all parties involved.

Despite the focus group's appraisal of the pattern-based business model design, one has to be aware of the fact that their adaptations to the business model and the expected impacts on viability are based on certain assumptions. The participants judged their assumptions to be realistic, however, a next step would be to further validate them. For example, one assumption of the updated business model is, that an insurance company would like to offer digital services to its customers and that it would be willing to cooperate with the app provider. Another assumption is that pregnant women are ready for e-health services and would be willing to use an e-mental health app for maternal depression. This assumption is consistent with a study performed by McKinsey which revealed that more than 75 % of all respondents (across all countries) would appreciate e-health services [1]. Another study showed that women would like to use an e-mental health app regarding maternal depression [7]. Additionally, the focus group participants assumed that pregnant women/new mothers would be interested in discussing their health status with other women. As other patient networks already proved that people like to share their conditions with others [30], this assumption could be valid.

In addition to the not yet verified assumptions, this paper is not without limitations. We applied the e-health business model design patterns in only one focus group to understand how the pattern-based business model design works and if the business'

viability can be supported. Moreover, even though the focus group participants judged the viability to be enhanced after applying the design patterns, there is no guarantee for market success as the business model has to be implemented yet. However, the focus group judged the pattern-based business model design as means to a viable business model and therefore as a precondition for market success.

Despite the limitations, the paper contributes to research and practice: On the one hand, it enhances extant research on business models as it gives deeper insights on the support of design patterns during business model design. On the other hand, practitioners get an idea how e-health business model design patterns can facilitate the design of viable business models for their own e-health services.

Future research should conduct further pattern-based business model designs and should also analyze the businesses over a longer period of time to see if a pattern-based business model design leads to market success or not.

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