

APPLYING the STOF BUSINESS MODEL FRAMEWORK in EHEALTH INNOVATIONS

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Abstract— eHealth solutions create opportunities for improving efficiency and quality in health care. Still many eHealth innovations never get beyond the project phase. A business model approach can help eHealth entrepreneurs and innovators to bridge the gap between Buzz (ICT as a promise for better care) and Business (viable eHealth services and business models). The research group ICT Innovation in Health Care developed a business model approach based on three components: the STOF business model framework, the innovation process and relevant success factors for eHealth innovations. This resulted in the development of an online eHealth innovation Matrix (eHix). The approach is illustrated by an actual eHealth case.

Keywords- *business models; innovation; guidelines; success factors*

I. INTRODUCTION

The research described in this paper focuses on how to embed eHealth innovations in routine care. Nowadays there is still a discrepancy between the opportunities offered by innovative eHealth applications and the reality of routine health care. 'End-of-project' all too often means 'end of innovation'. This has also been observed by others [1] and although plenty of suggestions have been made for improvement, a comprehensive approach which supports innovators in bridging the gap between project and routine practice is still lacking.

IT-related business model innovations have become key factors in achieving structural innovation in healthcare [2]. A business model approach can therefore be used as an instrument to bridge the gap of innovative eHealth ideas to successful IT-based care services. The approach described in this paper is a combination of business model design, the phases in the innovation process and generic and eHealth specific success factors. These three components combined result in what we have called the *eHealth innovation Matrix* (eHix).

By combining the phases in the innovation process with a business model approach (based on the STOF Framework [3,4]) the future challenge of embedding the innovation in routine care gets attention throughout the various activities.

Success factors play an important role in business model design [3]. Success factors (SFs) can be described as "the key areas where things must be right for the business model to flourish" [4]. The success factors indicate to what extent a business model is capable of creating value for customers and capturing value by the network of stakeholders.

Well-known and lesser known success factors for eHealth innovation receive a better place in the innovation process by linking them with the correct phase and the right business model domain, thus avoiding pitfalls and underestimation of non-technical requirements.

The eHix is a combination of the STOF framework (Section II) and the phases in the innovation process (Section III). When combined, a matrix model (Section IV) is created that can be used to allocate the SFs (Section V) which are extracted from generic, market specific and case specific studies.

A case study called DiMove will be used to illustrate the added value of eHix. DiMove is a Real time Medication Monitoring (RTTM) service for patients with epilepsy.

II. STOF FRAMEWORK

The basis for the development of the methodology is to consider eHealth innovation as a service innovation rather than technological development. For successful implementation of eHealth services a healthy business model is required. We therefore use a business model approach. A business model is essentially a description of how organizations offer innovative services in an economically viable way. There are several business model frameworks available [5]; of these we used the STOF framework.

The STOF framework [3,4] describes a business model in terms of four interrelated domains, i.e. the service domain, technology domain, organisation domain and finance domain.

The service domain gives a description of the service offering, its value proposition and the market segment at which the offering is targeted. The Technology domain gives a description of the technical functionality required to realize the service offering. A description of the structure of the multi-actor value network required to create and provide the service offering and describe the focal firm's position within the value network can be found in the Organization domain. The Finance domain describes the way a value network

intends to generate revenues from a particular service offering and of the way risk, investments and revenues are divided among the various actors in a value network.

Figure 1 shows the perspectives and examples from the four business model domains. For example, data streams transferred over networks and the end-user applications and devices co-determine the required functionality in the technology domain.

Domain	Perspective	Example
Service	Value proposition Target group	Customer or End-user Market Segments Rate and Effort
Technology	Functionality required	Devices Applications Data
Organization	Structure of value network	Actors Roles Interactions
Finance	Cost structure Profit potential	Revenues Pricing Performance indicators

Figure 1. Business model domains, perspectives and examples

III. INNOVATION PHASES

There are many models in use to describe the innovation process [1, 6, 7]. We have chosen a model which is based on the innovation phases of Cooper [7] and which uses five innovation phases, each with its own goals and approaches, i.e.: inventory phase, design & development phase, experimental phase, pilot phase and implementation phase. The innovation process begins with the inventory phase. The purpose in this phase is to make an inventory of the needs and conditions of the users for whom the new service will be created. The next phase, design and development, focuses on thinking about the business model and how the technology will be designed and developed. This is followed by the experimental phase in which some users try out the new application, often in laboratory setup. Subsequently, in the pilot phase, more users will be involved to work with the new service in their daily practice. When successful, the process ends with the implementation phase. Figure 2 shows the five innovation phases and examples.

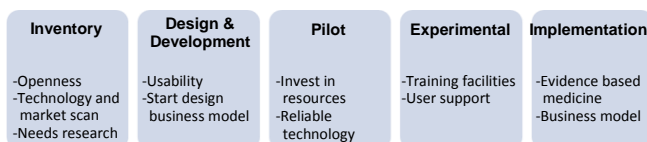


Figure 2. Innovation phases and examples

IV. MATRIX MODEL

The five innovation phases can be combined with the four business model domains to form a matrix with 20 cells, the eHealth innovation matrix (Figure 3). The matrix allows to allocate distinctive SFs to each cell. A cell describes the essential steps and choices in the innovation process for a specific area within the business model in a specific phase

and can therefore be matched with success factors for eHealth innovations. These SFs will be identified in the next step to complete the eHix innovation matrix.

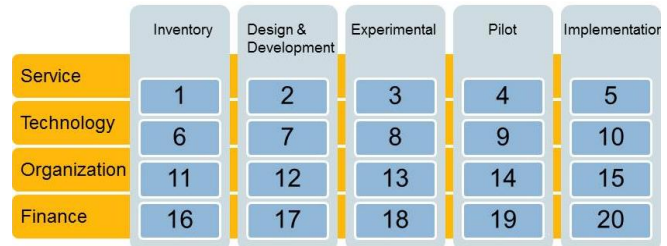


Figure 3. Combining business model domains with the innovation phases

V. SUCCESS FACTORS FOR EHEALTH INNOVATIONS

The third and final step of the approach is the identification of possible success factors for eHealth service innovations. The success factors can be divided into three groups, Generic Success factors, Industry and market specific success factors and Case specific success factors [8].

A. Generic Success Factors

A number of generic success factors need to be satisfied by any business model for it to be viable. For example, does the business model create value for the customers and does it create value for the (business) actors? A business model that obviously creates value for the customer does not necessarily create value for other actors participating in the business model and therefore may not always be viable.

One of the most important SFs is the “match to customer needs” [9]. In different studies this SF correlates strong with the actual success of the innovation. For eHealth applications, customers may include patients, doctors, medical specialists, caregivers, or health insurance companies. It is therefore important to determine who the customers are and their interests and requirements. Urban and Hauser added one success factor that emerged in several studies, “time to market”. This SF is especially important in industries where the lifecycles are short and frequent innovation must fit a moving window of technology or market performance [10]. This SF applies to eHealth services as well, as these services are usually based on the products of the fast moving ICT industry.

B. Industry and market specific success factors

The industry and market in which a business model and innovative concept is deployed, i.e. the business context, often comes with its own success factors as well. For example the care market requires new care solutions to be ‘evidence based’, i.e. with clinically proven value, before they are admitted to the care market.

An expert meeting can be an efficient instrument for gathering Industry and market specific SFs. To this end, one typically invites different stakeholders and experts such as actors involved in the business model, researchers, market specialists, end-users representatives, financial experts, innovation specialists or technology experts. A recent expert

meeting organized by our research group delivered the SFs shown in Table 1.

TABLE 1. SUCCESS FACTORS DELIVERED BY EXPERT MEETING

Success factors	
Service	Strengthening primary care
	Involve patients
	Lifecycle management
	Patient central
	Keep it simple
Technology	Proven technology
Organizational	Direct contact with customers
	Avoid network complexity
Financial	Avoid application for grant before structural plan is created
	pricing strategy: dirty cheap in beginning

C. Case specific success factors

Finally the specific case at hand may come with its own success factors. The innovation in itself may entail specific SFs due to for example the use of a specific technology. Specifically the issues regarding the adoption of the technology, the technological developments and the reliability of the chosen technology should be addressed. Case specific factors can also be more specified versions of generic or industry specific success factors. We will discuss examples of case specific SFs in the next section, where we apply the eHix in the specific case of real-time medication monitoring for epilepsy patients.

Now each combination of a business domain and a innovation phase can be coupled with SF's, completing the eHix.

	Inventory	Design & Development	Experimental	Pilot	Implementation
Service	Customer needs	Usability	Opportunity to try	Evidence based medicine	Lifecycle management
Technology	Proven Technology	Standardization	Security Privacy	Support and training	Support
Organization	Healthcare supplier involved	Avoid network complexity	Support opinion leaders	Direct contact clients	Support opinion leaders
Finance	Finance structure	Cost effectiveness study	Provide resources	Cost effectiveness study	Pricing strategy

Figure 4. eHix with success factors

VI. THE DIMOVE CASE

This section illustrates the method explained earlier in this paper by a specific practical case. First we provide a description of the DiMove case. This case has gone through all innovation phases and is now in the implementation phase. Then we provide the designed business model based on the STOF framework and match the business model design with the earlier mentioned success factors. The last section contains an enumeration of the most important "lesson learned" based on this case study.

A. The DiMove service

DiMove [11,12] is an eHealth solution for assisting patients with epilepsy in taking their medication. For patients with epilepsy it is important to take the medication

at regularly set times. A Dutch study into the medication use of people with epilepsy found an adherence of 65% [13]. Some patients frequently forget taking the medication at the correct time, which can lead to the occurrence of more epileptic seizures. DiMove uses a smart medicine box in combination with a web application (Real time Medication Monitoring, or RTTM) [15]. The medicine box will send a message to a server when the box is opened. The messages are wirelessly transmitted by GPRS or SMS. A message contains information about the time of opening, an identification of the user, an identification of the drug if the patient uses different types of drugs, and any other desired information. The RTMM works wherever there is a connection with a GSM network. Approximately 20 seconds after opening the box, the information is processed, stored and available in the DiMove application. The details of that message are stored in a central database and are accessible via a secure Internet account. When the patient forgets to take his or her medication he or she will receive a text message as a reminder to take the medication.

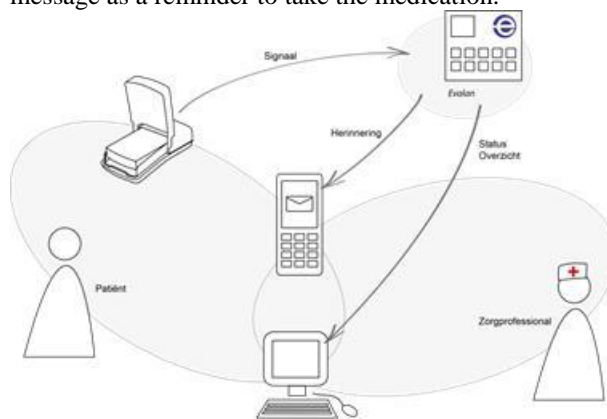


Figure 5. RTMM concept

B. The DiMOVE business model

1) Service domain

This part of the STOF Frameworks describes the service offering, the value proposition and the possible market segments of the DiMove service. DiMove is offered as a support program for epilepsy patients. The patient uses the RTMM device for real time monitoring of medication use. The DiMove Support Program includes a web-based user interface that provides overviews of medication use and seizure history, an electronic diary to record seizures, and distribution of regular summary reports to monitor use of the DiMove program. The application also supports sending questions to patients and for patients to send answers back to health care professionals.

The program starts with a consultation during which the epilepsy patient receives instructions about the DiMove Support Program. A dedicated health care professional monitors the patients that use the program. The customers who will actually pay for the DiMove service are specialized clinics for treating patients with epilepsy. They can use DiMove as a service for some of their patients. The

DiMove service also provides extra information for their medical specialists. So the users of the service are the *patients* and the *specialists*.

DiMove assumes that patients who got acquainted with RTMM during their treatment in an epilepsy clinic may also want to continue their subscription once hospital treatment has ended. In the Netherlands there are 120.000 epilepsy patients [15]. The potential target market for DiMove is 10.000 patients, as patients have to be able to operate the DiMove technology (mobile phone and web application). It is easy to see that the concept is also suitable for many other users of medical drugs (in solid form) with a chronic illness. This could considerably increase the market potential of DiMove. The value proposition for the patient is *medication adherence*.

For the medical professional the service provides more *detailed information* about the use of the medication by the patient and the possible effects of the medication based on adjustments in the medication. Health organizations can *improve the effectiveness* of their treatments and create competitive advantage compared to other health organizations. The value proposition for parents of a child with epilepsy is an *enhanced sense of security* because the child is less likely to forget to take medication. The parents can receive a text message as well, if they want.

2) Technology domain

The technology domain contains a description of the technical functionality required to realize the service offering. Some relevant variables in this domain are: the technical architecture, network accessibility, needed devices and applications.

DiMove's *technical functionality* consists of five main components:

1. a standard cell phone that is able to receive and display text messages;
2. a medicine box that is able to send a signal to a server when it is opened;
3. a web application that is accessible for the patient, caretaker and medical professional,
4. a server where the data is stored,
5. the mobile internet connecting the box, the application and the server.

The technology used in the DiMove service is *proven* and *relatively simple* and therefore reliable. Reliability is important because the service intends to deliver complete and accurate information about the use of medication. The messages sent by the RTMM device are wirelessly transmitted by GPRS or SMS. SMS has proven to be a reliable communication service. Another advantage compared to, for example, using a 3G network, is that the client can use a standard telephone instead of a smartphone. Almost every cellphone is able to send and receive SMS. In most cases the client already has a cellphone and doesn't need (or want) to buy an expensive smartphone with mobile internet subscription.

3) Organization domain

This part of the business model contains a description of the different actors in the network needed to deliver the eHealth service and the position of these actors in the value network.

Actors: Evalan is the supplier of the hardware and the developer of the DiMove concept. Evalan is also responsible for the marketing, sales and technical support. SEIN is a specialized clinic in the Netherlands for epilepsy treatments. SEIN is the paying customer for DiMove and provides the DiMove support program to its patients. SEIN is also responsible for the development of the medical protocol for the support program. Other actors of interest are the pharmaceutical industry (for instance by offering a package deal, DiMove in combination with the medication), insurance companies (extra service for their customers with epilepsy) and the NVN (Dutch Society for Neurologists). The NVN determine the standard treatment for epilepsy patients in the Netherlands. If the NVN would decide to include the DiMove concept in the standard treatment for epilepsy, all care providers would have to make use of DiMove.

Actors' strategic interests: For SEIN and other epilepsy clinics the strategic interest is mainly providing extra service to their clients and getting more detailed information about their patients to improve their treatments. Evalan is trying to get a solid market position in the Dutch health market and a stable starting point for further development of the DiMove concept. Our research group at Windesheim is studying how to design and implement eHealth solutions like DiMove and aims to spread this knowledge towards other projects and publications.

Organizational Arrangements: The cooperation between the partners is specified by a term sheet. This term sheet summarizes the main commercial terms and conditions of the Collaboration Agreement for the development, testing, and commercial exploitation of the DiMove Program. SEIN is responsible for the training and guiding of the healthcare professionals and is supporting the marketing of the DiMove service. Evalan is accountable for the sales and marketing of the DiMove concept and responsible for further development of the DiMove service and the technical support during the exploitation.

4) Financial domain

The financial domain describes the way the service intends to generate revenues and the way risk, revenues and investments are divided among the various actors in network. *Revenues*: The revenue model at this moment is a subscription, based on a monthly fee per medicine box. *Financial arrangements*: There are also arrangements about how to divide the revenues among the initial DiMove partners. For a period of seven years each partner receives a development fee as a percentage of the sales revenues.

C. The success factors for DiMove

In section V three levels for finding success factors were described. Table 2 contains some of the success factors for each of these levels that are relevant for DiMove. The next paragraphs describe the success factors for DiMove for each level.

1) Generic success factors

Table 2 shows three important generic success factor for DiMove. *Understanding of the potential target group(s)* is a success factor mentioned in many studies [4, 8]. Much is known already about DiMove’s target group, namely epileptic patients. The same applies for a *clear value proposition*. DiMove has a clear value proposition for the different users (doctors and patients), namely improved medication adherence.

The business model variable *Actors* has a positive effect on the success factors “Understanding potential target group” and “Contribution to improvement of quality of care”. The current partners in the DiMove development know the target group very well. One of the largest specialized epilepsy clinics in the Netherlands is involved in this project. They have considerable experience with treating epilepsy patients and have the necessary expertise to provide evidence that the DiMove support program indeed improves the quality of care.

Little research has been done to identify other potential target groups. So it is recommended to investigate possible other target groups to increase the market potential and make the business model more viable.

2) Industry specific success factors

The contribution of eHealth solutions towards improvement of quality and efficiency in healthcare is a considered an important success factor. The ability to reduce the costs of health care after implementation of the innovation is also a strong success factor. The costs of health care continue to increase due to aging of the Dutch population. There is considerable political interest to reduce the costs and improve the efficiency in health care at this moment. Cost effectiveness was an issue in this case, although a proper cost effectiveness study has not been performed for this specific target group. In this case DiMove is not a new treatment but an instrument for the medical specialists and the client to improve the effectiveness of the standard treatment. During the design of DiMove SEIN conducted a pilot including 48 patients. The preliminary results showed improvements in medication adherence and experienced quality of life, and a decreasing frequency of epileptically seizures.

Another important success factor in health care is the opinion of health care professionals, especially medical specialists. The neurologists of SEIN are part of the NVN (Dutch Society for Neurologists). SEIN is enthusiastic about the potential of DiMove and they are lobbying to include DiMove in the Standard Treatment for epilepsy. When this succeeds the DiMove service is eligible for reimbursement

by health insurance companies. This can increase the market potential of DiMove because health care organizations like SEIN can use the service for their customers and get reimbursement from the insurance companies. Now SEIN is paying for the service using their own financial resources.

3) Case specific success factors

In the DiMove case the specific success factors were discovered by conducting a business model workshop with the different project members of the DiMove project. The participants consisted of a professor of eHealth innovation, a technology specialist, a supplier of hardware and software, a manager of an epilepsy clinic, and a health innovation broker. The goal of the workshop was finding a viable business model for DiMove, but the results of this workshop also contained some case specific success factors for DiMove. The three most relevant case specific success factors are listed in Table 2.

TABLE 2 SUCCESS FACTORS DiMOVE

Success factors for DiMove	
Generic SFs	Understanding of potential target market(s) or target group(s)
	Clear value proposition(s)
	Creating a team with knowledge and experience
Industry specific SFs	Contribution to improvement and efficiency in health care
	Support of opinion leaders
	Support and training facilities
Case specific SFs	Proven technology
	Market situation
	Technology adoption among target group and health professionals

For DiMove the *market situation* is important. In the Netherlands the concept is unique, but there are some international initiatives that can compete with the DiMove concept using different approaches. These initiatives are from two multinationals with the capabilities and resources to introduce their concepts on the Dutch market fast. DiMove is tailored towards epilepsy patients, a relatively small niche market. This creates a knowledge lead for DiMove, and because the market size for this niche is small, it is probably less interesting for big multinationals. To keep track of competitors is an important case specific success factor for DiMove. Another success is *adoption by the target group*, patients and health professionals, and being able to understand and use the DiMove technology. Pilots concluded that the target group is enthusiastic about using DiMove. Having the support of the medical staff and especially the treating doctor was found to be important.

VII. LESSONS LEARNED AND FURTHER RESEARCH

A. Lessons learned

A workshop based on the eHix with the different actors involved in the development of DiMove resulted in the

awareness of possible other target groups for the service. For example home care organizations could be an interesting target market for a concept like DiMove. These organizations deliver care to patients who often need to take many different kinds of medication. The workshop also created a broader perspective on the impact of the service for different stakeholders like the pharmaceutical industry, caregivers like parents and relatives, and insurance companies. This actually led to initiative to start the lobby with the NVN (Dutch Society for Neurologists) mentioned earlier. In an evaluation session the owner of Evalan, the entrepreneur behind DiMove, stated that one of the most important success factors for implementing eHealth services like DiMove is the need to have a health care supplier acting as a partner during the development of the eHealth service. The support of opinion leaders, for instance the medical specialists, was also mentioned by him to be an important success factor.

This case study doesn't validate the effects of the mentioned success factors. Therefore more evidence about the contribution of the success factors to an actual successful market introduction of health services like DiMove is needed. For instance, a retrospective approach might be used to establish the effects of the mentioned success factors in a range of different cases, including the further development of DiMove.

B. Further research

In the previous paragraphs we identified the success factors that are relevant for services like DiMove. This actually represents only one dimension of the eHix. The other dimension are the five innovation phases. The current version of the eHix (www.ehix.nl) offers two functionalities: the eHix Scan and a Tools Library. The instruments in the Tools Library are grouped by cell and consist of templates, checklists, approaches, examples and references with which the required steps in the innovation process can be followed as closely as possible.

The eHix Scan consists of a questionnaire with which entrepreneurs and project owners can establish the status of their project and the designed business model. The scan's questions are connected to the cells of the eHix matrix. After completing the questionnaire, the results show the status of the project by color coding the cells in the eHix matrix. Red cells need attention, and the tools in these cells provide the project owner with some instruments or templates to improve the status of the project. Green cells, on the other hand, indicate that the most important factors are taken into account. In January 2013 the development of a new version of the eHix starts. This version will integrate the mapping of the success factors for eHealth services to the cells of the matrix model, as presented in this publication. The questionnaire of the eHix scan will then be based on the success factors instead of deliverables like a project plan or business plan. The online toolbox will be targeted more specifically to eHealth entrepreneurs, helping

them to design robust and viable business models for their eHealth innovations.

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