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Abstract

Inspired by the vast opportunities that today's technologies provide and driven by the need to both cut the costs and increase the quality of health services delivery, many e-health initiatives and ventures were launched in the last couple of years. However, a large number of these projects failed. They were either not able to articulate a clear value proposition to patients or lacked a sustainable profit generation formula. It seems to be difficult to understand the business logic behind e-health services in today's complex environment. This study aims to analyze and explain the business logic of e-health service provisions. Based on a design pattern-based approach, three distinct examples are illustrated as archetypical design solutions of successful business models: freemium, two-sided market, and crowd-based e-health. Explanations of the different, isolated business logics help to foster the understanding of the essence of value creation and revenue flows. These findings provide an instrument for e-health marketers to develop more sustainable business models. They facilitate further research in innovation and experimentation with different business model designs.

Keywords: Business model, design patterns, e-health, innovation, revenue mechanisms.

1   Introduction

European healthcare systems are facing a considerable pressure to reduce costs while improving the quality of health service delivery which was arduously established over the last decades. Collateral effects, such as an aging population, lack of qualified health workers, increased mobility of patients and higher expectations and demands additionally complicate the fulfillment of this mission (cf. European Policy Centre, 2011; Valeri et al., 2010).

According to Poon et al. (2006) the healthcare industry hitherto shows a low Information Systems (IS)/Information Technology (IT) adoption rate and thus has a significant potential for improvement. Therefore, expectations are high that at least some of today's problems could be solved by the extensive use of IS/IT: *e-health*, a term coined amongst others by Eysenbach (2001), emerged as a silver bullet for achieving cost-savings, efficiency, quality, and revenue increases in all sorts of medical areas (World Health Organization, 2005). For instance, the RAND Corporation examined the potential benefits of digitizing paper-based health documentation and came to the conclusion that if 90% of the hospitals and doctors in the United States adopted IS/IT over the next 15 years, the health system could save about $77 billion a year from efficiency gains (Vaitheeswaran, 2009).

Many e-health projects emerged in the last few years (cf. Valeri et al., 2010). Encouraged by a pioneer spirit, local health administrators were in the first wave of adapting the ideas of electronic markets to the healthcare context. Many projects failed, but those that succeeded are often characterized by not only providing a noticeable value for the patient (e.g., compared to the traditional health service delivery), but also by generating sustainable profits.

On that account, much research is currently being undertaken to develop instruments and methods to help health service providers quantify the benefits of their investments in e-health (e.g., Dávalos et al., 2009; Fitterer et al., 2011; Hamid and Sarmad, 2009). Still, there is a considerable lack of guidance and an inability to establish effective *business models,* as a recent study conducted by the eHealth Initiative (2011) shows. Our goal is, therefore, to introduce and develop a rationale for experimenting with e-health business model designs. Based on the research and the rethinking that took place some years ago in the field of electronic commerce (Aldridge, 1998; Brynjolfsson and Hitt, 2005; Mendelson, 2000), we aim to explore how well-known design patterns can be used as a basis for describing possible sustainable business models for e-health. The research questions are: *What are sustainable business models for e-health? How can design patterns help in their specification?*

In order to answer these questions, the paper is structured as follows: in the next section we define important terms such as e-health or business model and discuss the most important findings in the recent literature. In the subsequent section the methodology is described. Then, an introduction into design patterns is provided and this approach is applied to the area of e-health. The section is followed by a discussion about design patterns' potential for shaping more sustainable business models. The paper concludes with an outlook on future research and scientific and managerial implications.

2   Related work

Before being able to specify one or several distinct business models for e-health, it is necessary to clearly define the boundaries and to understand the basic meaning of what e-health is and what a business model is.

2.1   E-Health

Despite only being known for a few years, the concept of e-health shows a significant variability in its scope and definitions. According to Pagliari et al. (2005) most definitions conceptualize e-health as "a broad range of medical informatics applications for facilitating the management and delivery of healthcare". Possible e-health applications include the "dissemination of health-related information,

storage and exchange of clinical data, inter-professional communication, computer-based support, patient-provider interaction and service delivery, education, health service management, health communities" (Pagliari et al., 2005). As opposed to this mere technological view, Eysenbach (2001) defines e-health as "not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology". In this sense, e-health can be understood as both, a specific area of application of IS/IT as well as a particular paradigm of how health services are delivered in the future.

Mettler and Raptis (2011) attempted to outline a possible future "technology-enabled" healthcare scenario while differentiating between three main areas of research (Figure 1):

- Clinical systems, i.e. inter-organizational and inter-disciplinary research in the intersection between medical institutions (e.g., primary care, secondary care, pharmacies) and/or the service industry (e.g., insurance industry, government, learning provider) in order to first and foremost improve the outcome of a medical intervention.

- Personal health and independent living, i.e. research emphasizing the adoption of IS/IT in the peripherals outside a healthcare organization (e.g., at the home of the patient) and which might not necessarily have the medical outcome as a main focus, but rather patient-centricity, accessibility, and usability of technology (e.g., consumer health informatics).

- Connectors/trans-sectional systems, i.e. research that is focused in connecting the clinical with the personal environment by means of secure and standardized interfaces and that helps us to understand the effects of ethical, cultural, or educational differences on technology use.
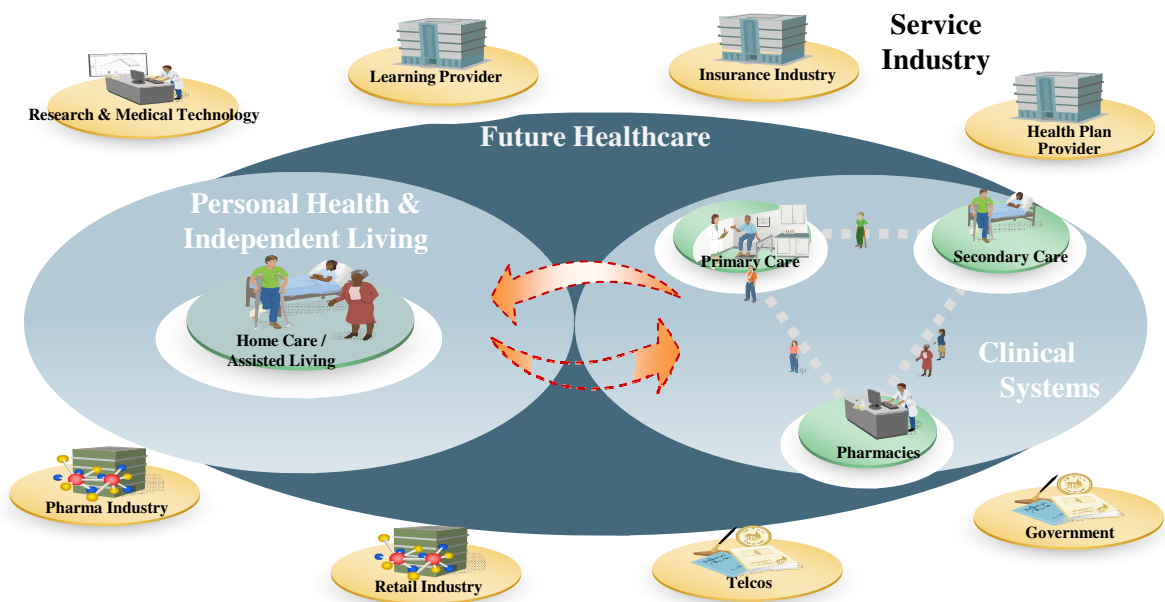

Figure 1   Vision of future health service delivery, adapted from Mettler and Raptis (2011).

It is generally fairly difficult to unequivocally define the boundaries of e-health with respect to other areas of research. On the one hand, e-health has strong connections to "telemedicine", which is the term used to describe "the use of telecommunication technologies for the provision of medical services to distant locations" (Mitchell, 1999). However, as opposed to telemedicine, the range of e-health applications is broader, because it comprises the delivery of health services both at a distance and locally. Hence it can be seen as an "umbrella field" of telemedicine (Mitchell, 1999). On the other hand, e-health should not be put on the same level as selling drugs on the Internet. This is rather a

good example for the area of electronic commerce, because it is not the delivery of a (intangible) health service which is in focus, but the supply of a (physical) product.

2.2 The Role of Business Models for the Future of Healthcare

A business model depicts an organization's value creation, proposition, and capturing (McGrath, 2010; Timmers, 1998). It is a meaningful concept for explaining the relation between strategy and IS (Hedman and Kalling, 2003): the same technology commercialized in different ways may result in different economic outcomes (Chesbrough, 2010). Hence, a business model can be understood as a mediating construct between IS/IT and economic value (Chesbrough and Rosenbloom, 2002).

It is necessary to put a substantial effort in the design of a useful business model for e-health because the e-health initiatives that survived were typically those which generated sustainable profits in combination with a well-defined value proposition to the patient (Valeri et al., 2010). The design of business models matters: while we found that a considerable effort was put into the development and deployment of an IS/IT infrastructure, we saw that the business perspective was neglected. This can be dangerous, as similar situations like the burst of the "dot.com"-bubble in the late 1990s demonstrated.

Venkatraman (1994) brings these two perspectives – technological and business development – together by describing five levels of IT-induced business transformation, which differ in their degree of business transformation potential. Heinzl and Güttler (2000) draw upon Venkatraman's theory to explain an IT-enabled healthcare reconfiguration:

- On the first level ("localized exploitation"), standard IS/IT systems or system components are used for accounting, controlling, billing, and the like. Typically, only rudimentary medical knowledge is needed to develop and maintain these systems.

- On the second level ("internal integration") more sophisticated IT/IS is deployed, like hospital information systems, in order to gain internal integration. The classic example for this is an electronic medical records system that is shared by different departments.

- The third level deals with a business process redesign to streamline medical, nursing, and administrative processes, such as clinical pathway systems (Yang et al., 2011).

- The fourth level is concerned with "business network redesign", which refers to internet-based application systems in e-health. For instance, the reach of usage of an electromagnetic radiation device can be extended from hospital-internal to a wider range. In general, this enables a connection among general practitioners for appointing tasks or for exchanging patient history via web applications.

- The fifth level is termed "business scope redefinition" and deals with no less than an organization's right to exist. In e-health this may refer to the development and distribution of medical software solutions (e.g., financial and medical simulation systems).

In this framework, the current e-health permeates throughout all five levels from a technical perspective. However, the business perspective seems to have difficulties in keeping pace with the technological development. The higher the level, the higher the need is for a clear understanding of the business logic (Heinzl and Güttler, 2000; Venkatraman, 1994). In this sense, "business scope redefinition" means nothing less than business model transformation. Notwithstanding, already from level four on, IS/IT penetration necessitates changes to the existing business models. While talking with the responsible parties in public organizations (e.g., local health administrators, hospital CIOs) and in private firms (e.g., general practitioners, pharmacies), we witnessed a lack of empathy with the customer and a lack of business thinking in capturing value from e-health's evolution. This leads to e-health solutions focusing on efficiency instead of value for the patient (Valeri et al., 2010). We found evidence for this type of thinking by e-health solutions dropping out of the market (e.g., Google Health) and by e-health systems terminating at the stage of a "successful pilot" (Spil and Kijl, 2009).

We identified a particular challenging gap between a successful pilot and the first stage of a commercial service of an e-health solution. To fill this gap, we propose the utilization of business model design patterns. Business model design patterns are *archetypal design solutions of successful business models* (Eurich and Mettler, 2012). A business model needs to evolve over time under consideration of the organization's mission, environment, and competences (Drucker, 1994). High aspirations can hinder e-health marketers (e.g., pioneering doctors, consumer health providers) in getting started as much as the fatal tendency to neglect the importance of the business perspective in e-health solutions. Moreover, context matters: the situation in which an e-health marketer is operating can have a decisive impact on the choice of which business model to use. For instance, the characteristics of a national health system are only compatible with very few business models out of the whole spectrum of commercial, mixed and non-commercial business models. Under consideration of context factors, business model design patterns provide a useful basis to start the business model design process by helping to not only better understand the logic behind a business model, but also to figure out the contextual conditions under which a business model might be implementable or not. It is this first step that is often the most challenging. After e-health marketers and other interested parties (e.g., funding bodies) have decided on the basic business logic, fine adjustments, evolutions and minor experimentations on the business model can follow.

3   Research Design

We gained first insights from a thematic literature review on business models in the healthcare sector (Webster and Watson, 2002) and from direct observations and conversations in the field (Creswell, 2009), i.e. with local health administrators, hospital CIOs, general practitioners, and pharmacies. In literature, we found that most research in this field is either on a rather abstract level (e.g., the business model framework described by Spil and Kijl (2009) or on specific level (cf. European Commission, 2011). However, there is little work available on an analytical level to identify common business logic patterns. In practice, we found almost no conceptually designed approaches. Due to the lack of analytical business design in healthcare, we had to abandon the narrow view on e-health business models: in a second step, we gathered insights from general business logic in e-commerce and discussed it directly in the field. To concretize and exemplify the application of business model design patterns in e-health, three design patterns were analyzed: freemium, two-sided market, and crowd-based e-health.

Due to our own participation in the field, the research is of ethnographic nature: the business logics were studied in their social and cultural context. In comparison to case study research, the collection of empirical material is supplemented by data gathered through our observations in hospitals, nursing homes, and medical practices (Creswell, 2009; Myers, 1997; Yin, 2009).

The prevalent philosophical perspective of our research is based on an interpretive paradigm: interpretive research methods claim that knowledge of reality is a social construction by human actors (Orlikowski and Baroudi, 1991; Weber, 2004). An interpretive perspective suits our study well, since we had the chance to gain a deeper understanding of how IS/IT is being implemented and used by local health administrators, hospital CIOs and general practitioners in its operative environment. It is important to note that we did not involve explicit control or manipulation of any variables of the subject under study. However, to get a deeper understanding we acknowledge our own subjectivity as part of the research. Interpretive research contrasts in terms of ontology, epistemology and methodology with a positivist research, where it is assumed that the objective data collected by the researcher can be used to test prior hypotheses or theories (Chen and Hirschheim, 2004). Thus, it is not the aim of this paper to develop hypotheses in order to test existing theories, but to provide a grounded basis from which empirical and practical investigations on the implications of e-health adoptions can be started.

4   A Business Model Pattern View on E-Health

The initial idea to communicate and encourage the re-use of proven design principles was first developed within the domain of building architecture (Alexander et al., 1977). The idea was later seized in software engineering, where design patterns are used to describe archetypal solutions to recurring design problems (Gamma et al., 1995). Recently, design patterns were picked up by business model researchers to analyze the logic of a business model design (Osterwalder and Pigneur, 2010) or to communicate archetypal design solutions (Eurich and Mettler, 2012). In general, business model design patterns are useful to discuss different business model designs and their features and to analyze the logic behind a business model design module. In e-health, they are particularly useful for guiding health service providers and e-health marketers in their first step towards the commercialization of an e-health service.

A business model design pattern consists of its name, context of application, problem summary, solution summary, visualization, and references. In addition, cross-references to other design patterns, restrictions, an overview of actors involved, and concrete implementation tips can be part of a business model design pattern (Eurich and Mettler, 2012). As there are many different customer segments in e-health, it is particularly important to describe the problem from the points of view of the different stakeholders. Management in e-health is different to other sectors and customers and stakeholders vary largely in different e-health services. Therefore, a description of actors involved and restrictions are more important than in other sectors.

To get a better handle on business model design patterns, a selection is outlined in Table 1.

Pattern Name	Short Description	Example	Exemplary reference
Freemium	Basic services are offered for free, while a premium is charged for an advanced service	Skype	(Anderson, 2009)
Multi-sided	The value creation is based on the interaction among parties	Facebook Developers	(Bughin et al., 2010)
Crowd Sourcing / Open	Commitment of motivated individuals produce value for the organization for free	Huffington Post	(Chesbrough, 2007)
Inverted Freemium	Customers pay a premium for being entitled to consume free services	Insurance	(Osterwalder and Pigneur, 2010)
Razor and Blades	A customer is lured with a special deal and by relying on lock-in effects profit is made from sales of complementary goods	Printers and ink cartridge	(Picker, 2010)
Inverted Razor and Blades	Complementary goods attract the customer and make her buy the core product	Apple iPhone and Apps	(Osterwalder and Pigneur, 2010)
As A Service	Only the usage of service is charged but not the product itself	Rolls Royce's "Power by the hour"	(IfM and IBM, 2008)

Table 1.   A Selection of Business Model Design Patterns.

In the following section, we give some basic insights into three business model design patterns that can help frame the business model of an e-health service: a simple example (e-health as freemium), a complex one (e-health as multi-sided market), and a yet rather unconventional one in the domain of e-health (crowd-based e-health).

4.1   E-Health as Freemium

Given that an e-health service is not funded by a third-party (e.g., government, patient foundations) or its use is not compulsory (e.g., by law, insurance contract), a critical task of any newly developed e-health service is to build up a profitable customer base. Several studies have shown (cf. U.S.

Department of Health and Human Services, 2006) that establishing credibility, for instance by using certified health information and a professional layout, as well as conforming to the socio-cultural and country-specific aspects is important for increasing acceptance. Still, even if all of this is adequately adhered to, potential users might not be willing to test and use the service.

The basic idea behind the design pattern "freemium" (see Figure 2) is that certain basic features of a service are offered for free, while premium content and functionalities are charged for (Anderson, 2009). A key assumption is that the freemium approach is capable of creating a lock-in or leveraging effects of networks: the more people use a service for free, the more valuable the service becomes for all consumers; and the greater the network, the higher the lock-in effect gets and costs and efforts increase to change to a competitive service (Zott et al., 2011). A major difficulty is to keep the balance between free and premium users, since the latter sponsor the former, respectively the free provision of the basic features. Hence, it is important to consider this during the design of the service.
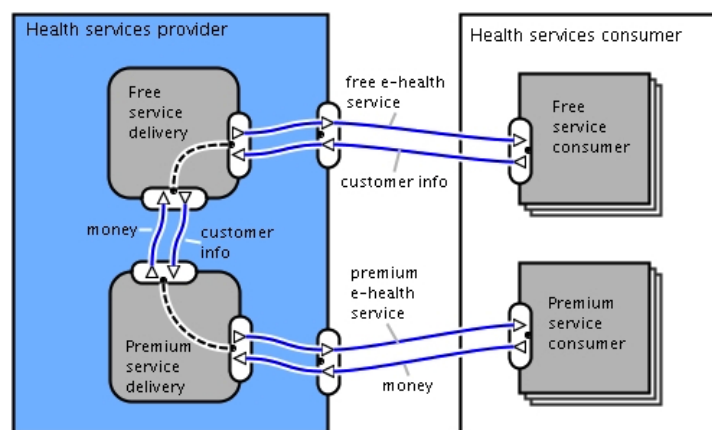

Figure 2.   *Freemium design pattern: basic e-health service is free, advanced service are charged a premium.*

There are different possibilities to translate the freemium approach to e-health services. For instance, in the case of health information portals where a vibrant community is important, free users might only access a standard set of information and interact with other "fellow sufferers"; whereas the premium service might also include the possibility to consult expert doctors and to access more advanced content. Nonetheless, the postings from free users might be interesting for all. Another use case for the freemium design pattern could be the provision of free standard analyses (e.g. obesity check) while offering chargeable advanced checks.

4.2   E-Health as Multi-sided Market

Another form of "subsidization" often takes place in multi-sided markets. This design pattern basically comes into use when one party has a considerable interest that another party is given subsidized or easier access to a service, e.g., insurance companies that want their policyholders to track their health status in a personal healthcare record, or hospitals that are interested in having an electronic medical report (e.g., including a patient history, diagnostic findings) from all of their referring doctors. Typically the service to be delivered is either very complex from a technical point of view or there is a lack of trust when it is provided by the interested party on its own. Besides the role of the service consumer (subsidized party) and the service provider (subsidizing party), there is also the need for a mediator or broker who has a certain level of trust or the required competencies to operate the e-health service.

This broker has a pivotal role within this cycle (see Figure 3): once a dedicated quantity of loyal service consumers is reached, other service providers might get attracted by this large customer base and may be willing to offer their services via the broker (Eisenmann et al., 2006). Being a kind of "platform" for all sorts of services, the broker has the crucial task of balancing the subsidies and revenues from multiple parties in order to ensure both a large customer base (who trust the broker) as well as a high quantity and quality of services. Especially the former is difficult to achieve because there is a high risk that the broker is misled by short-term profits, which e.g., may result in not investing enough in security or marketing (Dunbrack, 2011). Furthermore, a large amount of people are uncomfortable with the idea that their health information is sold or reused by a third-party.
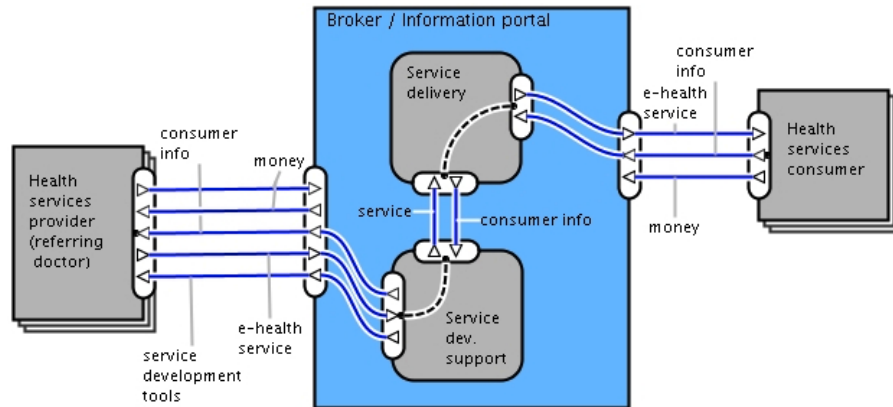

Figure 3.   Multi-sided design pattern: broker operates e-health service for service providers which subsidize its use.

4.3 Crowd-based E-Health

A great part of health and social care services are of general interest and are thus often subsidized by governmental and local authorities. Since in times of financial crisis the public funding schemes are retracted, alternative strategies to state subsidization are needed, especially for orphan diseases. Possible solutions are crowd-based concepts such as crowd sourcing, crowd creation, crowd voting, or crowd funding (Agrawal et al., 2011; Chesbrough, 2007; Geiger et al., 2011; Howe, 2008). The basic idea behind the crowed-based business logic is to use the creativity, knowledge, leisure, or money of dozens, if not hundreds of individuals for co-creating and co-financing the development and maintenance of services or knowledge that is of general interest (e.g., PatientsLikeMe.com). This mode of operation gained considerable acceptance in the last couple of years and might also be conceivable for the e-health context (see Figure 4): starting from a basic e-health service, which addresses one or several issues relevant to society, more and more users may get attracted by the offering and possibly may be inclined to volunteer in the further extension of the service (e.g., by means of providing content, generating additional code). Once the e-health service creates a *real* value for users, some of them – besides or instead of co-creation – might also be willing to make donations to keep the service alive.
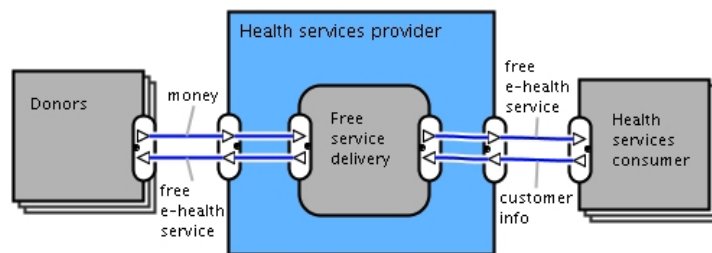

Figure 4.   Crowd-based design pattern: interested users co-fund and co-create e-health service.

Overall, e-health services that rely on crowd-based concepts are risky as they have a high dependency on altruistic user behavior. Therefore, there is also a kind of "dark side effect" attached to crowd-based business (Orlikowski and Baroudi, 1991): on the on hand, the founder of such an e-health project typically bears the costs of the initiation phase. Consequently, the founder either has sufficient seed capital for developing a complex e-health service or, in case he does not, only a rudimentary initial solution is developed which bears the risk of not attracting enough users. On the other hand, a considerable effort has to be made every year to mobilize users to make donations as well as to draft a contingency plan in case the fundraising is not successful. This time might be better spent for improving the quality of the existing services or developing new innovative ones. Finally, as some medical expertise is needed in the context of e-health, co-creation might be restricted to only a few medical specialists, thus is only an "illusion" of a truly open and everyone's venture (cf. European Commission, 2011). Nevertheless, crowd-based business might be a good strategy in case of limited public funds or for bridging the time until a private investor is found. In addition, a crowd-based model might be interesting in case the co-created content improves the value proposition of the e-health service (e.g. experience reports from patients).

5   Discussion

Up until now there is no clear understanding and evidence why some of the e-health projects are successful and others are not. Some studies, however, showed that many of the projects were extremely technology driven, thus primarily centered on how to use and adapt new technologies (such as radio frequency identification) for the healthcare context instead of "listening what the users really want" (Engelen, 2011). As a result from a too strong infatuation with technology, many of these projects lacked a perspicuous definition of their value proposition and revenue streams which would motivated investors to provide funding or would have made the customers actually want to use the service (Spil and Kijl, 2009). Accordingly, economic and social aspects should be given more attention when defining a business model for an e-health application. We believe that the comprehensive knowledge about technologies needs to be complemented by business awareness and a perception of the consumers' wants and needs in order to achieve long-term economic and social sustainability.

A better conceptualization of the "service value chain" (Wang and Xu, 2009) or an exhaustless availability of funds (Lawer, 2011; Spil and Kijl, 2009) might not necessarily guarantee project success per se. However, a more profound understanding of the value-creation mechanisms behind the technology might help in various ways, e.g., as a groundwork for the definition of a business case or as basis for the specification of simulation models in order to analyze market dynamics. For long-term sustainability, it is necessary "to go beyond the quantification of financial resources" (Valeri et al., 2010).

In the previous section, three business design patterns were described exemplarily to demonstrate the utility and application of the concept. In particular the freemium and the multi-sided approach are strategies that proved to be successful in other industries. Their application in healthcare appears therefore promising. The design pattern "crowd-based" is an approach that yet needs to render its long-term success. Still, design patterns only depict a restricted part of an overall business model (as to Osterwalder and Pigneur (2010). However, we are convinced that they are helpful for providing a common language for explaining and communicating the business logic behind an e-health venture as well as for fostering systematic and creative thinking. Business models in practice are complex and need an acceptable simplification. A design pattern explains a particular business logic in isolation. It sharpens the awareness with respect to revenue flows and customer base dynamics. In this sense, it does not aiming for short-term gains but for sustainable profits and long-term success.

Using design patterns is likewise no guarantee for success. Especially inexperienced e-health marketers may trust standard design patterns too much and may run the risk of randomly combining design patterns if they misleadingly assume that mixing several proven design elements will results in

a good design (Gamma et al., 1995; Pree, 1994). As design patterns continuously evolve, there are always new business logics that may possibly better satisfy a customer's demand or generate more revenues.

6   Conclusion and Future Work

Innovation in healthcare through the use of IS/IT is seen as a "land of opportunities" (Spil and Kijl, 2009), promising a wide range of improvement potential with respect to quality, cost, and efficiency. Nevertheless, many e-health projects fail because of a too strong infatuation with technology and incapacity of formulating a clear value proposition and revenue model.

Accordingly, it was our aim to introduce a new way of thinking with respect to e-health business model innovation. Based on the constituent literature, we derived seven basic design patterns, which can be applied as instruments for analyzing the revenue mechanisms of an e-health service. Its application might not be restricted to an ex post analysis, but can be useful before implementing the business model (e.g., in the formulation phase or when searching for an investor). Hence, the design patterns enhance the understanding of the essence of business models and their role in innovation, realization of strategic goals and business performance in e-health.

Several studies postulate that business models "need to be dynamic in order to exploit the potential new benefits brought about by an e-health system and its future developments" (Valeri et al., 2010). In this sense, the identified design patterns might be used as "archetypical business logics" in the case of changing market conditions, technology and regulatory environments or resources and capabilities. They are capable of being dynamically assembled (i.e. similar to Lego bricks) and also allow for "inexperienced" e-health marketers to think of new possibilities of bringing their idea on a more sustainable ground. There is no one truth: many patterns can be mixed up together.

As we are among the first to explore this area, certainly there are limitations and further research is needed to gain more understanding. For instance, future research can include the description of additional business model design patterns; the presented examples are certainly not complete and might be backed up with empirical findings. Another interesting research direction would be the creation of guidelines that help e-health marketers handle the usage and the selection of the right business model design pattern.

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