Moving tele-monitoring and -treatment from promise to practice: A business model approach for a chronic lower back pain application.

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Abstract

The availability of new information and communication technologies, in particular public wireless networks with high bandwidth, creates opportunities for new, mobile tele-health services. While many promising tele-health projects deliver working R&D prototypes, they often do not result in actual deployment. We aim to identify critical issues than can increase our understanding and enhance the viability of the mobile tele-health services beyond the R&D phase by developing a business model. The contribution of the present study is that it describes the systematic development and evaluation of a business model for tele-monitoring and -treatment of chronic lower back pain patients based on a mobile technology prototype. We present a service-oriented business model and addresses challenges of multi-sector collaboration and disruptive innovation.

Keywords: tele-health, telemedicine, lower back pain, service, business model, revenue model, health care innovation, health care delivery, R&D, health care technology, information technology

Introduction

Our current health care system is incapable of continuing to treat all patients according to the conventional way of health care delivery (Wootton, 2007). This incapability is caused by the growing number of care demanders (i.e. elderly) relative to a decreasing number of care providers. Moreover, spending on health care (16,2 % of US gross domestic product) has grown faster than the economy since the 1960s (Kaiser Family Foundation, 2007). These high and growing numbers of patients and costs put pressure on the health care system. Due to economic and social priorities directed at affordable health services, research and development (R&D) relating to new modes of care delivery is on the increase. The availability of new information and communication technologies, e.g. high bandwidth public wireless networks, creates the possibility of new (mobile) tele-health services. Tele-health services can be a "compelling" alternative for conventional care (Heinzelmann et al. 2005). The focus of the tele-health R&D is often on proving the capabilities and efficacy of prototypes by means of technology projects and clinical user studies. Many R&D projects seem promising and often succeed in delivering working tele-health prototypes. Moreover, the results of the clinical user studies are often encouraging, However, most tele-health initiatives do not succeed in actual deployment in routine clinical practice (Tanriverdi and Iacono, 1999) (Berg, 1999) (Barlow et al. 2006) (Alemi, 2000). The established health care sector still mainly relies on traditional modes of health care delivery (Christensen et al. 2000). Obsolete business models stand in the way of breakthroughs in health care (Aspinall and Hamermesh, 2007) and the business value of information technology is often questioned (Anderson, 2003). Apparently, there is a large gap between R&D prototypes and the actual large-scale deployment. The long-term tele-health service offerings to patients seem difficult to sustain in practice. What can be done as a follow on from the technology and user evaluation studies? How can the gap between R&D and actual deployment in routine health care be bridged?

Very often the R&D results do not readily fit traditional offerings, roles, organizational structures and capabilities in the health care industry, nor the juridical and financial arrangements (Fielt et al. 2008) (Grigsby and Sanders, 1998). In a R&D stage, service production and consumption, relevant stakeholders, financial arrangements and organizational issues are often not explicitly addressed and knowledge barriers exist (Broens et al. 2007; Tanriverdi and Iacono, 1999; Berg, 1999). Among the stakeholders involved in the R&D stage, there is often a lack of awareness/vision or urgency, for example, with regard to the division of roles, costs, and longer term sustainable incentives for all stakeholders about the tele-health service to be actually deployed after R&D (Fielt et al 2008). Developing a business model in the R&D stage could help to create a "shared vision and understanding", because it addresses all relevant deployment issues in a systematic way, and could thus help to accelerate the tele-health market (Broens et al. 2007). Moreover, development of a

business model facilitates communication with, and potential future commitment amongst, the different stakeholders.

Business models are used in areas such as electronic business, strategy, management and information systems (Pateli and Giaglis, 2004). A business model is a conceptual tool containing a set of objects, a set of concepts and the relationships between them with the objective to express the business logic of a specific firm (Osterwalder et al. 2005) or business network (Bouwman et al 2008). A good business model addresses who the customers are and what they value (Magretta J, 2002). It also addresses how a firm or a set of firms can make money and the underlying economic logic that explains how customer value can be delivered at appropriate cost. Business models play a prominent role in creating customer and business value form technological innovation as "success comes from enveloping the new technology in an appropriate, powerful business model" (Johnson et al. 2008).

A promising area for tele-health services is chronic pain. Chronic pain patients often require highly intensive treatment in order to adjust their maladaptive pain-related behavior. Therefore, a business model approach will be used to support bringing the output of a specific R&D project to the market. In the R&D project a mobile tele-monitoring and -treatment application for chronic lower back pain has been developed, aimed at long-term monitoring of physical activity patterns and providing feedback to the patient about their unbalanced activity patterns. The underlying idea is that balancing patients' daily activity patterns can reduce lower back pain and associated functional disabilities (van Weering et al. 2008). Because a single therapist can treat several patients simultaneously, these kind of remote monitoring and treatment services are considered to be more efficient, and create the possibility of replacing costly intramural care with less costly extramural care. These services are also assumed to be more effective because subjects train in a relevant environment, e.g. at their own home or work; further they are not limited to the available treatment hours of the therapist but can train much more intensely. The degree of compliance and practice is believed to be a key factor in obtaining beneficial health results in (physical) therapy (Schmidt and Lee, 1999).

The contribution of the present study is that it describes the systematic development and evaluation of a business model for chronic lower back pain patients based on the R&D prototype of the mobile monitoring and treatment application. We aim to identify critical issues than can increase our understanding and enhance the viability of the mobile tele-health services following the R&D funding phase. The remainder of this paper is organized as follows: first a description is provided of the method that was deployed for developing business models and its deployment to the chronic lower back pain R&D application. Thereafter, the results of the project-internal deployment (phase 1) and the project-external deployment (phase 2) of the business model method are described. In addition, the knowledge obtained from an analysis of the business models of two operational tele-health services is used to refine our business model.

Business Model Design

To design a business model for tele-monitoring and -treatment services for chronic lower back pain patients in a structured and systematic way, the STOF method (Bouwman et al. 2008a) was applied. STOF stands for the components (or domains) of the business model to be examined, namely Service, Technology, Organization and Financing. The STOF method was chosen for four reasons: a) its focus on business model design, b) its focus on mobile services, c) its explicit attention to technology as one of the business model components and d) the availability of checklists that make it easily applicable in a practical setting. The business modeling process can include a stakeholder-dominated approach which implies the continuous involvement of potential stakeholders since they are considered to be the driving force for innovation (De Rouck et al. 2008).

The STOF method describes the different design steps (De Vos and Haaker, 2008) based on the STOF model (Bouwman et al. 2008b), which is schematically represented in Figure 1. The service component identifies the value proposition (the service from the end-user perspective) and the market segments. The technological component addresses the functional and technical architectures of the service delivery system. The organizational component deals with the value network, e.g. all the roles and actors necessary for realizing the new service. The financial component includes the revenue model, e.g. the activities that create value and the streams of money, and the cost structure.

While the R&D project in question resulted in the development of an ICT product (consisting of a distributed system incorporating hardware, such as sensors and a feedback device, and a number of software components) the focus for developing the business model was on the deployment of the tele-monitoring and treatment as a mobile service and not on the ICT products themselves. In line with the service-dominant paradigm (Vargo and Lusch, 2004), we want to address that value is only created the moment the customers receive the benefits from an offering and this requires in more than just providing a technological product, in particular given that tele-health is still in its infancies. The service perspective stresses the need to provide an enhanced offering consisting of physical product components, service components, information, personal attention and other elements of customer relationships (Gronroos, 2007). Grönroos labels it a service offering, even when the core solution is based on a physical product, because all elements of the offering are combined to provide a value-generating service for customers.

< Insert Figure 1: The STOF methodology (Bouwman et al 2008)>

Study design

As R&D and business models are highly applied areas of research and we intent to merge research and action to produce relevant research findings, an action research approach was adopted (Baskerville and Wood-Harper, 1998). As such the researchers were participatory observers affiliated with the R&D project team and involved in organizing, facilitating, documenting, analyzing and

reporting (feeding back) on the business model design activities. The steps in this action research trajectory are based on the STOF method, as described above, and implemented as a 2-phased approach: phase 1, with an internal project-oriented focus to specify the initial business model, and phase 2, with an external stakeholder-oriented focus to validate the business model (Figure 2).

< Insert Figure 2: Two stage business modeling trajectory>

The approach for Phase 1: an internal, project-oriented focus

For phase 1, an internal, project-oriented focus was chosen meaning that the development of the initial business model was led by the stakeholders (and/or delegates from their associated partners) involved in the R&D project, in particular a large rehabilitation centre, a technology research institute, a university of technology, a technology supplier, and (tele-)health professionals and experts. In ongoing R&D projects, access to results and products is commonly restricted pending publication or registration of patents. By starting with an internal project focus, the business model design could get started while keeping access restricted to the project partners. Moreover, there is also a great deal of expertise available at the different project partners beyond technological knowhow, for example, expertise related to health care, marketing, organization, and finance. This expertise can also be with persons at the project partners that are not directly involved in the R&D project. In addition, (some of) the project partners might be potential stakeholders in the further development and commercialization of the R&D prototype. So an internal project focus also enabled us leverage the project partners' expertise and interests.

To develop the business model a total of six designs workshops of about two hours each were organized: two for the service domain, one for each of the other STOF domains, and a wrap-up and integration workshop to conclude the development of the initial business model. The participants came from different backgrounds, including physiotherapy, technology, finance, management and insurance. The workshops were organized and facilitated by researchers experienced in the areas of business models, in particular the STOF method, and the rehabilitation of patients with chronic lower back pain. All workshops started with an update of the business model as it had been developed so far. Open issues that arose during a workshop were investigated in secondary sources afterwards (such as expert opinions, and journal and web searches).

The approach for Phase 2: an external stakeholder-oriented focus

Phase 2 had an external stakeholder-oriented focus to validate the initial business model and consisted of two activities. The first activity focused on obtaining input from experts regarding the business model developed in phase 1. Therefore, an expert meeting was organized with international experts; two professors in remote monitoring and treatment, two socio-technical researchers, two directors of tele-health companies, and one consultant specialized in ICT innovation. The expert meeting was

attended by 60 potential external stakeholders consisting of health care professionals, policy makers, managers, researchers, technicians, and consultants. The objective of this meeting was to discuss the barriers to, and opportunities for, tele-health implementation and deployment. In order to concretize the service domain in more detail, three semi-structured in-depth interviews were conducted with health professionals who are specialized in the treatment of (chronic) pain patients and are affiliated with a large rehabilitation centre. The professionals were chosen because they were regarded as potential launching customers with a reputation as "early adopters" and were willing to try our tele-treatment service. The in-depth interviews allowed the researchers to gather detailed information on the chronic lower back pain tele- monitoring and -treatment service and to lay the groundwork for the refinement of the business model developed in phase 1. The general guiding questions were "what are your opinions on the tele-treatment and monitoring services in relation to your profession and business, in particular the specific application?" and "how do you prefer the service of the chronic lower back pain application to be implemented in your working practice?". The interviews lasted about one hour, depending on the amount of information provided by the participants, and were conducted by researchers who were also involved in the organization and facilitation of the phase 1 workshops. In keeping with qualitative interviewing methods, participant's own priorities and concerns determined the depth, emphasis and order of topics in each interview.

To overcome the knowledge barriers in telemedicine innovation (Tanriverdi and Iacono, 1999), the second activity in phase 2 was a comparison of the business model developed in phase 1 with the business models underlying two operational tele-health services currently offered by two companies in The Netherlands. The first company is a provider of tele-medicine and tele-alarm products and services to the BeNeLux. The second company offers tele-consultation services between physicians. Most information needed for the comparison was collected from the company websites. In addition, researchers had collected other, publicly available company information and had attended presentations by representatives of the companies.

Results

Description of the results of phase 1: The initial business model

This section describes the results of phase 1 where an initial business model was developed over the course of six internal, project-oriented workshops. The description covers the service, technology, organization and financial domains.

The Service Domain: Based on the chronic low back pain prototype, the core service would be a combination of tele-monitoring and tele-treatment, and could be supplemented with tele-consultation and tele-community services. This service could either partly replace traditional care or could be offered in addition to traditional treatment. Patients with chronic low back pain and the professionals who treat them, such as physiotherapists, are the obvious target market. Because this is a niche

market, the identification of other potential markets would create opportunities to increase the overall market size, to (partially) leverage the investment in the application and infrastructure and to mitigate the risk in case the acceptance of the service or the cooperation of the stakeholders in this market is less than anticipated. Employees with lower back problems and the companies and/or occupational health providers responsible for preventing them from becoming ill are an adjoining market (and a possible growth market). Consumers with obesity were suggested as a third possible target market (and a much bigger market than the other two) because influencing activity patterns is also an important aspect in achieving weight loss. Together, these three markets cover clinical and occupational segments of the health care market as well as the consumer market. Success factors emphasized were training, treatment protocols, and an adequately functioning helpdesk in the service delivery process.

The Technology Domain: The R&D prototype (Figure 3) was the starting-point for the technological solution for the tele-monitoring and treatment service. The prototype consists of three main components:

1. Body Area Network (BAN) (Jones et al, 2001) for patients, incorporating a uni-dimensional activity sensor, an actuator for giving feedback, and a (dedicated) mobile device running the software application which incorporates, amongst others, the medical algorithms.
2. Mobile communication infrastructure for data transmission between BAN and BAN back end system.
3. Clinical Back-end for professionals, including user management, storage/back up facilities, medical algorithms to facilitate data interpretation, medical display, and tele-video consultation.

< Insert Figure 3: Functional architecture tele-monitoring and –treatment prototype>

Offering basic tele-monitoring and tele-treatment may also be possible with less exclusive, high-end activity sensors, without the BAN back end system, and with a lower level of personalization(or none at all) compared with that included in the R&D prototype used here. There are also potential technological risks that have to be taken into account. The current BAN requires a certain number of dedicated devices and is quite expensive (+/- 1800 Euros), Reducing the number of devices would make the system cheaper and easier to use. A more consumer electronic scenario would be that you would just need to buy a cheap (disposable) sensor at a store and then plug-and-play by connecting it to your personal mobile phone, Power consumption is a problem when continuous real-time monitoring over a longer period is required and processing and data transmission requirements are high. In cases where real time data transmission can be replaced by non-continuous transmission of data, power consumption is lower.

The Organization Domain: A model of the tele-health network was constructed with the tele-health service provider as focal actor and with demand-side roles (e.g. patients, consumers, employees) and supply-side roles (e.g. software supplier, hardware supplier, communication service provider) (see Figure 4).

< Insert Figure 4: Roles in the tele-health network>

The tele-health service provider is the focal role responsible for implementing and delivering the service. It is a new role that is required to take the initiative in the market and is responsible for offering a complete solution to the user. Some of the important activities related to the tele-health service provider may be: managing the tele-health initiative, developing the relations in the tele-health network, arranging the financing of the tele-health initiative, handling legal issues for the tele-health service, marketing and sales of the tele-health service, responsible for delivering the tele-health service, user training and support (both end-user and health service provider), stimulating research and development for tele- health service.

One of the major questions is, who will be the central actor playing the new role of tele-health service provider. It has to be an actor who is willing to invest and capable of starting a new enterprise in this overlapping area of health and ICT. We present four start-up scenarios:

1. *Demand-side scenario*: Actors involved in the demand-side of the tele-health network, such as health providers or health insurers, can take on the role of tele-health service provider as part of their own organization or invest in a separate organizational entity.
2. *Supply-side scenario*: Actors involved in the supply-side of the tele-health network, such as health solution providers (e.g. Philips) or communication providers (e.g. KPN), can take on the role of tele-health service provider as part of their own organization or invest in a separate organizational entity.
3. *Outside investor scenario*: Actors who play no specific role in the tele-health network, such as venture capitalist, can invest in the start-up of a new organizational entity that is directed towards the role of tele-health service provider.
4. *Mixed scenario*: This scenario is a combination of the other there scenarios. Different actors cooperate and together start-up a new organizational entity that is directed towards the role of tele-health service provider

The traditional health provider/sector can integrate the tele-health service into its overall health service and offer it to the customers. A tele-health portal may be involved, acting as “one face to the

customer" for providing a range of tele-health services of different health providers and possible also integrating different, complementary tele-health services.

The Financial Domain: Three revenue models are possibly suited for the different scenarios; two based on an insurance scenario namely the public health (insurance) and employer scenario (Table 1). The third revenue model is a commercial sale.

< Insert Table 1 Revenues models for the tele-health services >

On a macro-level, there is an incentive to adopt tele-health innovations in the health care sector due to the need for productivity improvement because of the expected lack of capacity. On a micro level, the benefits that tele-health services offer to the health services of health professionals and occupational health providers are related to a higher quality of service (more intense in the patient's own environment, more easily accessible) against lower costs (multiple patients treated simultaneously). These benefits can result in higher margins and/or more competitive prices for the services of health professionals and occupational health providers and/or health insurance companies. In the case of obesity commercial sales through purchase and/or subscription seems most suited. Health insurance is also a possibility for obesity; it may prevent future insurance claims due to obesity related to co-morbidities (e.g. diabetes and vascular diseases).

The tele-health provider may differentiate in price for a basic service and a top-up for more luxurious options (personalization, context-awareness). The costs of the tele-health service provider are related to delivering the service (eg. hardware, software, communications, service centre, maintenance contracts) and running a business in general (e.g. marketing, premises, administration). As discussed in the technological domain, the costs depend upon the technological solution. The technological solution and costs are likely to vary for the different target markets. Moreover, paying for higher quality technology (reliability, ease of use) may save on service costs (training, support). In the non-purchase models it may be possible to reuse the technological devices making the service more affordable. The investment scenarios will depend upon the start-up scenarios presented in the organizational domain.

Description of the results of Phase 2: Evaluating the business model

This section describes the results of phase 2 where the initial business model was evaluated via expert sessions and a comparison with two tele-health business models relating to existing market offerings. The evaluation involved a reassessment of the service, technology, organization and financial domains. Table 2 provides an overview of how the results of phase 2 augmented the results of phase 1.

< Insert Table 2: Summary of results >

The service domain revisited: The strength of the two operational business models lies predominantly in the provision of a complete tele-health concept (service delivery and products) in contrast with focusing only on products/technology. This was confirmed by the fact that all tele-health initiatives discussed during the expert meeting focused on service delivery (and not solely on products). This corresponds with the service focus of our initial business model. According to the experts, the additional value of tele-health services over traditional care can be expressed by tangible and intangible factors. Tangible factors are, for example, financial reimbursement, cost efficiency, quality of health care and accessibility of health care. Intangible benefits (e.g. enjoyment and enrichment for the medical profession, enhanced image of institutes/insurance companies, patient empowerment) can also be influential in convincing decision makers. If at all possible, benefits should be quantified in some way. Over the long-term, monetary factors, e.g. reimbursement of professionals, are considered to be most crucial success factors for implementation. The results from interviews revealed that the initial target group of the service, i.e. chronic lower back pain patients, can be extrapolated to other clinical populations characterized by under- and over exertion in daily physical activity patterns such as patients suffering from fibromyalgia, chronic fatigue syndrome and arthrosis. The interview responses also indicated that there may be specific target segments (both patients and professionals) more suited as launching customers, for example, patients with busy agendas may prefer tele-treatment over current care and so may professionals who have more patients than they can handle.

The technology domain revisited: The operational tele-health models both make as much use as possible of readily available technology that is proven and affordable. Scalability, usability and cost are the most important decision criteria when it comes to the technological system. The professionals suggested that continuous real-time data transmission of activity data between the BAN and back-end is not needed because working practices of therapists will not allow them to monitor the data continuously. So continuous real-time data transmission can be replaced by periodic transmission of data which could save costs, depending on the cost-model of the wireless data service used . As with

all tele-treatment applications, a reduction in the number of BAN devices and miniaturization of equipment is preferred. This pleads for a complete technological re-design of the current BAN before large-scale deployment. In order to be able to deliver an acceptable level of quality of care, professionals expect a service level agreement (SLA) from the technology providers. The most important parameter of the SLA is the (un-)reliability of the technology. In addition, juridical responsibilities in case of system failures need to be covered. However, these are probably more important for tele-treatment services where technological failures could have potentially devastating effects on the health status of the patient (e.g. diabetes, cardiology). With respect to scalability issues, the experts stated that it is wise to start with small separate applications & infrastructures and to extend later to a portfolio of services. This applies not only from a technological perspective, but also from an organizational and financial perspective.

The organizational domain revisited: The experts concluded that the majority of successful tele-health organizations generally started small and that the tele-health market will therefore be opened up by small companies. Because of their flexibility, small companies can be more adaptive for innovation, making them more suited to the complex new role of tele-health service provider. Both operational tele-health service providers used as exemplars started as small companies. They are also both new actors in the market and fit the mixed start-up scenario (combination of outside investor and demand side scenario). In addition, both companies take care of developing, introducing and operating the service. The organizational network (Figure 3) appears to be quite generic and not to be very dependent on the type of technology used (one operational tele-health provider uses mobile while the other uses wired technology) and the service delivered (telemonitoring/-alarming versus teleconsultation). In both operational business models, the tele-health providers combine the role of tele-health service provider with roles related to service delivery and system integration (in line with our initial business model).

The financial model revisited: From the symposium and the expert interviews it became clear that insurance companies are willing to reimburse tele-health care delivery but it requires a substantial effort on the part of the service provider to arrange this with every insurance company. For instance, one of the operational tele-health service providers agreed upon a reimbursement tariff with the majority of insurance companies in the Netherlands. After inspection of their business model, it became clear that the insurance tariff is subdivided and paid out in sub tariffs to different stakeholders involved in the service delivery. The payment of different stakeholders was arranged by the telemedicine provider. Revenues may come from a subscription fee that can be a combination of a fixed amount, an amount per user/device and/or usage-related charging (e.g. number of hours, amount of data). In the start-up phase of a telemedicine enterprise extra income aside from service provision,

for instance additional research funding, may be necessary to keep up the business while the number of users is still low.

Discussion

A considerable number of R&D tele-health initiatives fail to survive after the funding phase or to run in routine operation (Tanriverdi and Iacono, 1999; Berg, 1999; Barlow et al. 2006). If a viable business model is developed in the early stages, it is believed that the failure rate can be reduced. The contribution of the present study was the systematic development and evaluation of a business model for a tele-monitoring and tele-treatment service based upon a R&D prototype for chronic lower back pain patients. For this, the STOF method (Bouwman et al 2008) was applied in a two phase business modeling trajectory. The development of the business model provided insight relevant for the chronic lower back pain application but also for tele-health business models in general. These general lessons relate to the challenge of multi-sector collaboration between different stakeholders, managing tele-health as disruptive innovation, and tackling generic barriers that are common for many tele-health initiatives.

The business model for tele-monitoring and tele-treatment in chronic lower back pain

The business model for the chronic lower back pain application is service oriented, the technological product (a BAN with mobile device and sensor) is only a small part of the total customer solution. The business model is complex due to the many roles involved and the diversity of the roles. There are roles related to health care, ICT, and finance. These roles have to be brought together. This coordination and integration is an important responsibility of the tele-health service provider. What is delivered is a combination of device and services and how this package is delivered is dependent upon the new, crucial role of the "tele-health service provider". This tele-health service provider is the initiator and link between the technology and health domains. Introduction of the new services requires additional services such as training and support. This service orientation can be developed further by a service strategy (a total service offering, the interactions between customers and relationship management) and service quality management (the quality of the service outcome and process) (Gronroos 2007). The start-up initiative for a tele-health service provider can originate from health, ICT or outside investors, but the tele-health service provider will in the end have to be able to deal with all these issues. The chronic lower back pain patients are considered to be a good market. The tele-monitoring and tele-treatment service, i.e. long-term monitoring and feedback on deviating physical activity levels, is considered to be generic treatment concept that could relatively easily be extended to other market segments (i.e. obesitas, work-related lower back pain, fibromyalgia, chronic fatigue syndrome).

While the developed business model is well-advanced after the two phases, it is not yet fully developed and there are critical issues that require further research For example, the legal issues, in

particular in relation to possible internationalization are hardly addressed. Moreover, there may be alternative technological options that need to be explored, such as disposable sensor devices that may be very cost-effective with respect to after-sales and support costs. Also the integration with other health information systems and standardization requirements (for interoperability and to stimulate competition) have not been properly addressed yet.

The challenge of multi-sector collaboration

The tele-health service provider needs to coordinate and integrate many diverse roles played by actors from the health, ICT and finance sectors. The tele-health service provider has the crucial role of initiating and coordinating the required change. However, achieving involvement and commitment of stakeholders in the early phases of the design process is recognized to be *easier said than done*. Different stakeholders have developed their particular expertise, habits, interests, power, roles, needs and expectations (De Rouck et al. 2008). This is both an issue of professional culture, as well as a problem of an applicability of a method (De Rouck et al. 2008). Little knowledge is available on how to realize this change successfully but we have shown that by inspecting the business models of existing, early-mover tele-health service providers, the knowledge gaps can (to some extent) be bridged.

Managing tele-health as an disruptive innovation

The tele-health innovation is not only technological, but foremost socio-economical. It requires, for instance, adaptation of financial arrangements and traditional work processes. It is crucial to be aware that tele-health is an innovation coming with uncertainty and will, possibly, be disruptive and thus require change and meet resistance (Christensen et al. 2006). Tele-health services are able to challenge the traditional paradigm of health care delivery in the sense that they have the potential to fundamentally change the accessibility, costs, and convenience of health care delivery (Christensen et al. 2000). However, to establish real industrial and social change, these tele-health innovations have to be 'disruptive' (Christensen 1997) This mean that they meet a need that (1) is either over-served (that is, the existing solution is more complex than necessary for many people) or not served at all, and (2) are simpler and cheaper as existing alternatives, but recipients view them as good enough, and (3) bring in resources that are unattractive to the existing system and (4) they are ignored, put down, or even encouraged by the existing organizations because they do not see the innovator's solutions as viable (Christensen et al. 2006). As Christensen showed through examples in education and economic industries (e.g. steel industry), disruptive technologies are actually able to fundamentally change the existing paradigm (Christensen, 2007). With respect to our business model, customers with busy, less flexible agendas (e.g. entrepreneurs, managers, professionals) are currently under-served with treatment possibilities that fit into their life-style. They usually are not able to, or have no time to, see a therapist during working hours and are therefore considered to be less attractive for

traditional health care deliverers. The tele-treatment service might be a good alternative for them because they can be treated while working. Since the tele-treatment service is believed to increase the efficiency of care, the market entry is expected to be more successful for practices with long waiting lists compared to practices with no waiting lists at all.

Tackling generic, common barriers at a higher level

The complexity of tele-health innovation lies both in initiative-specific and initiative-generic issues. For instance, initiative-specific issues concern the decision on how to provide and integrate the service of a particular application optimally for specific target groups, and how to concretely organize the service delivery within the daily practice. These specific issues should, and can only be, solved by the initiative taker, i.e. the tele-health service provider. Generic, common issues concern initiatives "exceeding" barriers, i.e. that go beyond the specific tele-health initiative, such reimbursement procedures and tariffs for tele-health, juridical aspects concerning system failures and (medical) responsibility, and policy and legislation (on for instance data security, storage, and privacy protection). Preferably, these issues should be solved at a national or even global level for remote monitoring and treatment services. Currently, the tele-health service providers need to spend a lot of time dealing with these generic issues separately for every initiative. Tele-health initiatives are recommended to collaborate by combining forces with a view to solving these generic barriers collectively on a higher level with governments and other relevant regulatory bodies.

Conclusion

The introduction of a tele-health service is complex due to the many roles involved and the diversity of the roles (e.g. dealing with health care delivery and processes, technology, financing, policy and legislation). In the business model proposed, the large-scale deployment of the tele-health service is dependent upon a crucial and new actor, the "tele-health service provider". This actor should be able to coordinate multi-sector stakeholder collaboration (clinicians, technology providers, insurance companies) and develop a revenue model in order to keep up the business. Importantly, the introduction of the tele-health service is not only a technological innovation but more significantly a socio-economic innovation. It requires new health care practices and changes the traditional paradigms and processes. The tele-health service provider has the crucial role of initiating and coordinating the required change. A few existing, early-mover tele-health providers have already established proofs-of-concept to demonstrate the feasibility of tele-health deployment and could provide valuable lessons for future tele-health service providers. Because of the complexity of the business model and the uncertainty of the socio-economic innovation, we are of the opinion that the successful introduction and deployment of tele-health services for now will, in general, be the result of small and focused initiatives that offer direct, tangible benefits and do not require considerable

change. This may mean that in the short-term the benefits and impact of tele-health are more narrow in scope than some of the more ambitious tele-health initiatives claim.

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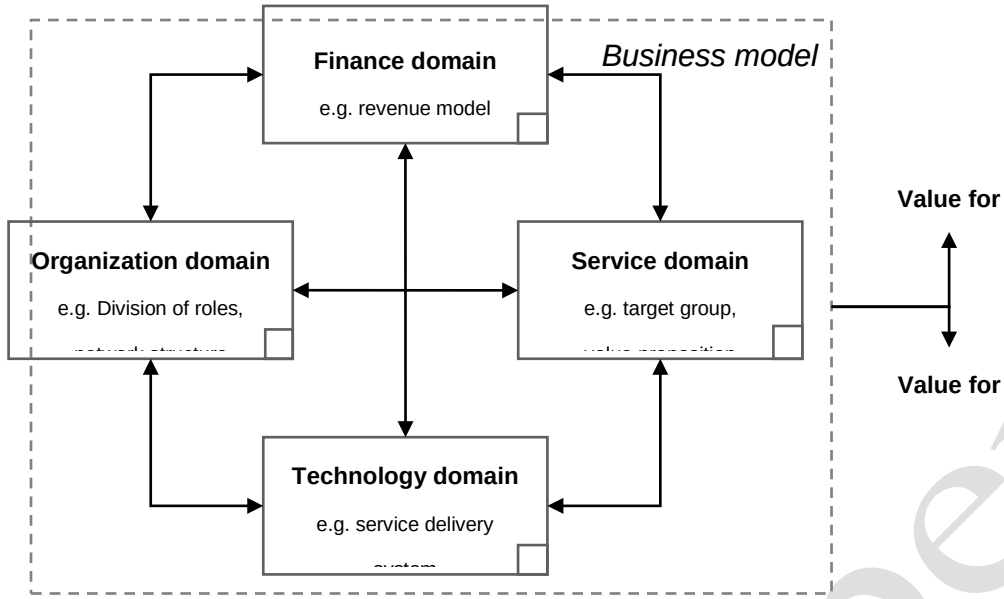

Figure 1: The STOF methodology (Bouwman et al 2008)

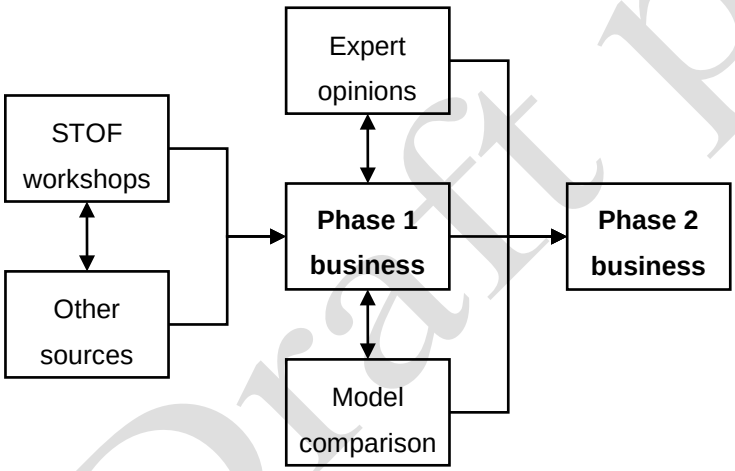

Figure 2: Two stage business modeling trajectory

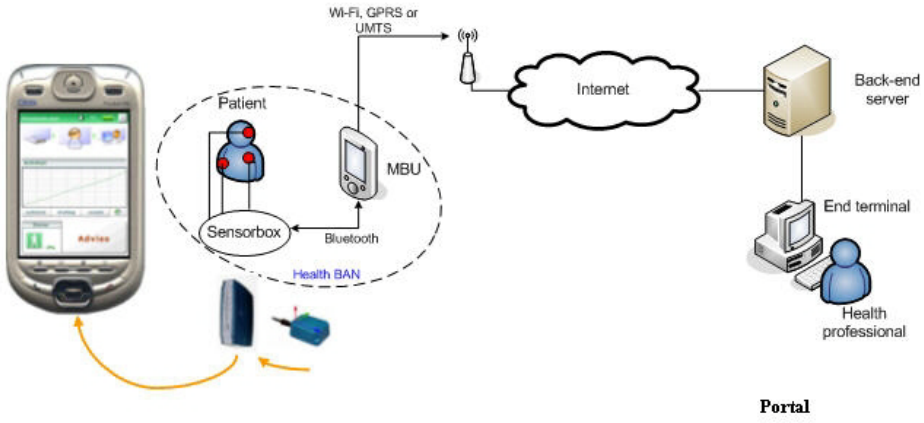

Figure 3: Functional architecture of tele-monitoring and –treatment prototype

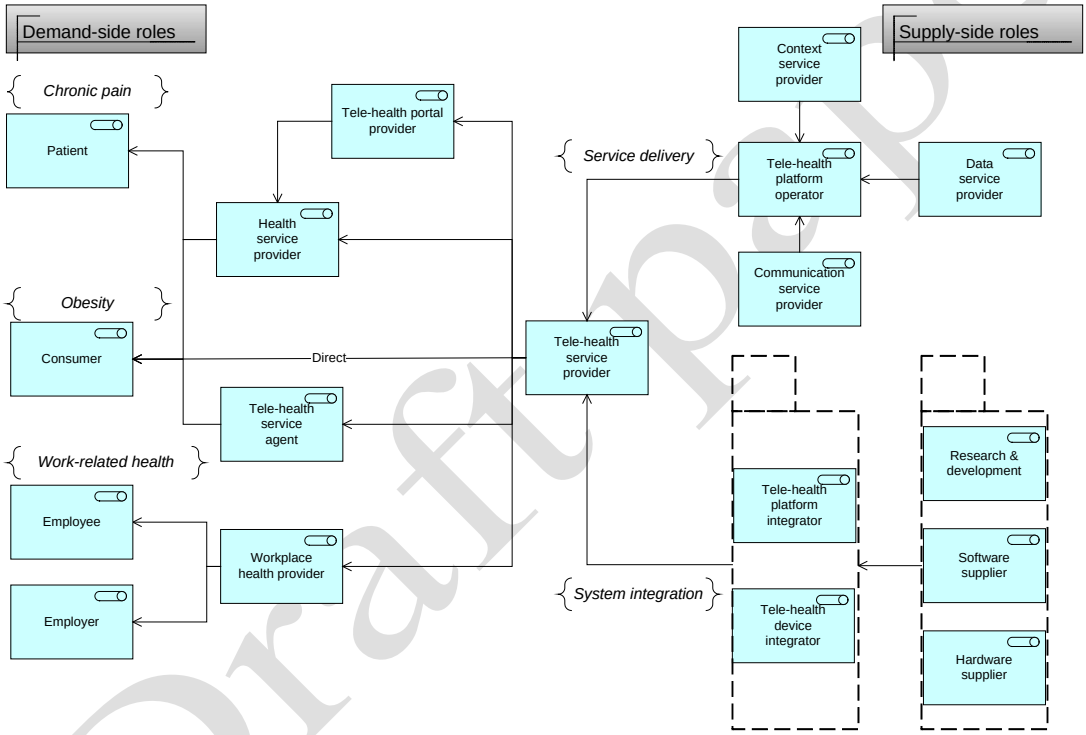

Figure 4: Roles in the tele-health network

Table 1 Revenues models for the tele-health services.

	Chronic pain	**Work-related**	**Obesity**
Health insurance	**XX**	x	x
Employer insurance		**XX**	
Commercial sales			**XX**

XX=high suitability, x=medium suitability

Table 2: Summary of results

	Phase 1	**Phase 2**
Service	Three target populations -> portfolio of tele-health services	Generic treatment concept for affected health status due to over- and underloading

	Implemented as replacement and/or add-on treatment Importance of training, helpdesk	Additional value for professionals monetary (long-term) and non-monetary (short-term) Target specific groups as launching customers
Technology	Prototype status High-end versus basic solution: redesign Continuous wireless data communication necessity?	Redesign prototype Design criteria: scalability, usability and costs Proven & affordable technology Continuous wireless communication not an necessity Training, helpdesk and support are essential elements because they influence the quality of service delivery
Organization	Telemedicine provider as crucial & central actor/role Different start-up scenarios for fulfilling role of telemedicine provider Model proposed (see figure X): telemedicine provider integrates role of system integrator and service delivery	Telemedicine provider is small & flexible entity Telemedicine provider indeed integrates role of system integrator and service delivery Start small and focused Combination of start-up scenarios most likely; enthusiastic leading champion was essential
Financing	Three revenue models: two insurance models and one commercial sales model Need for reimbursement (even from public/insurance money)	Reimbursement by insurance (public) money and commercial sales is possible but not straightforward. To keep up the tele-health business still depend, too a minor extent, on capital investments or external grants or project funding Exact revenues are unclear (subscription fee or pay per usage are most likely) Reimbursement tariff is divided in sub-tariffs for stakeholders involved in service delivery.