E-health Business Models: From pilot project to successful deployment

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Abstract

Innovation in healthcare through information systems can be seen as the land of opportunities. E-health promises both quality improvements and higher efficiency but many of these systems end up as "successful pilots". Although end users are satisfied and initial objectives are reached in terms of product quality and testing results, most of the innovations never reach the real world. In this study the main question is how to break through the impasse of e-health diffusion? With five cases empirical proof of the impasse is found and with business model theory these cases are analyzed. The practical contributions of this study show an emphasis on the financial business model and show that most of the innovations are technology driven. The case studies add dynamism and context to the model and change the perspective from ex post research to ex ante research. This result facilitates further research in business modeling by delivering a dynamic business model research framework.

Keywords: Business models, Business model dynamics, Innovation, Adoption, Diffusion, E-health

1. Introduction and Research problem

E-health innovations will be applied over the next ten years to achieve universal coverage and improve the quality of health care delivered to people [23]. However, the innovations are highly technology driven and therefore cannot reach the market [6]. Value, previously viewed as the price of things [3] is now often more market-oriented and must be viewed from a customer's perspective (Braaber, 2008).

Business modeling is seen as a solution to bring (technological) innovations to successful deployment and several determinants have been identified that were responsible for this success [2, 7, 6]. Still, e-health services and telehealth services are lagging behind and often end as "successful pilots".

Morris et al. [19] stated that methods are needed for appraising the fit of the business model with changing environmental conditions and further insights are needed into the dynamics of model emergence and evolution. This study addresses this problem by evaluating five successful e-health pilots with a traditional business model approach. From the knowledge valorization a new dynamic situational model is drawn.

2. Literature study

E-health and business models

In order to commercialize or deploy e-health service innovations, the concept of a business model concept plays an important role. The concept supports structural and logical thinking about designing viable and feasible service concepts [4].

What is a business model?

During the 1970s the business model concept was used for describing IT-related business processes [14, 27]. More recently, the business model concept has been used related to market structures as well as strategic choices related to positioning of organizations within these market structures [4, 24, 11]. A widely used business model definition within this context is that from Chesbrough and Rosenbloom [7] who concisely define a business model as "a blueprint for how a network of organizations co-operates in creating and capturing value from technological innovation". In our view, it is important to explicitly distinguish the two main types of value to be created: customer value (value delivered from a customer perspective) as well as monetary value (value delivered from a provider perspective). So we define, in similar words, a business model as "a description of the way a company or a network of companies aims to make money and create customer value" [10, 12].

Business model components

In literature, little attention has been paid to the theoretical components of a business model and much more on empirically defined business model typologies [11]. Afuah and Tucci [1] see businesses as systems consisting of components (value, revenue sources, price, related activities, implementation, capabilities and sustainability), relationships and interrelated technology. Osterwalder and Pigneur [22] more systematically define the following four business model components: product innovation, customer management, infrastructure management and financial aspects. Based on an extensive literature review (see [4, 12]) we defined the following four components (see also Figure 1):

- Service (description of intended value, delivered value, expected value, perceived value)
- Technology (description of technical architecture, service platforms, devices, applications)
- Organization (description of actors, roles, interactions, strategies and goals, value activities)
- Finance (description of investment sources, cost sources, revenue sources, risk sources, pricing)

The framework as depicted in Figure 1 has been used for analyzing the e-health projects as described in the next sections. The case studies are summarized according to the table structure (see table 1 Appendix A).

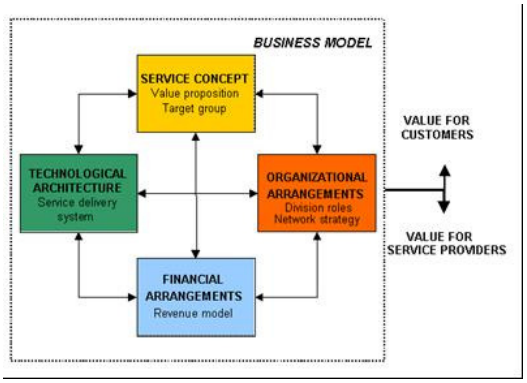

Fig 1. Business model framework

3. Case studies

Methodological considerations

To further develop our ideas on the possible relations among business models, innovations and e-health, we decided to conduct case studies for further theory development. Glaser and Strauss [8], Lee [17] and Yin [28] have argued in favor of case studies for theory construction. In contrast to case research for grounded theory development [8] and interpretive research [13], we use the cases as additional experiential sources for explicitly finding additions on the theoretical insights gained from the literature study. This implies that the research design, data collection, and analysis are led by the theoretical insights that have been gained already in the previous section and that we thus do not apply a fully open research strategy. With the data collection and data analysis we want to answer the question what variables and relations should be added to the current theory.

Five e-health projects in the Netherlands were selected. The Dutch health industry is interesting from a business modeling perspective, because the government and health insurance firms are increasingly 'forcing' hospitals to reduce costs and maintain and increase the service levels offered at the same time. The need for hospitals to innovate and rethink their organizational boarders is also recognized internationally [25]. Healthcare organizations are also relevant for this study because of the large IT investments they require, and thus the high levels of complexity that may appear in IT implementation. We selected five e-health projects that implemented an e-health system and that were willing to participate in the study by interviews and making relevant documents available. From the experiences with these five cases we draw an adapted model that we are currently testing in one action study (see Sections 4 and 5). For each case study interviews were done with the model of table 1 as an interview framework.

In the next five paragraphs short descriptions are given of the five e-health projects. For a more extensive overview, see Appendix B.

3.1 General Practitioner Information System (GPIS) (Appendix B)

The first step toward a national electronic patient record is to create a general practitioner system (GPIS) that will allow GPs to check each other's records. The second step would be to implement an electronic medical record (EMD) that would show all medication prescribed to the patient nationwide. During the evaluation of the pilot projects it became apparent that the current state of pilots was bad. The EMD pilot hasn't started yet and the GPIS pilot is on the verge of being shut down, although it was a regional success.

3.2 Radio Frequency Identification (RFID) (See also Appendix B)

RFID is a technology that makes use of radio waves for the remote exchange of data between a RFID reader and a so-called RFID tag. This tag is attached to a specific (mobile) object. The RFID technology is already being used in other sectors than healthcare, for example during sport competitions where a chip is placed in runners' shoes in order to measure start and finish time. However, the use in healthcare is new and therefore a pilot project has been started in Amsterdam. The costs involved regarding the implementation of new IT applications are the biggest hurdle to overcome.

3.3 Transmural information systems (TIS) (See also Appendix B)

This case handles two transmural projects that create a better data exchange between different healthcare organizations. Locally, these systems are successful but it is very hard to apply them on a regional or even a national level. Clear allocation of tasks and responsibilities between participating chain partners during the project, continuous project financing, shared stakes and opinions and a firm and proper communication structure between different players are of significant importance.

3.4 Telecare (See also appendix B)

The Telecare-project is very successful as a pilot-project. There was a good cooperation between the general practitioners, the central practitioners practice in a local city, and the hospital. The used PDA was technically complete and adjusted to the needs and wishes of the general practitioners. The

different research phases were carried out in perfect order which contributed to the success of the pilot. No investors were found though to get the pilot to a commercial state.

3.5 Mobihealth (see also appendix B)

Mobihealth is a system which allows patients to be fully mobile whilst undergoing health monitoring for all kinds of ailments. There are four potential applications; patient care, emergencies, sports and clinical research. The patients wear a lightweight monitoring system - the BAN (Body Area Network) - which is customized to their individual healthcare needs. Good cooperation between all the different parties involved in the project is very important. The system that can be implemented has to make a difference in the organization, for example stimulate more efficient work, cut down expenses or improve health status of patients. The used technique must work, be adjustable to personal needs and wishes of patients and physicians, be able to detect the right signals and be user-friendly. And it is very important to have a financial partner.

4. Analysis

In this cross case analysis we first show the practical similarities, peculiarities and conclusions from the different case analyses. Second, we critically assess the business modeling technique used. Finally we come up with an ex ante case where the new variables are put into practice.

4.1. Traditional business modeling

Lack of focus on value proposition
In all five cases, the service concept or value proposition is not the starting point of development. In the first case, the electronic patient record as value proposition is most clear but still not reached. In the second case a certain number of users is important but it is not clear how they want to reach this level of use. In the third case the main value is efficiency improvement and it is relatively difficult to define the value proposition in a more explicit way. Making relevant information available in trauma situations is the main value proposition in the Telecare case. Despite the positive evaluation of the mobile service no investors have been found yet. In the Mobihealth project (case 4) the service can deliver care at home so the patients do not have to go to the hospital.

Technology driven
Three of the five cases are clearly technology driven. In the Mobihealth project, the new technology enables the monitoring of relevant body functions from a remote location. The new technology which made the equipment portable worked perfectly and the related Body Area Network received positive feedback as well. Unfortunately, the project depended on wireless data networks such as GPRS and UMTS and at the time of the pilot project these technologies were not reliable enough to allow further implementation of the pilot system. In the RFID project (case 2) multiple applications of RFID technology have been developed like tracking temperatures of blood samples and the usage of medical equipment in surgery and other areas. However, when the different applications had been worked out, the basic RFID tag technology appeared to be incomplete and not ready for implementation. This resulted in higher project costs and more development time needed. Telehealth projects (case 5) are very ambitious, and they should be. Specialists in telematics see numerous applications for the fast developments in their field. Of course this is a supernal objective and new applications can potentially result in major improvements for healthcare in general and patients as well.

Organization
In the cases of Telecare, Mobihealth and GPIS, management support has been mentioned as a critical success factor. The pilot projects need financial and non-financial resources in order to become a success. If management has the role of idea champion all these resources are more likely to become available. Also, as was the case in the RFID project, existing practices, roles and data structures might change as a result of the implementation of newly developed systems. Getting management involved becomes more difficult when organizations become larger or if multiple organizations are getting involved in the development project as mentioned in the Telecare project. Because multiple organizations had difficulty with agreeing on one standard procedure and the sharing of information with others, the future of this project became problematic. The organization of the project can be considered crucial for success of a pilot project to diminish resistance. In the Mobihealth project this was achieved by analyzing how their implemented project would save time and money and achieve a positive ROI. Presenting the achieved benefits in management terminology can improve support.

Financial focus
Due to the small scale of many development projects ranging from an individual project of one hospital to a corporation of different general practitioners, funding is limited. Luckily for these initiatives, numerous funds can be called upon. Funding can come from e.g. the Dutch government, the European Union or an independent development fund. A major drawback of these sources is that funds are rather limited. And when the funds have run out, other financial resources prove hard to find. In multiple cases lack of funding resulted in the project's ending (Mobihealth, RFID, TIS and Telecare). Clearly, limited funds can be considered rather common for telecare projects. However, this does not have to

result in project failure: when managed with care, limited funds can even result in more efficient projects. Projects with significant financial resources such as the 'National Patient Record' project [9] often do not excel in efficiency.

4.2 Critical appraisal of traditional business modelling

In all five cases the business model is applied ex post as an evaluation tool. In practice and theory we notice the same tendency. The business modelling exercise would be much more effective in an ex ante study. After showing an improved version of the business model framework in Section 2, the e-health business modeling study as described in Section 4 is explicitly designed ex ante with the service and value proposition as central element.

A second criticism to the business modeling framework is that it does not comprehend the context or external environment of an (e-health) service innovation. In all five cases as described earlier, the (regulatory) context is complex and of an inter-organizational nature which influences the implementation of e-health systems. In the sixth action study, described in the next section, explicit attention is given to this external environment.

Finally, we observe from the five case studies that the model as given is not dynamic. We think the implementation process changes constantly in a complex environment forcing the business model to adapt continuously to new situations. In the sixth case study we experiment with how this can be done.

4.3 A dynamic view on business models

Based on the cross case analysis we concluded that in reality business models, also in the context of e-health services, are not static but have a dynamic character. However, although the development process from business idea to established business can actually be divided in different phases [15], we see that in literature business models are mostly researched from a static perspective.

Phasing models help to understand the evolution of the competitive landscape following an innovation or change, as well as the impact of an innovation or change on firm strategies and business models [1]. Based on an earlier mobile service business model case study [12], we propose a dynamic version of the business model framework as described in section 2 consisting of several development phases. In order to develop this model, we have examined phasing from five disciplines: technical service development, business planning, entrepreneurship, innovation adoption and diffusion, and marketing respectively (see [12]). When we compare the phases as distinguished in these perspectives, one can broadly speak from three main phases: the technology/R&D phase (which focuses on technology, investments, and the development of service concepts), the implementation/roll-out phase (focusing on testing of service concepts, field experiments, first introduction and small scale roll-out of services), and the market phase (aimed at commercial exploitation after market experiments proved to be successful).

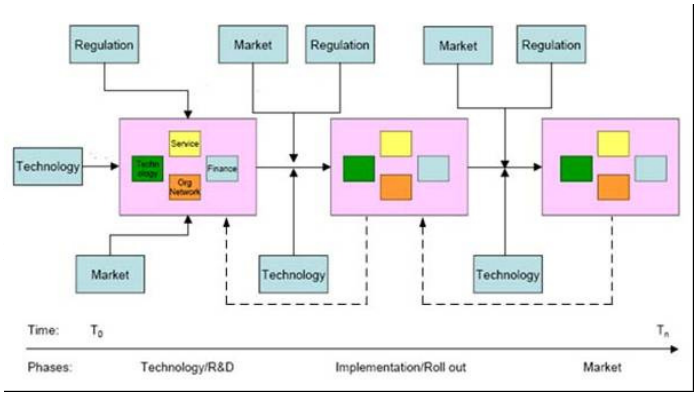

Fig 2. A dynamic business model framework [12]

4.4 A dynamic business model case

Myotel is an e-health service in development. Myotel stands for MYOfeedback based TELetreatment. Myofeedback means that patients get feedback based on muscle tension measurement. Myotel aims at patients with chronic neck/shoulder problems and the service can be provided in the daily environment of the patient by letting the patient wear a garment. The patient can be supervised by a remote care professional (for more information, see Appendix C).

By making use of the phases as depicted in Figure 2, the dynamic business model development process of Myotel can be described as follows (see also Appendix C):

1) Technology / R&D phase
Based on earlier more fundamental research, in this phase the medical and technical effectiveness of the Myotel service concept is being further researched and developed. As a result of an international market, technology and regulatory analysis (the three external factors as defined in the dynamic business model framework) as well as a business model survey and workshop output analysis, a first business model for Myotel has been developed with an overview of needed roles, relationships and money streams (see also Appendix C). Based on feedback from professionals in the field and medical as well as technical research results the business model is being further revised and quantified. In addition a concise implementation plan for deployment is in development.

2) Implementation / roll-out phase

In this phase, the business model and related value network design will be tested on a small scale but in a real life setting with real organizations and real related value and money streams in one of the countries involved within the project. This will lead to further validation and improvement of the business model design. Goal is to optimally match the design with the available resources and capabilities as well as the external environment.

3) Market phase

If the business model testing in the previous phase proofs to be successful, the Myotel service concept and business model will be further refined as well as optimized to commercial exploitation on a larger, international scale.

Although the Myotel project is still in development, the first results of this more dynamic approach look promising. By having a more dynamic view, the business model seems to be better aligned with its external environment as well as with the resources & capabilities available.

In order to stress to importance of value creation, an adapted STOF-V model with the value concept central for all dimensions is being presented in Figure 3. To make this model dynamic it could be inserted in the dynamic framework as depicted in figure 2.

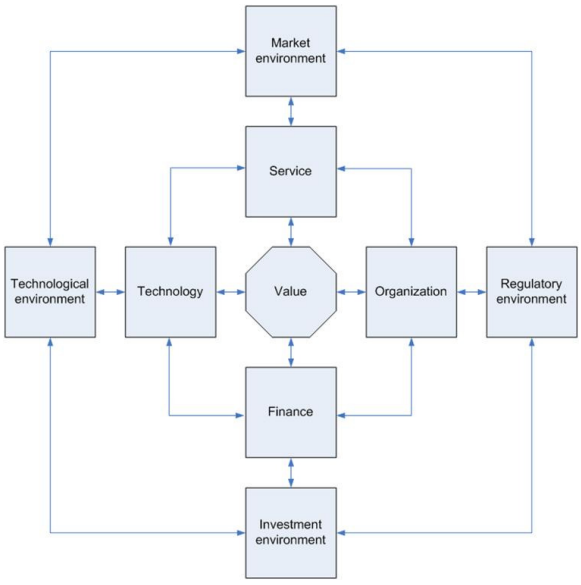

Fig 3. STOF-V model adapted from Bouwman et al. [4].

5. Conclusions and discussion

All five ex post case descriptions show financial problems in the commercialization stage of the product or service. Only the first case seems to survive since the government supports the development of electronic patient records. Although the ex ante action study as described in the previous section is still running, the first results look promising – by giving business model innovation a high priority right from the beginning of a project and developing the business model in iterative loops, the failure rate of e-health service innovations may be lowered because the business model designs are expected to be more viable as a result of better alignment with available resources and capabilities as well their external environments. Besides, this way of working with a stronger focus on value delivery may also lead to better pilot project resources usage.

The second conclusion is both practical and theoretical. The e-health innovation world seems to be mostly technology driven instead of being focused on actual value creation. All innovations except case 1 start out with technology. Although the business model framework already pays explicit attention to the value proposition, the service component could be given a more central role in the framework to emphasize the crucial importance of this component.

The use of a business model framework as an evaluation tool does not seem to be sufficient. The focus should change from ex post to ex ante usage, by creating a flexible business model that can be adapted to changing market, technology and regulatory environments and changing resources and capabilities. A dynamic business model framework potentially more suitable for this kind of ex ante usage has been described in Section 4.

Although still in development, the sixth Myotel study already shows that thinking in a more dynamic way about business models within the context of a project may also support decision making in other (e.g. technical or medical) parts of the project.

Future research should create more empirical data on ex ante business modeling. This data then could be used to validate or refute our hypotheses on developing business models in a dynamic and iterative context based on the ex ante action study.

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Appendix A: Summarized interview results

The interviews have been conducted following the traditional business modelling approach.

Table 1: Case study table

Case #	**Case Name**
Brief Description	Short Summary of the case.
Why STOF model	What is the reason as described in the case to apply the STOF model?
Service	Summary of the discussion and conclusions of the service element.
Technology	Summary of the discussion and conclusions of the technological element.
Organization	Summary of the discussion and conclusions of the organizational element.
Finance	Summary of the discussion and conclusions of the financial element.
Case Conclusions	What is the main conclusion of the case?
STOF Contributions	How has the STOF model contributed to the case analysis and conclusions?

Appendix B: Interview results in case summaries

In the next five tables the results of these interviews are summarized.

Case 1 – The GPIS and Electronic Medication Record

Case 1	**GPIS**
Brief Description	Developing an electronic patient record in Dutch healthcare. Electronic patient record (EPR) is split up into two main parts; GP Information Systems and Electronisch Medication Record. These two elements are developed to decrease the complexity and efforts for the development of the EPR.
Why STOF model	The STOF model has been used to gain insight in the main incentives and hurdles for the development and implementation of the three systems.
Service	The EMD is proposed to help in the decrease of medical problems due to the admission of the wrong type or dosage of medicine. The GPIS is proposed as a way for better communication between substitute and regular GP's. This should lead to better diagnostics and to a more efficient and effective treatment because there is a better medical history available.
Technology	The healthcare industry is a late adopter of technology. Many doctors feel that new technologies are replacing the medical instead of improving effectiveness, efficiency and quality of healthcare. This results in resistance for technology adoption.
Organization	The initiative for the EPR system has been started by the Dutch government. Hospitals are very large organizations with complex organizational structures. The implementation of the EPR in the different hospitals will be follow a top-down approach.
Finance	The government has supported the development of the IT network for the EPR until 2007. Now the healthcare sector needs to financially support maintenance and further developments. More information about paying schemes is not mentioned in the case description.
Case Conclusions	The building blocks for the EPR; WDH and EMD still have a long way to go. The financial risk for the general practitioners has to be eliminated to make the project a success.
STOF Contributions	The four elements of the STOF model have been used to describe the case. However no attention has been paid to the relations between the elements and the explanatory potential of the STOF model.

Case 2 – RFID tracking systems

Case 2	**RFID**
Brief Description	The report describes a case of RFID in health care. Some potential applications of RFID in healthcare are; tracking temperatures of blood monsters and tracking usage of medical equipment in surgery, needles etc. The development and implementation of RFID has been evaluated.
Why STOF model	The STOF model has been used to gain insight in the main incentives and hurdles for the development and implementation of the three systems.
Service	It is of vital importance that everyone involved in using the new service knows how to work with this new service. It is clear that also a small new service can have far-reaching influence in the organization. These problems *can* be overcome by well organized learning sessions and meetings, increasing development and implementation costs.
Technology	The tags and readers for the tags used in the RFID case were still in development. The project team thought that the development of RFID technology was already completed. However different completely new products and technology had to be developed for this specific application. This results in higher development costs and time.
Organization	Changing processes may result in changing existing practices, data structures, roles and management practices, which may result in resistance from various professional groups. A second challenge is managing clinical knowledge and skills. For instance, healthcare professionals may not have the knowledge required to efficiently use new technologies. Therefore, training is essential when applying new technology. Also, extra staff may have to be hired to provide sufficient knowledge of technology.
Finance	Wide spread implementation of a new technology is necessary to become cost effective. Since pilots often implement technologies or innovations that have not proven themselves in healthcare, widespread implementation is difficult and therefore it is difficult to become cost-effective. Secondly, pilots are often financed by means of subsidy. This subsidy enables the pilot but does not cover costs that are necessary for the implementation of the innovation after the pilot-period. A final financial hurdle for adoption is the depreciation term, which is often a very short period when using new technologies.
Case Conclusions	The costs involved in the RFID project are the biggest hurdle to overcome to allow for further development and implementation of the technology. Although costs may be the most important factor when implementing new solutions in healthcare, changing organisations is also an essential factor. Without proper organisation, new solutions may never be properly implemented, which may cause them to have no surplus value.
STOF Contributions	The four elements in the STOF model have been used as a checklist to perform the analysis of the RFID project. The possible relationships between the different elements are not mentioned and the STOF model has therefore been applied on a very low level.

Case 3 – TIS

Case 3	**TIS**
Brief Description	This report describes two currently running IT-project in health care: *Transmural integral patient information system* (TIS). The project is aimed at improving data exchange practices between chain partners. Numerous IT-projects are started on an annual basis in a health care setting and few seem to be successful. Therefore this study focuses on the success factors and hurdles for IT-projects to succeed.
Why STOF model	The STOF model is used to identify the main incentives for the project. Next to the four elements in the STOF model, the roles of legislation & regulation as well as the roles of Customers, suppliers & competition have been analyzed.
Service	The service element presents the value proposition for the individual clients and connected partners. Individual clients will be more responsible for their own decision making and information management. Therefore clients can come to the desk and ask for information, services or products. The requested information will be stored and can also be linked to other information if proven relevant. This kind of service is a

	contribution to the efficiency improvement of services provided by the connected partners.
Technology	The IT-project is largely based on the introduction of an encoding standard used for processing and transmitting information around a network. Whether the used standard of this encoding system (HL7 version 3.0 and XML) will be the standard of choice is still undetermined. In this project safety and authenticity issues are very important. The outcome of the project is depending on regulations employed by the ministry HWS. It is still undetermined what medical information requires approval from a responsible person or physician and what information does not.
Organization	The organizational element of the STOF model has been used to describe the key players and the functional structure of the system. The most important key player in the project in the SRE (collaboration Region Eindhoven). The most important functional element in the system is the desk which is the database from which the back and front office applications abstract their information.
Finance	The main benefits of the project are big time savings because of a drastic decrease in the amount of paperwork. Direct financial benefits are will not be achieved. A Hurdle of influence for the continuation of this project is the financing. As explained earlier, the pilot is mainly financed by several funds and a couple of one-time financial contributions. This means that the project does not have an unlimited budget.
Case Conclusions	Both pilots are focused on improving information exchange between chain partners by means of IT-implementation. In addition to the earlier mentioned factors that stimulate or inhibit the success of IT-project in healthcare other aspects probably have a vital role to play as well. For example, clear allocation of tasks and responsibilities between participating chain partners during the project, continuous project financing, shared stakes and opinions and a firm and proper communication structure between different players are of significant importance.
STOF Contributions	The elements of the STOF model have been used to categorize the main conclusion of the report. Next to the four STOF elements, the elements Legislation & regulation and Customers, suppliers & competition were added. This allowed some more insight in the role of external factors on the project. Legislation & regulation plays a big role in healthcare. Very rigid requirements are set on privacy and system performance. Therefore, using the STOF model alone would have resulted in an incomplete analysis of this project.

Case 4 – Telecare

Case 4	**Telecare**
Brief Description	The first step in the Telecare project acquired insight into how healthcare chains work: who communicates where and when with whom, and what information is exchanged in these communications? Telecare used the knowledge available in the care chain to determine which requirements and opportunities exist for ICT applications. The requirements from the practical situation formed the basis for the next steps: the development of the Telecare platform and the different applications that will run on it. The last step was the actual testing of the applications in the care practice, which consisted of providing PDA's with the Telecare application to general practitioners, the general practitioners post and the Hospital in Enschede.
Why STOF model	The major incentives and hurdles for further adoption are evaluated based on the four elements of the STOF model. The financial viability, the organizational embedding found, is it technically possible and scalable and is there a fit between the service delivery model employed by the institution and the new service.
Service	The major gain of the Telecare-project is that the needed information of the treatment history of the patient is available before entering the hospital. Normally that happens after the admittance in the hospital. This advantage fits with the service delivery model of the hospital and the general practitioners. Besides that, the system standardizes all incoming information, which improves information sharing throughout the hospital.
Technology	From a technical perspective, all requirements were fulfilled, the application is user friendly and information security is guaranteed which is important to secure the patients privacy. Technically the application is ready to implement in other departments. Because the information in the system is standardized, broader implementation will lead to improved information synchronization throughout national healthcare. All new users of the system have to convert their information to the

	Telecare information standard, and the systems that are currently used will have to connect to the Telecare system. This leads to a lot of work and costs. The PDAs make use of the GPRS network, this network is not stable yet. However, even during the project significant improvements in the network quality have been made.
Organization	The organizations involved cooperated with a number of health care professionals and institutions in the region, in order to ensure that the applications that will be developed connect with their every day practice. Therefore the pilot-project was an organizational success. To change the organization so that the pilot project could continue, the people and management of the different care-givers have to be willing to share the information with each other. Besides that, the way of working of the different users has to be the same, therefore newly developed standard protocols have to be introduced.
Finance	The project was initially financed with funding from the Freeband Knowledge Impulse fund. After the pilot was finished new investors were searched to finance the further adoption. No investors have been found so far. It is difficult to find an investor because the benefits of the project are gained at a different level than the costs are incurred.
Case Conclusions	The Telecare-project is very successful as a pilot-project. There was a good cooperation between the general practitioners, the central practitioners post in Enschede and the hospital. The used PDA was technically complete and adjusted to the needs and wishes of the general practitioners. The different research phases were carried out in perfect order which contributed to the success of the pilot. With all respect, it can be said that the project was 10 years ahead of the developments in the health care sector. Normally there is about ten years of investment needed until a certain technology is completely adjusted to its users and environment. With the Telecare-project, the technology was finished after two years, but all further developments (organizations, legal system) were behind. And necessary financial resources to complete the development were not available.
STOF Contributions	In the report two analyses are performed based on the STOF model. Major incentives and major hurdles have been identified for each of the four STOF elements. Legal, regulatory and competition factors have also been included in the analyses. Because the system will be operating in a healthcare environment, a lot of legislation rules are in place. Competition is important because hospitals in the Netherlands will have to increase efficiency in the future. This is a result of the open market for insurance companies. The benefits of the Telecare project will therefore become more interesting for hospitals in the future.

Case 5 – Mobihealth

Case 5	**Mobihealth**
Brief Description	Mobihealth is a system which allows patients to be fully mobile whilst undergoing health monitoring for all kinds of ailments. There are four potential applications; patient care, emergencies, sports and clinical research. The patients wear a lightweight monitoring system - the BAN (Body Area Network) - which is customized to their individual healthcare needs. The Mobihealth services are based on GPRS and UMTS technologies for wireless broadband data transfer. When the transmitted data exceeds a pre-adjusted threshold an alarm is sent to the patient and the healthcare provider in order to take action. In 2002 a pilot project started for 18 months with 120 pregnant women at the hospital of Enschede.
Why STOF model	The major incentives and hurdles for further adoption are evaluated based on the four elements of the STOF model. The financial viability, the organizational embedding found, is it technically possible and scalable and is there a fit between the service delivery model employed by the institution and the new service.
Service	During the pilot at the hospital in Enschede the University of Twente was responsible for security, reliable hand-over of the data and maintenance of the system. The Mobihealth system suits the service ambitions of the hospital in which the patient plays a central part of the organization, another incentive for adoption. This service allows the patients to remain in their home environment and reduces the amount of visits to the hospital. Next to the obvious benefits for the patient, cost savings for the hospital can be regarded as another important incentive.
Technology	Because of the application in healthcare, technical issues are very important. Data

	transmission has to be error free and secured. Data transmission in the Mobihealth project was secured and error free, all used applications were CE approved, the total project was evaluated by the Medical Ethical Testing Commission (METC) and it received their technical approval. The test system suffered from data loss and delays in transmissions caused by the GPRS and UMTS networks. The developed system worked according to specification but data network improvement before the system can be rolled out.
Organization	Management support is a critical factor for project success. It is therefore every important to show during a pilot project how the finished project will cut expenses and have a positive ROI. The management of the hospital has been involved during the whole Mobihealth project.
Finance	Mobihealth was a consortium of several different (commercial) companies, universities and institutions which together were granted a fund from the European Union to develop the Mobilhealth service. This meant that for a period of 18 months funding was no problem. Now the funding has stopped, a commercial partner willing to invest in the project has to be found to be able to continue developments.
Case Conclusions	The Mobiihealth project has shown that the basic technology of the BAN is working and effective. The current GPRS and UMTS networks have too much data loss and delays in order for the system to be successfully implemented. In systems development healthcare external factors play an important role. The system has to comply with laws and regulations and the system acceptance of the patients has to be kept in mind during the development.
STOF Contributions	The STOF model has been used to describe the four different elements for the case. However as was already described in general conclusions, external factors play an important role in business cases in health care. Laws and regulations on privacy, security and accreditation have to be considered when developing new systems. These external factors are not covered by the current STOF model. Also, keeping in mind the speed of development in mobile internet connections, insight the influence of these developments would be very helpful in new business development.

Appendix C: Myotel project information

Case 6 – Myotel

Case 6	**MyoTel**
Brief Description (source: Myotel project flyer)	The goal of the Myotel project is to analyze the feasibility of deploying a MYOfeedback based TELetreatment service; a myofeedback treatment for patients with chronic neck-/shoulder problems that is provided in the daily environment of the patient but supervised by a care professional on distance..The starting point of this treatment is scientific research showing that patients with chronic neck-/shoulder problems have problems with relaxation of their neck/shoulder muscles. During the Myofeedback treatment the level of muscle relaxation is measured continuously by electrodes that are incorporated in a harness. The patients wear this harness under their cloths during their daily activities. By means of vibration of a system that is worn by the patients they receive a warning (feedback) in case the level of muscle relaxation is insufficient. By this the patient becomes aware of the lack of relaxation and is able to improve his "muscle behaviour". Besides, the data of the patient are send wirelessly by telephone to a secured server which is remotely accessible for the responsible care professional. In line with the needs of the patient a teleconsult (consult on distance) can take place to discuss the progress of the treatment.
Why STOF model	After researching the clinical effectiveness of Myotel, the commercial deployment of the Myotel service concept is being analyzed within the context of a European deployment research project by making use of the dynamic STOF model. The dynamic character of the framework should help to heighten the changes of successful commercial deployment by increasing awareness related to the importance of business model innovation also in the earlier stages of service development.
Service	With the Myotel myofeedback treatment patients get feedback based on muscle tension measurement that should help lessening their pain. Myotel aims at patients with chronic neck-/shoulder problems and the service can be provided in the daily environment of the patient by letting the patient wear a garment. The treatment can by remotely supervised by a care professional.
Technology	The underlying technological architecture consists of a Body Area Network (BAN) which connects the garment to the patient end user device (e.g. a PDA/Smartphone), a back-end system (server), and an end user device for the care professional (e.g. a desktop computer).
Organization	The organizational element of the STOF model has been used to distinguish the key roles and their relationships needed for deployment (see Figure 4).
Finance	The deployment project itself is financed by the European Union. The finance element of the STOF model has been mainly used for describing the money streams between the key roles as distinguished in the organizational element needed for deployment (see Figure 5).
Case Conclusions	The project is still running and the feasibility and viability of the service concept is currently being researched..
STOF Contributions	The dynamic STOF model has been used to describe a possible Myotel business model. The dynamic STOF model already proofed to be valuable to support business model thinking in a dynamic and iterative way right from the beginning of the project, e.g. by supporting decision making with respect to medical and technological development choices to be made within the project.