Assessing the Viability of Service Innovations: A Structured Business Modeling Approach[1]

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Abstract. Currently, business modeling seems to be an art instead of a science, as no scientific method for business modeling exists. This causes many service innovation projects to end after the pilot stage, unable to fulfill their apparent promises. We propose a structured method to create "as-is" business models in a structured manner. The method consists of the following steps: identify the involved value network roles, recognize relations among these roles, specify their main activities and develop a quantitative model using realistic estimates. The resulting quantitative business model is suitable for analysis of the current situation. This is the basis for further predictions, like business cases, scenarios and alternative business model designs. We offer two extra steps to develop and analyse these alternatives. Using our method may increase the viability of service innovation projects by helping to improve the underlying service innovation business model design.

1 Introduction

The use of information and communication technology (ICT) is increasingly proliferating in transportation. It is applied to support main functions like car management and navigation. Other applications include navigation systems that guide drivers to their destination taking traffic information into account and ICT systems that support the entertainment of travelers with games, music, video and connectivity. Next to this, traffic management systems are emerging that capitalize on the possibilities of ad hoc car networks (e.g. by using sensor technology) in order to optimize traffic management by for example adapting flows through changing the timing of traffic lights. Also sensor and actuator networks may be used for increasing safety and lowering the prevalence of car accidents.

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[1] This chapter is primarily based on L.O. Meertens, M.E. Iacob and L.J.M. Nieuwenhuis, Developing the business modeling method, Proceedings of the First International Symposium on Business Modeling and Software Design 2011 (BMSD 2011), pp. 88-95 and Kijl, B., Nieuwenhuis, L.J.M., Deploying e-health service innovations – an early stage business model engineering and regulatory validation approach, International Journal of Healthcare Technology and Management, Vol. 12, No. 1, 2011.

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The functionalities as mentioned above – car sensors, engine management, traffic information systems, entertainment and telecommunications – have mostly been developed independently of each other. It is expected that in the near future, these technological systems will become integrated and less car / brand independent. In such a context, these technologies may provide an architectural platform for many new service innovations.

At the service platform domain we have to define and develop an environment where interacting services can coexist. These new services are typically context aware. Next to more technological challenges like service intelligence and service management, assessing the commercial viability of these service innovations will also be a critical aspect.

2 Early Stage Service Viability Assessment

For assessing the viability of future traffic management systems and related service innovations in early project development stages, we propose to analyse the underlying business models. A business model essentially describes how value can be created (for users) and captured (e.g. in the form of profits) with a specific product or service.

In order to perform such an early stage analysis, we first need to identify all stakeholders involved. One can think of individuals participating in the traffic as well as organizations responsible for infrastructural services. However, a wide range of other service providing organizations are also expected to play an important role, like governments (probably interested in road pricing strategies and traffic management issues), the energy sector (for fueling or taking care of charging electronic car batteries), the health care sector (monitoring the wellness of drivers and their passengers), telecom operators (connectivity), entertainment and media companies (video, music, …) and of course also car manufacturers (by building excellent cars with competitive services they may create the basis for open service platforms).

Typical business related research questions relevant for organizations involved in offering new service innovations are:

- How will the value network that is needed for creating these new service innovations exactly look like – which organizations need to work together and in what way?
- Which revenue models can be used (relevant for private as well as private parties)?
- How can we optimally balance costs and revenues among the organizations participating in the value network?

In earlier research projects (see http://www.myotel.eu and http://www.utwente.nl/ewi/ucare/), we developed a structured business model validation approach aimed at answering these questions and tested it on specific e-health service innovations.

After introducing the concept of business models in Section 3 and 4, we will describe our business modeling approach by describing the six steps it consists of in Section 5. In Section 6, we will apply this approach to an illustrative case study.

3 Business Modeling Background

A business model is critical for any company. Its importance has been recognized over the past few years by several authors that have created different business model frameworks aimed at identifying the main elements of a business model (for example, Osterwalder [9]; for an overview, see Pateli and Gialis [10], Al-Debei and Avison [1] and Vermolen [14]). However, the state in which this field finds itself is one of pre-scientific chaos [7]: there are several competing schools of thought and progress is limited because of a lack of cumulative progress. Because of this, there are no clear and unique semantics related to business models. The concept of a business model is associated with many different definitions [14]. The elements of such a business model differ significantly from one approach to another. Furthermore, to the best of our knowledge, there are no methodological approaches in the literature for the design and specification of business models [14]. This lack of cohesion in the field clearly diminishes the added value of business models for companies and makes business modeling an art, rather than a science. This state of affairs motivated us to propose such a method, which enables the development of business models in a structured manner. Thus the contribution of this chapter is three-fold:

- A proposal for a business model development method;
- A definition of the concept of business models and the identification of its core elements, captured by the deliverables of the method steps;
- An illustration of the method by means of an illustrative case study from the healthcare domain.

4 Theoretical Background

A simple analysis of the two words “business model” already gives an idea of what a business model is about. On the one hand, there is “business”: the way a company does business or creates value. On the other hand, there is “model”: a conceptualization of something – in this case, of how a company does business.

We extend this common and simplistic interpretation of a business model as “the way a company earns money” into a broader and more general definition of the concept: “a simplified representation that accounts for the known and inferred properties of the business or industry as a whole, which may be used to study its characteristics further, for example, to support calculations, predictions and business transformations.”

The last part of the definition above, namely the indication of the possible uses of a business model is of particular importance in the context of this chapter. The method we propose not only facilitates the development of such a design artefact – a business model – but also takes a business engineering perspective. Thus, its application will result in essentially two (or more) business models: one that reflects the “as-is” situation of the business and one or more alternative “to-be” business models that represents possible modifications of the business as result of, for example, adoption of innovative technologies or more efficient business processes.

To the best of our knowledge, such a method does not exist yet (Vermolen 2010). In the remainder of this section, we position our work in the contexts of design science and method engineering, to which it is related.

4.1 Design Science

A business modeling method can be seen as a design-science artefact. It is the process of creating a product: a business model. We use the nine guidelines of Hevner et al. [4] to frame how we use the methodology engineering approach from Kumar & Welke [8] to create our method.

The first guideline advises to design as an artefact. Design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation. As said, we produce a method.

The second guideline tackles relevance. The objective of design-science research is to develop technology-based solutions to important and relevant business problems. Viable business models lie at the heart of business problems. However, our solution is not yet technology-based. Partial automation of the method is left for future research.

The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods. We demonstrate the business modeling method using a case study. We leave more rigorous evaluation for further research.

Research contribution is the topic of the fourth guideline. Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations and/or design methodologies. We provide a new artefact to use and study for the academic world. The methodology may be extended, improved and specialized.

Guideline five expresses the scientific rigour: Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact. We aim to be rigorous through using the methodology engineering approach. Existing, proven methods are used as foundation and methods where applicable. Evaluation was handled in the third guideline.

The sixth guideline positions design as a search process. The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment. Whenever possible, we use available methods for each of the steps. Following the methodology engineering approach helps us to satisfy the laws for creating a new methodology.

The final guideline instructs us to communicate our research. Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences. This chapter is one of the outlets where we present our research.

4.2 Methodology Engineering

Methodologies serve as a guarantor to achieve a specific outcome. In our case, this outcome is a consistent and better-informed business model. We aim to understand (and improve) how business models are created. With this understanding, one can explain the way business models help solve problems. We provide a baseline methodology only, with a limited amount of concepts. Later, we can extend, improve and tailor the methodology to specific situations or specific business model frameworks.

The business modeling method has both aspects from the methodology engineering viewpoint: representational and procedural [8]. The representational aspect explains what artefacts a business modeler looks at. The artefacts are the input and deliverables of the steps in the method. The procedural aspect shows how these are created and used. This includes the activities in each step, tools or techniques and the sequence of steps.

5 Defining the Business Modeling Method

We defined six individual business modeling steps. We will concisely describe each of these steps in this section, by using the following elements:

- Inputs of the step;
- Activities to perform during the step;
- Possible techniques to use for these activities, and
- Deliverables resulting from the step.

Each step in the proposed method requires specific methods, techniques or tools that are suitable for realizing the deliverables. We will mention examples of those. However, others may also be useful and applicable, and it is not our aim to be exhaustive in this respect. **Table 1.** shows an overview of our method.

Table 1. Business modeling method.

Step	***Inputs***	***Technique or Tools***	***Deliverables***
Roles	Documentation, domain literature, interviews, experience, previous research	Pouloudi and Whitley [12]	Role list
Relations	Role list, stakeholder map, value exchanges	e3-value	Role-relation matrix
Activities	Role-relation matrix, role list, business process specifications	BPM methods, languages and tools	List of activities
Quantification	Process specifications, accounting systems and annual reports	Activity based costing	Total cost of the business “as-is”
Alternatives	As-is business model, ideas for innovations and changes	Business model method (step 1-4), brainstorming	One or more alternative business models
Analysis	Alternative business models	Sensitivity analysis, technology assessment, interpolation, best/worst case scenarios	Business case for each alternative

5.1 Create As-Is Model

As mentioned in the previous section, our business model development method takes a business engineering perspective. Thus, the first four steps of our method focus on creating a business model that reflects the current state of the business. Therefore, steps one through four create a so-called as-is model.

Step 1: Identify Roles

Identifying the relevant parties or roles involved in a business model should be done as systematically as possible. The business modeler must carry out a stakeholder analysis to identify all roles. The inputs to this step include for example documentation, domain literature, interviews, experience and previous research. The output is a list of roles.

For an example of a stakeholder analysis method, we refer to Pouloudi & Whitley [12]. They provide an interpretive research method for stakeholder analysis aimed at inter-organizational systems. The method consists of the following steps:

1. Identify obvious groups of stakeholders;
2. Contact representatives from these groups;
3. (In-depth) interview them;
4. Revise stakeholder map;
5. Repeat steps two to four, until...

Pouloudi and Whitley do not list the fifth step, but mention that stakeholder analysis is a cumulative and iterative approach. This may cause the number of stakeholders to grow exponentially, and the question remains when to stop. Lack of resources may be a reason to stop the iterative process at some point. Closure would be good, but seems hard to achieve when the model is more complex. Probably, the modeler has to make an arbitrary decision. Nevertheless, one should choose stop criteria (a quantifiable measure of the stakeholder's relevance for the respective business model and a threshold for the measure) before starting the process [11].

For step four, "Revising the stakeholder map", the information on stakeholders as gathered from interviews can be complemented with information found in the literature. The business modeler then refines the list of stakeholders by focusing, aggregating and categorizing.

Step 2: Recognize Relations

The second step of our method aims to discover the relations between roles. The nature of these relations may vary substantially, but it always involves some interaction between two roles and some exchange of value. Much of the work and results from the previous step can be reused as input for this step. In theory, all roles could have relations with all other roles. However, in practice, most roles only have relations with a limited number of other roles. Usually, these relations are captured in a stakeholder map, which often follows a hub-and-spoke pattern, as the focus is on one of the roles. This pattern may be inherent to the approach used, for example if the scope is defined as a maximum distance from the focal or nodal role.

To specify all relations, we suggest the use of a role-relation matrix with all roles on both axes as technique. Within this matrix, the cells point out all possible relations among the roles. Each of the cells could hold one or more relations between two roles. Assuming that roles have a limited number of relations, the role-relation matrix will be partially empty. However, one can question for each empty cell whether a relation is missing or not.

Cells above and below the diagonal can represent the directional character of relations. Usually, relations have a providing and consuming part (above and below the diagonal) but sometimes constructions that are more complex occur, such as loops including multiple roles.

The output of this step is a set of relations.

Step 3: Specify Activities

For a first qualitative specification of the business model, the next step is to determine the main activities. Relations alone are not sufficient: the qualitative model consists of these main business activities (business processes) too. These activities originate from the relations identified in the previous step. Each of the relations in the role-relation matrix consists of at least one interaction between two roles, requiring activities by both roles. Besides work and results from the previous steps, existing process descriptions can be valuable input. Techniques from business process management may be used.

The output from these first three steps is a first qualitative business model, including roles, relations and activities. It reveals what must happen for the business to function properly.

Step 4: Quantify Model

Quantifying the business model helps us to see what is happening in more detail and compare innovations to the current situation. To turn the qualitative model into a quantitative model, numbers are needed. The numbers are costs and volumes of activities (how often they occur). Together, these numbers form a complete view of the costs captured by the business model.

Several sources for costs and volumes are possible, such as accessing accounting systems or (annual) reports.

5.2 Develop To-Be Model

The as-is model, created in previous steps, is suitable for analysis of the current state only. However, from the as-is model, it is possible to derive alternatives. Such alternatives can be created to assess how reorganisations, innovations or other changes influence the business. These are the to-be models.

Step 5: Design Alternatives

From here on, we aim to capture a future state of the business in a business model. To make predictions, the model may need further instantiations. Each instantiation is an alternative development that may happen (to-be). Using techniques such as brainstorming and generating scenarios, business modelers create alternative, qualitative, future business models. These alternatives are used to make predictions. Usually, such alternatives are built around a(n) (technical) innovation. This may include allocating specific roles to various stakeholders. A base alternative, which only continues an existing trend without interventions, may help comparing the innovations. Next to the business model, ideas for innovations serve as input. The resulting alternative business models show future (to-be) possibilities.

Step 6: Analyse Alternatives

The final step for a business modeler is to analyse the alternative business models. Besides the qualitative business models, several sources of input are possible to quantify the alternatives. Applicable techniques include sensitivity analysis, technology assessment, interpolation and using best/worst case scenarios. Each alternative can be tested against several scenarios, in which factors change that are not controllable. We can use the models to predict the impact. This step and the previous one can be repeated several times to achieve the best results. The final output is a business case (including expected loss or profit) for each alternative.

In the next section, we will describe by way of illustration the main results of the application of our business model engineering approach to an e-health service innovation project called Myotel.

6 The Myotel Case

The business modeling case consists of a so-called myofeedback based teletreatment service, aimed at patients with 1) chronic neck shoulder pain or 2) whiplashes – directly in the R&D deployment phase of the service innovation project.

The myofeedback teletreatment system monitors muscle relaxation during daily activities via sensors and actuators implemented in a wearable garment which is connected to a PDA. The system provides continuous feedback when there is too little muscle relaxation. The monitoring data is sent wirelessly – e.g. via a GPRS, UMTS or HSDPA connection – to a back end system which can be accessed by health care professionals. These health care professionals can use the system for optimizing treatment, working more efficiently by saving on face-to-face contact hours with their patients and giving them more personalized feedback as well (see Fig. 1 for a high level architectural overview of the system).

Earlier clinical evaluation studies already proved the clinical effectiveness of the specific treatment [3]. Clinical trials proved a work ability increase during treatment for both the whiplash patients (of whom 68% were employed) and chronic neck shoulder pain patients (of whom 100% were employed) that got treated with the teletreatment service. The work ability concept shows how well workers are able to perform their work [5, 6] – it can be seen as an indicator for employee productivity increase or decrease.

Below, a concise description is given of the results of each of the business modeling steps as described above with a special focus on the “to-be” business models.

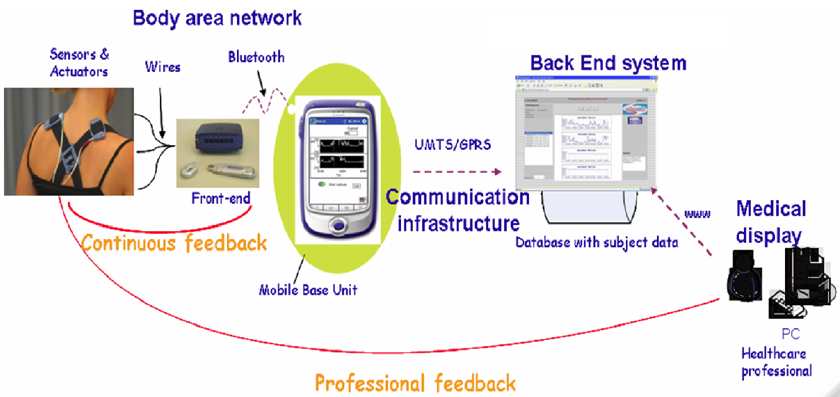

Fig. 1. The teletreatment service.

Step 1: Identify Roles

We organized a half-day business model design workshop for twelve experts within the field of myofeedback and teletreatments from four European countries in which the service could be offered – The Netherlands, Belgium, Sweden and Germany.

Based on the expert workshop, different value network roles and potential actors were identified. A value network role is performed by a specific value network actor who may perform the actual activities in the value network (cf. a specific actor playing a certain role in a movie). All value network roles and possible value network actors as identified can be found in Table 2.

Table 2. Value network roles, actors and activities identified by the experts.

Roles	*Actor*
End user / patient	Therapist patient
Network provider	Telecom operator
Hardware provider (e.g. for communication devices and sensors)	Hardware company
Telerehabilitation (myofeedback) service provider	(Spin-out) company / independent organization
Health care professional	Therapist organization
Software developer	Company
Software platform provider	Company
Insurance company	Company
Employer	(Non) commercial organization
Medical research & development organization	A (group of) medical institution(s) that support(s) the commercial exploitation of the myofeedback service

Step 2: Recognize Relations

By developing a matrix with all value network roles on both the x and y axis, we identified all possible relationships between the roles. This analysis formed the basis for Step 3, defining the activities of the value network roles.

Step 3: Specify Activities

Based on the previous two steps, the experts identified the activities of each value network role that had to be modeled in the quantitative model. Here we especially focused on the most critical, so-called first tier roles as identified by the experts: the service provider, the healthcare provider, the employer and the patient (because of resources limitations and time constraints, we decided not to model the other, less critical roles). According to the experts, these roles would be affected most by the introduction of the new teletreatment service. For these roles, the experts also had to identify the activities that are expected to lead to the most substantial cost and benefit changes. These activities are italicized in Table 3 and modelled in the quantitative model in the next step.

Table 3. Main value network roles, actors and activities identified by the experts.

Role	***Activities***
Myofeedback service provider	*Manage telerehabilitation service (overhead)* *Develop telerehabilitation market (marketing)* *Acquire telerehabilitation customers* *Build back office* *Manage back office* *Build device service* *Manage devices needed for treatment* *Train myofeedback service delivery personnel* Deliver myofeedback service Request reimbursement myofeedback treatment Receive payment for myofeedback service
Healthcare provider	Develop telerehabilitation treatment *Train personnel telerehabilitation treatment* *Diagnose patient* *Consult patient with traditional treatment* *Consult patient with telerehabilitation treatment* Request reimbursement treatment Receive payment for treatment
Employer	*Employ traditionally treated employee* *Employ telerehabilitation treated employee*
Patient	*Undergo traditional treatment* *Undergo telerehabilitation treatment*

Step 4: Quantify Model

Based on the previous steps, we started to develop a quantitative model. We used a traditional activity based costing approach to determine costs of the activities. For each activity we determined the number of times N the activity is carried out and the cost price P per activity. With respect to cost price, we distinguished between investments and yearly costs. Investments are onetime costs e.g. for training and education (needed when new employees get involved) as well as investments for equipment (needed when more devices are needed or old devices are worn out). Examples of yearly costs are costs for personnel and housing. The volume and cost tables are part of a spread sheet that simulates the provisioning of the telerehabilitation service in year *i* from 2008 to 2018. Multiplying N_i and P_i gives the overall costs for year *i* for each activity. The values for N_i are based on an S shaped technology adoption curve [13]. The values for P_i are based on today's market prices that develop over time, i.e., technology prices decline (deflating prices), whereas, e.g., salary costs for professionals increase (inflating prices). This enables Net Present Value calculations over the ten years period as well.

For calculating the costs and benefits of the myofeedback teletreatment service, a so-called variables cockpit was developed. This cockpit gives an overview of the most important variables that influence the costs and volumes as mentioned before and based on which the actual benefit and cost calculations can be made. Important variables in this context are e.g. the hourly cost price of a health care professional, the expected productivity increase resulting from treatment, the number of therapy appointments per treatment and the myofeedback device costs. All figures for the cockpit variables were determined based on results from literature research, medical research results, surveys filled in by and related workshops held with the experts as mentioned before.

Based on these variables, the volumes and costs for each of the activities identified were calculated over the period 2008 – 2018. Because the model was designed in the form of a spread sheet, the model is very flexible: the effects of changing one or more variables can be calculated directly. Based on a different set of cockpit variables for different countries, the model can automatically estimate the expected volumes and costs on a country-by-country level over the period 2008 – 2018. In this way, the model formed a useful tool for evaluating the costs and benefits related to a new service innovation like the telerehabilitation service in direct interaction with field experts.

Step 5: Design Alternatives

Based on the analysis, two alternative business models were developed – one in which the insurance company of the end user or patient would form the main source of revenue (see Fig. 2) and one in which the employer (or its occupational healthcare / disability insurance organization) formed the main source of revenue (see Fig. 3).

Step 6: Analyse Alternatives

The quantitative model as described in Step 4 revealed three critical insights (The related figures as mentioned below show the calculations for the Dutch market. For the other three countries, similar conclusions can be made):

1. The new myofeedback treatment is more expensive compared with traditional treatment – mostly because of IT related investments and operational costs (see Fig. 4).
2. Although the myofeedback treatment is expected to be more efficient compared with the traditional treatment method (less treatment hours are needed), the IT investments are likely to exceed the related labour cost savings on a health care professional level (see Fig. 5).

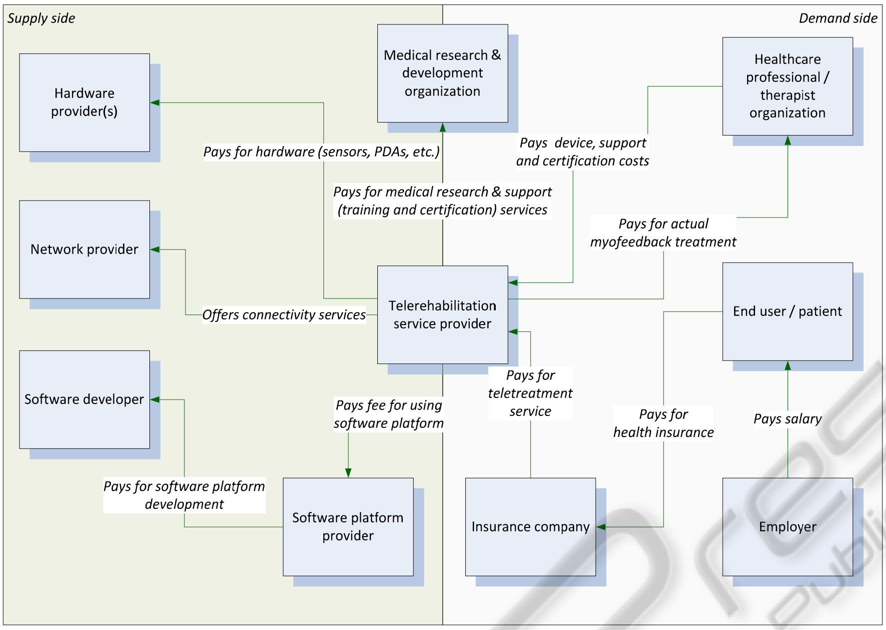

Fig. 2. The first business model design alternative – the end user / patient as revenue source.

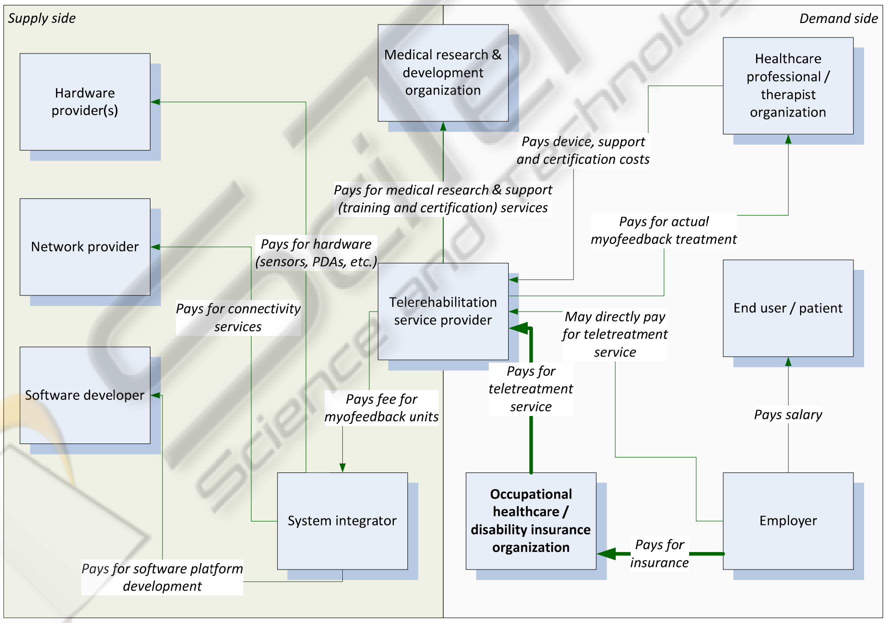

Fig. 3. The second business model design alternative – the employer of the end user / patient as revenue source.

3. However, the expected absence reduction and productivity increase of working myofeedback patients does compensate the investments needed on an employer level (see Fig. 6).

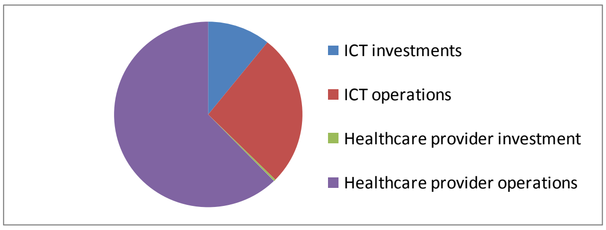

Fig. 4. The cost benefit model showed that the new myofeedback treatment is more expensive than traditional treatment – mainly because of ICT related investments and operational costs; the total costs are expected to increase with about € 100 (from ~€400 to ~€ 500) per patient with chronic neck shoulder problems.

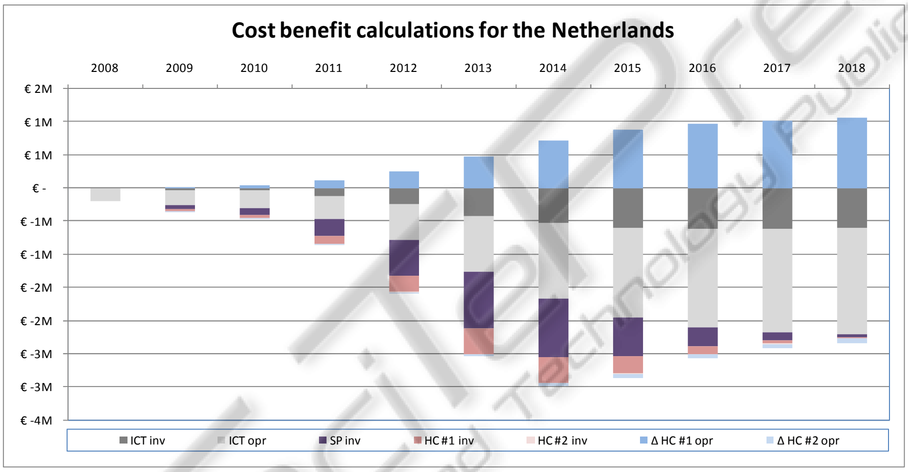

Fig. 5. A graphical overview of the cost benefit analysis in the Netherlands; showing respectively expected ICT investments and ICT operational costs, service provider and health care professional investments and the expected operational benefits/costs for health care professionals.

Based on these three critical insights, we expected the second business model design (where the employer of the end user / patient formed the main source of revenue source; see also Fig. 3) to have a higher viability than the first business model design (where the insurance organization of the patient formed the main source of revenue; see Fig. 2).

The service innovation is expected to deliver a more efficient, less labor-intensive treatment, but these savings do not outweigh the related technological investments and costs (see Fig. 5) – as a result, we don't expect healthcare insurance organizations to be very interested in paying for a new, effective but also more expensive treatment. However, our analysis showed that the service may lead to an absence reduction and productivity increase that is substantially outweighing the related technology costs

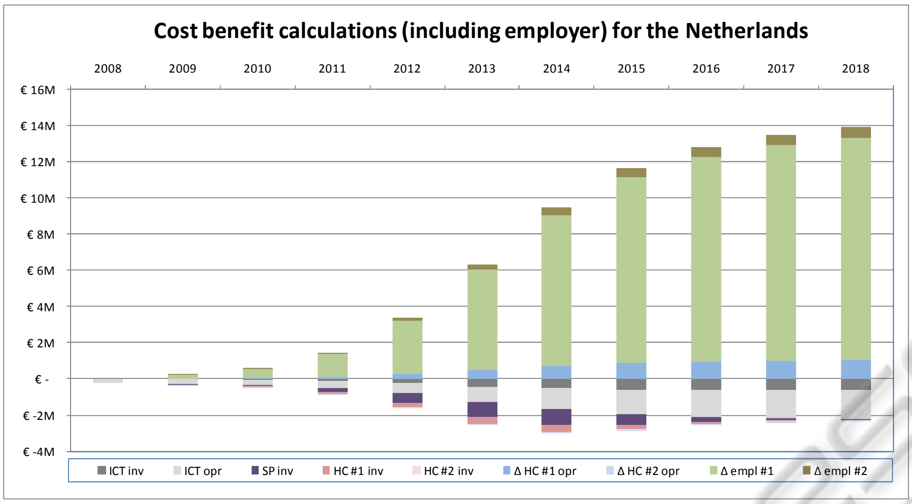

Fig. 6. A graphical overview of the cost benefit analysis in the Netherlands. Compared with Fig. 5, now also the maximum employer benefits related to absence reduction and productivity improvement are shown.

and investments (see Fig. 6). Therefore, employers may be more interested in paying for this new service innovation than healthcare insurance organizations.

7 Conclusions

Three contributions are made in this paper. First, we created a business model development method. Second, we defined the concept of a business model and identified its core elements, captured by the deliverables of the method steps. Finally, we demonstrated the method by means of an illustrative case study from the healthcare domain.

The business modeling method provides a way to create business models. Innovators can apply the steps to systematically create business cases for their ideas. This may help them to show the viability and get service innovations implemented. With our business modeling method, we provided a new design science artefact to use and study for the academic world. As business modeling has several goals, conducting only the first few steps of this method may be sufficient in some cases. For example, if one's goal is to achieve insight in the current state only, the last two steps are not useful.

The business modeling method could be extended further. Situational method engineering seems suitable for this [2]. For example, for information system development, it is interesting to analyse the possible integration of and linkages between enterprise architectures and business model designs. Also, a domain analysis step could be added before the role identification step (each domain requires different improvements). The steps in the method could be further specified and detailed as well. One way of doing this is to tailor the techniques discussed for each of the method steps. In the future, new tools and techniques may also support partial automation of the steps.

In general, we expect that by using our method for early stage business modeling the quality of the service innovation business models may be substantially improved. By early stage interaction with the more technology oriented activities within a service innovation project, we think our approach can play a critical role in maximizing the added value of the project outcome.

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