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An Integrated Approach for eHealth Service Engineering

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Abstract: To plan and implement eHealth services, medical and accompanying services on the one hand and information technologies on the other must be integrated. In this paper, an integrated approach for ehealth service engineering, based on an analysis of state-of-the art methods from the disciplines of service engineering and IT planning and deployment, is developed. This approach is then applied to the development of an eHealth solution for the acquisition and treatment of international patients and evaluated within the research project "Medical Export".

Keywords: eHealth, Service Engineering, Planning and Deployment of Information Technology, Medical Export

1. Introduction

eHealth services are based on two main pillars, medical services and information technology. This paper argues for an integrated approach of medical service engineering and the development of IT-solutions for designing and implementing successful eHealth solutions. The proposed model is based on state-of-the-art research in service engineering and information technology management. Including strategic objectives of medical service providers as well as the potentials of information technologies, this approach bridges the gap between both pillars. The theoretical framework is applied to the development of medical services for international patients travelling to German hospitals for treatment.

The paper is based on the findings of the research project "Medical Export - Technology enhanced internationalisation of medical services for patients from abroad", co-ordinated by the Research Institute for Operations Management (FIR) with a high quality 13 partner consortium (among other Siemens Medical Solutions as well as 7 German health care institutions with a total of 10 hospitals and clinics) funded by the German Ministry of Education and Research (project duration: 10/2005-03/2009, Grant Number: 01HQ0535). The project Medical Export aims to develop appropriate organisational approaches and suitable technological solutions for supporting hospitals and clinics in marketing and acquisition, transport and admission and discharge of international patients. The supported process steps within the reference model of international patient's handling are given in Image 1.

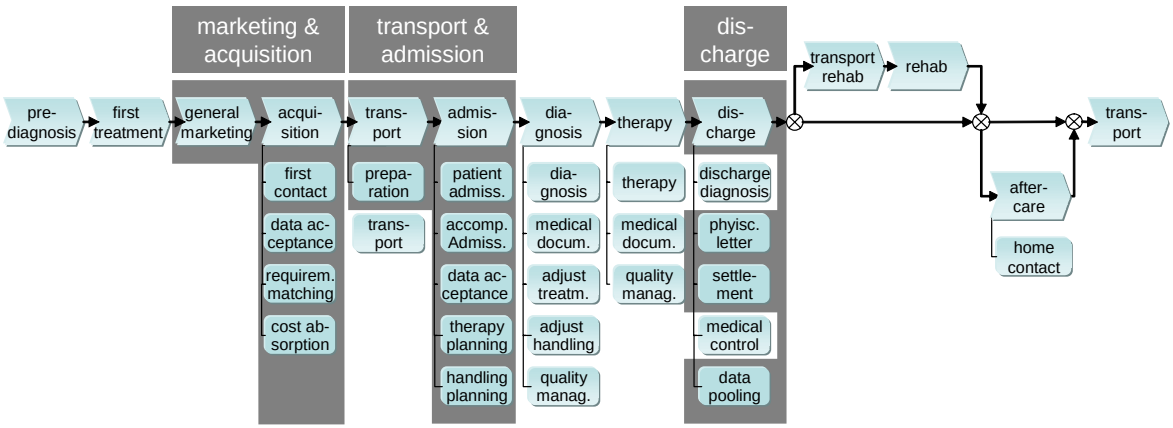

Image 1: Reference Process and Project Focus

2. Objectives

The objective of this paper is to present an integrated approach for eHealth service engineering. The successful implementation of eServices in the medical sector asks for a continuous synchronisation and coordination of processes for planning and development in the areas of service engineering and information technology. Building on an analysis of state-of the art methods from both disciplines, an integrated model for the design of eHealth services will be developed and applied to the development of a platform for the acquisition and treatment of international patients.

3. Methodology

The methodology was chosen to fit the above-mentioned objectives. The procedure to develop the integrated model can be classified as an applied sciences procedure according to Ulrich [1] and Yin [2]. The focus of the procedure was the assessment of experience problems, their resolution and practical validation. The phase problem detection was implemented by conducting interviews with project partners and experts, enriched by literature review. As a result, the need for an integrated approach for eHealth Service Engineering could be identified. This demand was met by developing a new model, based on desk research and deductive model development. The developed model was validated by case study design an execution. In total, eight interviews were performed, several models of different fields analysed and recombined and seven case studies conducted.

4. Developments

The above-mentioned three steps of the methodology were applied in four different steps of developments described below. First, a requirements analysis for eHealth Services was conducted. Secondly, current models for service engineering and information technology planning and deployment were analysed to match them with the requirements. The models were judged upon their strengths and weaknesses in order to derive models showing matters of strategy and organisation for information technology and service development. In a third step, the different approaches were integrated into a model that could be transferred into the medical sector. Fourth, the developed model is applied to the specific requirements of the current project to enable the final validation. This validation was conducted through several case studies carried out by patients, patient managers, IT-staff and administrative staff at hospitals bounded in the project “Medical Export”.

4.1 Requirements for the Planning of eHealth Services

Derived from the definition of medical service and planning of services in general, the following requirements could be identified as essential for a successful implementation. Due to strong interconnections between service processes and deployed IT, the planning of services and IT to support these services must be integrated. As the healthcare sector is becoming more competitive globally, this requirement is reinforced by the need of a shorter time-to-market for products and services. The planned items must be reduced in complexity to make them applicable for every medical service provider. Along with the simplicity of the model itself, it has to be practicably applicable and easy in implementation.

4.2 State-of-the-Art

Current models have not yet met the requirements of connecting the idea of services and IT on all organizational and strategic levels of a (health) service providing institution but support the user when implementing either services or information technology. To build an integrated model that combines service engineering and information technology into one systematic approach, current models in both sectors are analysed separately. This will enables the deduction of necessary steps for establishing eHealth Services.

4.2.1 Current Models in the Area of Service Engineering

An approach that covers the process of service engineering from the first idea of service to the final product was introduced by Bullinger [3], who developed a framework for the engineering of services allowing space for individual preferences in the area of potentials, processes, results and markets.

The model structures the process of service engineering into six different phases following one another in a circular manner. While all phases do not have to be passed through in a certain manner, rebounds are used to keep the process up to date and react to changing demands. By running through the process several times, new aspects will be added to the spectrum of the service while adapting old partial concepts and adjusting them to changing structures. The model enables the user to structure the task in several aspects while giving just a rough overview over many fields of activity.

Knowing about the necessary steps for establishing a service idea, managing the process in order to reduce the time to market should be another focus.

The funnel model described by Sontow [4] reduces an initially broad spectrum of influencing factors by systematically adding relevant criteria that need to be fulfilled by the service to be developed. The outcome is a more detailed, content-wise more specific choice of services, where the end of the funnel reflects the result being a positive selection of thoughts, potentials, possible customers, competitors and operative range. This leaves the user with freedom of choice in the area of content, time and systematic approach stating which crucial demands should be recognized throughout the whole process.

In order to keep track of the demands influencing the process of service, Sontow [4] further concretized his model and split the process into five steps, starting the algorithm with a project installation that defines the objective and framework of the project. In addition a team of decision makers is identified who coordinate upcoming tasks and monitor results and deadlines. The model thus enables users to follow the process and keep track on upcoming tasks. A representation of the model is given in Image 2.

Taking a look at the potentials and resources available at the site of the service provider, as suggested by Luczak [5], will help reduce the complexity of service engineering. For that purpose, he developed two different strategies for service engineering using a market driven and a potential driven approach. The objective is to deliver a profitable and future-oriented service that fits the customer needs while taking advantage of the provider’s potentials.

Necessary steps include an analysis of potentials in order to identify capacity and capability of the provider as well as a market analysis to identify customers' needs and problems.

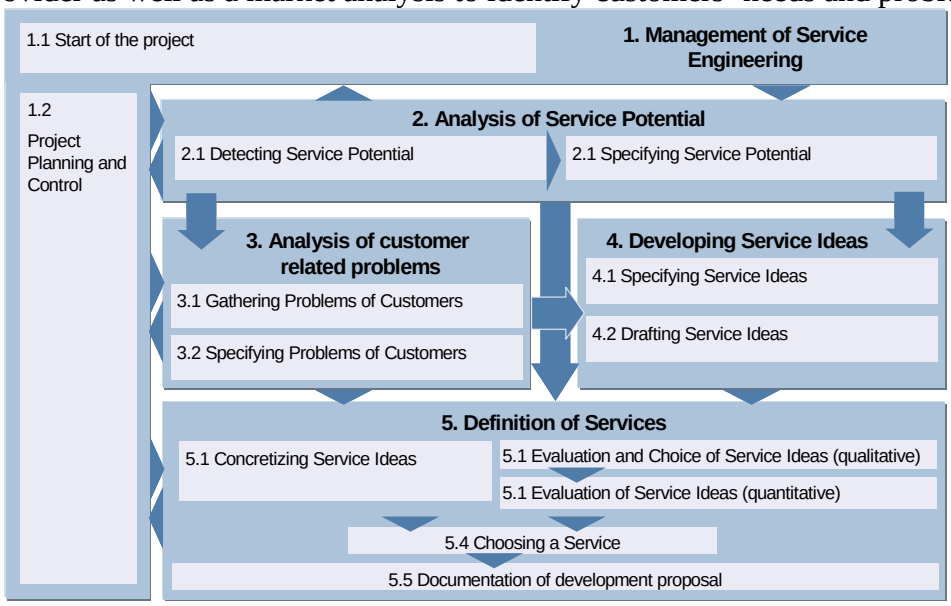

Image 2: Service Engineering Model by Sontow [2]

In comparison to the above mentioned, this model does not show developing steps beyond the process of defining a service solution, but delivers a differentiation of market oriented or potential oriented service engineering. As a consequence, large institutions should focus on the needs of the market, while for less wealthy institutions (as clinics and hospitals) the potential driven service engineering is much more feasible.
All of the above analysed models show different systematic approaches in the area of service engineering. Nevertheless, no interface to information technology use could be identified. Also, there is no explicit transfer to the medical sector.

4.2.2 Current Models for Planning and Developing Information Technologies

Just like the models for the development of service engineering, information technology models were analysed according to their structure, but also according their applicability to service engineering. Summarising, the models focus either on IT-architecture or provide a checklist for successful IT-projects.

IT models like the architecture pyramid of Dern [6] or the holistic information system architecture (ISA) of Krcmar [7] mainly display how information technology fits in the corporate strategy. They do not focus on how to develop an IT solution. While the architecture pyramid passes through business architecture to break down corporate strategy into IT infrastructure, information architecture and IT architecture, the ISA model defines less but more complex levels of specification. In addition, ISA builds up infrastructure as an antithesis to corporate strategy on the side of information technology.

To get a broader view on the structure of an IT system that efficiently delivers data for operational functions, the architecture model for integrated information systems (ARIS) by Scheer [8] was reviewed. He splits the model in five different descriptive views, of which each consists of three sub-levels. This model enables a complex interpretation and modulation of every element without the need to rethink or redo the whole concept. Though variance of separate elements is a big plus, the model lacks in lining up corporate strategy and IT structure as described in the architecture pyramid or ISA-model.

One model that brings together the needs of customers and information technology providers is described by the ITIL-Framework [9]. The model focuses on best practices for users and puts special emphasis on aspects of security of IT systems while showing

interfaces between customers and information technology providers through IT processes. All aspects from planning over initial operation and management of operation to technical support through research and development as well as technical service are mapped by the model. Therefore, the model already focuses on the needs of a customer (e.g. a services provider), but it does not align this view with the strategic orientation of a company.

Since the definition of IT architecture and its implementation are not as precisely described as for service engineering, two more models are analysed that could help judging information technology in order to gain more information about IT architecture.

The IS Management Processes were developed by IBM [7] as a framework and checklist for successful IT projects and the Cobit Framework that is even constantly advanced [9]. Cobit is supposed to support companies at matters of organisation, control and quality management in the area of information management, allocation of systems and technology. Starting from corporate objectives, IT goals are defined which then are assigned to single areas that build up IT architecture.

All these models of information technology have in common that they define IT architecture based on the service, the IT is supposed to fulfil. Still, none of them delivers necessary interfaces for an integrated model of service engineering (of services additional to the IT service itself) and information technology.

4.3 An Integrated Approach for IT-Supported Service Engineering

Despite the interdependencies between medical services and information technologies, their planning processes are usually separated. This leads to more complexity in the process of planning and enhances the time to market. In order to take advantage of the potentials of medical services and information technologies, the separate models were combined into an integrated intermediate service model.

All models – either for service engineering or for information technology development – lack of interfaces for merging them into one integrated model. Furthermore, the IT has to be considered as a supporting tool for service engineering and not as an end in itself. Finally, the integrated model is supposed to be simple, but applicable to reality. In combination, these requirements for the integrated approach rather ask for a new approach then for an adjustment of an existing model. Still, adequate components should be adopted. E.g. the separation between service engineering and IT-service development should still be visible, and both, strategic an operational view, should be included.

To fulfil all these requirements, Bleck's fourfold table model [10], [11], 0 was chosen as a basis, that beared originally on intermediary information services in electronic business. It consists of a fourfold table that divides the separate models of service engineering and information technology into a strategic and operative level each. Further, the interdependences of each level within the four fields are described.

In the current project, this fragmentation was re-evaluated and the whole model applied to the sector of IT-supported medical service engineering. Further, the interdependencies between all levels were re-modelled according to the above mentioned requirements of combining medical services and information technologies to deliver an integrated approach for the planning of eHealth Services. The model consisting of these fields and interconnections are shown as the core of Image 3.

The planning process for eHealth services is dominated by "Top-down" relationships as these medical services are highly innovative and demand a high technological input. This objective asks for a complex strategic management. Still, "Bottom-up" relationships need to be established to plan services that started out less innovative but entered a field of growing interest and upcoming technologies to improve medical treatment.

The main feature of the integrated model is the interconnectivity of medical services and information technology especially on the lower levels of the operative sector. While the

planning process of information technology is at the most part influenced by strategic decisions of the service provider, IT Value and IT required actions directly influence the shape of the offered medical service. Vice versa medical services demand certain IT solutions to be planned and developed in order to offer them to foreign patients.

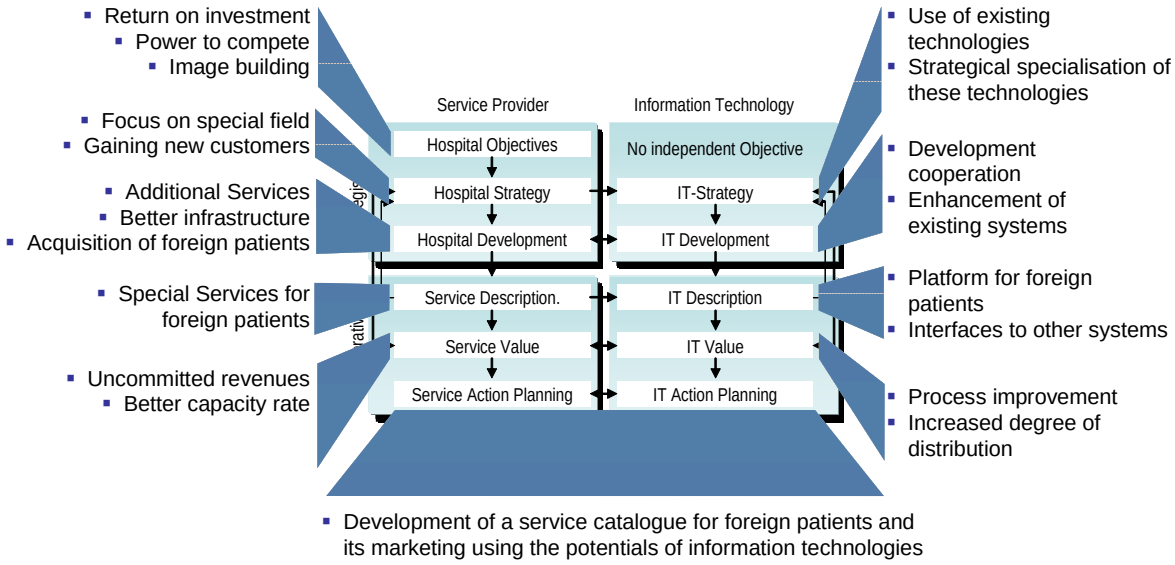

Image 3: Integrated Model for eHealth Service Engineering, Additional Application to the Project Focus

The integrated planning methodology covers all relevant properties of medical service, information technology and the complex interdependencies between them. E.g. the whole development process is depending on the overall hospitals objectives. Apparently, there are no overall IT objectives, as the IT cannot be an objective on its own. Nevertheless, while information technology is dependent on the medical service to be developed, general IT developments and potentials can influence the engineering of medical services. This is due to restrictions at the implementation of services with means of IT. Further, the operational and strategic levels of both – service provider and information technology – influence each other in certain directions. In total, the model gives all possible interactions, and therefore interfaces between Service Engineering and Information Technology Use.

4.4 Applying the Model to the Development of an IT-Platform for the Acquisition and Treatment of International Patients

The whole model was consequently applied to the requirements developed within the project “Medical Export”. This application is displayed in the outer areas of Image 3. The comments show, that the IT strategy is derived from the institution-wide strategy of increasing the return on investment. This can be done by attracting new customers e.g. from abroad, whose payments are not a priori committed. The services provided on the operational level are therefore situated in the special area of medical services, adding more complexity to demanded IT solutions. From an operative point of view, the developed IT-tool has also to be seen in the delicate context of medicine resp. of attracting new (international) customers. Planning IT solutions for medical service providers therefore implies in many cases the development of new IT solutions. These solutions have to fit the already existing technologies and could be developed in (hospital-) cooperation for cost saving. For the development itself, the above described information technology models in turn can be used. The described model was and still is applied to all hospitals and clinics participating in the project “Medical Export”. It is used for supporting patient managers who coordinate medical services offered to foreign patients. The integrated model was first validated in expert discussions and furthermore applied to each hospital’s service strategies.

Within the project, an IT-platform supporting the handling of international patients has been developed according to the default of the model. Certain medical services were developed based on new IT solutions, which were integrated in the IT-platform.

The expert group rated the model as very helpful for the planning of an eHealth platform and the outcome of the above described application in the case studies showed good results. The developed integrated intermediate service model can therefore be seen as a framework for eHealth Service Engineering and could be further specialised by applying the above mentioned and further models of service engineering and information technology to the particular needs.

5. Conclusions and Outlook

Developing an integrated approach for eHealth service engineering is the objective of this paper, to enable the use of potentials of information technologies in order to push forward services in the medical sector and support clinics at managing foreign patients. Therefore, requirements for a successful implementation of eHealth services were defined. Hitherto, existing models for service engineering or information technology were analysed to find interdependencies and points of contact. In a next step these models were combined to an integrated intermediate service model that showed interdependencies between the specified fields in the area of medical service and information technology. This model was applied to the handling of international patients and validated in project case studies.

The integrated approach for eHealth Service Planning gives a sustainable opportunity to combine the strategies and operations of medical service providers with their IT-assessment and offers a tool for planning an eHealth platform. Case studies at the hospitals bound in the project “Medical Export” showed good results and suggest the model could be easily transferred to other fields of eHealth services, e. g. for the development of Teleservices.

References

[1] Ulrich, Hans, Die Betriebswirtschaftslehre als anwendungsorientierte Sozialwissenschaft, in M. N. Geist; R. Köhler „Die Führung des Betriebs“, Poeschel, Stuttgart, 1981, S. 1-25

[2] Yin, Robert K., Case Study Research. Design and Methods, Sage Publications, Thousand Oaks, 2000

[3] Bullinger, Hans-Jörg; Schreiner, Peter, Ein Rahmenkonzept für die systematische Entwicklung von Dienstleistungen, in Hans-Jörg Bullinger "Service Engineering : Entwicklung und Gestaltung innovativer Dienstleistungen", Springer, Berlin, 2003, S. 67

[4] Sontow, Karsten, Dienstleistungsplanung in Unternehmen des Maschinen- und Anlagenbaus, Shaker, Aachen, 2000

[5] Luczak, Holger; Wildemann, Horst, Service Engineering: der systematische Weg von der Idee zum Leistungsangebot, TCW Transfer-Centrum, München, 2000

[6] Dern, Gernot, Management von IT-Architekturen: Informationssysteme im Fokus von Architekturplanung und -entwicklung, Vieweg, Wiesbaden, 2003

[7] Krcmar, H., Management der Informationsverarbeitung - Architektur und Überblick, in IBM (Deutschland) "Information Systems Management", 1, 1988

[8] [Scheer, August-Wilhelm, Architektur integrierter Informationssysteme: Grundlagen der Unternehmensmodellierung, Springer, Berlin [u.a.], 1992

[9] Hochstein, A.; Hunziker, A., Serviceorientierte Modelle des IT-Managements, HMD Praxis der Wirtschaftsinformatik, 232, 2003, S. 45-56

[10] Bleck, Stefan, Entwicklung einer Methodik zur integrierten Planung von Informationstechnologie-Einsatz und intermediären Informationsdienstleistungen im elektronischen Geschäftsverkehr, Shaker, Aachen, 2004

[11] Bleck, Stefan; Quadt, S., Planning and employment of information and communication technologies in the field of intermediary services, 2002, Proceedings of the 6th international Conference on Work With Display Units, Bertesgaden

[12] Luczak, Holger; Bleck, Stefan; Quadt, S., Electronic business engineering – exploiting the potentials of a wireless world, International journal of internet and enterprise management, 1, 1, 2003