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Emerging Markets Queries in Finance and Business

Business Models for the Internet of Things Environment

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Abstract

Over the past few years, the widespread use of the Internet and rapid development of Internet-based technologies has resulted also into shorter life cycles of product and services, requiring thus faster changing business models. This paper provides an overview of business models for Internet of Things, Services and People applications. The concept of the Internet of Things and Services envisions physical devices and appliances to be used as easily as a web service and seamlessly integrated into networked applications with required functionality. Technologically this concept is clear, and several smart applications are currently under development (see e.g. iCore, Hydra, Confidence or IoT@Work projects). However, the business perspective of information as an asset in its own right remains an open issue. To handle this issue we apply an originally value-based requirement technique, e3-value, to model value creation and value exchange within an e-business network of multiple business actors. Using this approach the business activity can be reduced to its core elements, which in the simplest case comprise the value proposition, distribution channels and the customers of the company, explaining how a multi-actor network creates, distributes and consumes value by production of a good or providing a service.

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Keywords: Internet of Things; business model; e3-value; requirement management;

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1. Introduction

In the last decades science and technology have experienced an impressive advance and many new business opportunities emerged in different enterprise environments. The introduction of new technologies like radio-frequency identification and smart computing has enabled many new application and business propositions in the business systems and domains like logistics, manufacturing and production, industrial automation, environment, transport, maintenance, health-care, services etc. New classes of applications combining virtual and physical world information from users, data repositories, devices and sensors into intelligent services have emerged as mentioned also by Thestrup et al., 2006.

This world-wide network of interconnected objects uniquely addressable, interoperable, and based on standard communication protocols is called "The Internet of Things" (IoT) or "Pervasive Computing". The term IoT was coined more than 10 years ago by Ashton, 2009 and Brock, 2001, but came into limelight in 2005 when the ITU, 2005 published the first report on the subject. It enables to connect everyday objects and devise for online communication between people and things and between things themselves, based on embedded smart wireless sensors and identification technologies. In this way active participants can share information with other members of the network or with any other stakeholder in their surroundings and of acting and reacting autonomously in an appropriate manner. According to Smith, 2012 there is an enormous effort to create a smart world through the research and development (R&D). A world where the real, digital and the virtual are converging to create smart environments that make energy, transport, manufacturing and many other areas more intelligent. According to Harbor Research, 2011 two major technology developments at the begin of the 21st Century emerged that appear now to be on a path of convergence – The Internet of Things and The Internet of People or more familiar social networking (Web 2.0). We can also see the enormous value that can be derived from collaboration on the Internet now. As the Harbor Research expects in the long run any manufactured object, which possesses inherent data processing capability, has potential to be networked. Such "invisible" machine-to-machine (M2M) applications will create many new automated services. These services will be much more important to business and to the whole economy.

These new inventions have change the way how products and services are marketed and distributed. These changes have affected the traditional business models and led to a series of new types of models. Alt and Zbornik, 2002 defines a typical business transaction through a physical product, information stream, and money stream. The product stream includes order processing from procurement via storage and production to distribution of products to the customer. The information stream includes processes, such as order processing, supply chain and product life cycle data sharing. The IoT may be seen as an approach to align these different streams. It provides a higher level of visibility and control mechanism. In the IoT, information itself may become a major source for value creation and thus also for the value proposition. Traditionally, the money stream is exclusively dependent on the product stream prices as mentioned in Andrejovska, 2011. A separate price for the information is not defined. Instead, information is most often expected to be free of charge. It is obvious that costs of information are hidden in the product price. However, the reluctance to pay for information may change over time.

2. Business Model and Its Application in Internet of Things Environment

The expression "business model" is frequently used in research and practice, a common definition is missing as mentioned in Morris et al., 2005. Probably the most cited definition can be found in Timmers, 1998, who defines a business model as "an architecture of products, services and information flows…", what includes the involved actors and their roles as well as the potential value created for all participants and the sourced of revenue. Negelmann, 2001 provides another definition, where "a business model defines and structures the fundamental way and form of the aspired added value of a firm. It contains the description of the exchange

processes, the roles of the participants, the profits for business partners as well as the revenue sources to be realised.“ A firm with a strong business model has much better foundation for understanding the challenges of the IoT environment and sharing its understanding among stakeholders. Mapping and using business models facilitates change, because designers can easily modify certain elements of an existing model and simulate new businesses. This is a way of undertaking risk free experiments, without endangering an organisation. A business model is thus an abstract (or exemplary) description of a company's entrepreneurial activity. Using the aforementioned definitions of business model, we use a notion of business model as an abstraction of the complexity of a company by reducing it to its core elements and their interrelations, which facilitates the analysis and the description of business activities. Also the business model description is an important and starting point for business innovation and transformation, so that it can serve as means to align technology development and economic value creation, as mentioned in Chesbrough and Rosenbloom, 2002. Business model in regard of the IoT can be seen as a major element to unite its technical developments with its economical business perspective.

Osterwalder and Pigneur, 2010 proposed the following definition of "business model": "A business model describes the rationale of how an organization creates, delivers, and captures value". According to de Man, 2012 a business model is a description of the rationale of creating value, or, as a part of it, making money. But this description does normally not take the form of a structure model. Osterwalder and Pigneur, 2010, Johnson et al., 2008, Gordijn, 2002, and other, introduced frameworks to describe business models, which are merely mental models to thing about business models. The business modeling community is the community of people and practitioners that are involved with process and service innovation. De Man, 2012 discusses the business modeling community has not been able to model how processes and services contribute to "the business", e.g. how processes contribute to value, how value is exchanged and consumed. The engineering representation reaches as far as is required to automate orchestration and choreography of processes, very well described in Weske, 2007, and so-far had a technical focus. So the rationale of how an organization creates, delivers, and captures value cannot be analyzed and design in the same way how processes and services are analyzed and designed. The NEFFICS consortium developed a structured modeling approach, based on so-called "value delivery models". De Man, 2012 explains the value delivery modeling is about creating value delivery models, whereby a value delivery model is "a model that support business analysis and design based on evaluation of performance and stakeholder satisfaction achieved through the activities and interactions of people and organisations using capabilities to apply resources and deliver stakeholder values". A value delivery model can serve to bridge gap between structured representation (processes in process models), and high-level abstractions of business models in business model frameworks. So the value delivery model can be motived by business values, support business models, and also be basis for discovery of processes and service models.

2.1. Business Model Elements and Frameworks

According to Pigneur, 2005 the basic questions to be answered in the business model are the fundamental questions of any business: What do we offer to the customer, who are they and how do we operate to deliver the product or service so that we can create a profitable and sustainable business? In other words, we need to identify and analyse the value proposition in the intended IoT based service, to which customer group the service is targeted and how we organise ourselves to deliver the service in the most efficient way. These three steps are performed have a great impact on the choice of modelling approach to be taken. When the three questions have been answered, we can easily analyse the revenue streams and cost models and derive the financial return and thus evaluate the sustainability of the proposed business. The value proposition is an overall view of a firm's bundle of products and services that together represent a value for its customer. As

discussed in Gordijn, 2002 an important reason for the failure of many e-business ideas over the years is the lack of a sound value proposition to customers.

From our perspective, the business model can take two very different approaches: The value model (or mental models) and the process model (also called structural model). Value modelling focuses on value creation; how value is created, by whom and for whom. It is thus foremost a strategic tool with the aim of identifying new business opportunities and how the firm can position itself strategically to derive maximum benefits from new and emerging opportunities, which may or may not require substantial redefinition of the enterprise infrastructure. Process modelling is in many ways different from value modelling. Process modelling refers to modelling the firm's business procedures. One possible use of a process model is to prescribe how things should be done in contrast to the process itself, which is really what happens. The process models are thus best suited to provide an architectural overview in the implementation of business strategies in established infrastructures.

3. Exploration of Internet of Things Business Ideas

Usually two approaches are traditionally used in the initial phase of business idea exploration, which are less informal than natural language, which have a graphical representation, and which are lightweight. These are the value chain approach as suggested by Porter and Millar, 1985 and value maps by Tapscott et al., 2000. However the value chain approach misses accurate power of expressiveness as discussed in Gordijn, 2002. It is not visible who is exchanging objects of value with whom. A value system also does not represent the objects of value themselves and does not recognize the notion of economic reciprocity. It only shows the sequence of value adding processes. To summarize, there is no way of assigning economic value to an object, which in turn is needed to assess profitability for actors and it is not possible to show bundling, so with a value chain picture, we cannot communicate partnerships. Unfortunately there is also a limitation with various stakeholder perspectives, which value maps do not distinguish very well, because there is no explicit focus on valuable objects as discussed in Gordijn, 2002. Gordijn, 2002 proposed a lightweight, graphical, model-based, multi-viewpoint, economic value aware, and scenario-based approach to explore, specify and validate innovative ideas in e-commerce. He has also put focus on developing a value viewpoint considering a requirement engineering perspective expandable on the business processes and information system viewpoints.

3.1. New Business Modeling Approach in the IoT

A major challenge for Internet of Things (IoT) projects in realizing the business potential is seen in the integration of multiple businesses operating in collaborative environments. There we should focus on analyzing the business system and its stakeholders. There are many innovative IoT projects starting with rather unclear or unfocussed development track. There is another important question, whether so many of projects' ideas are likely to be profitable. From this point of view, there is no problem with a new pervasive information system development; there is a problem with its combination with a new value proposition in the way that the innovative idea is clear to all stakeholders and allows their own assessment from profitability (economic feasibility) and technological feasibility perspective. We can also talk about value-added application services which are solutions that can integrate people, business processes and assets and are delivered as managed services. A service like Tele-HealthCare monitoring, can be seen in Figure 1 - the service provider or provider of a platform will analyze the service proposition together with a potential customer. The analysis must be performed quickly and often with an imperfect or partly unknown data, which is subject to frequent update. The analysis must provide answers to the following questions:

- Is the service feasible in terms of value proposition to the customer and to the end-users?
- Is the service overall profitable and has it a positive cost/benefit ratio?

- Is the global profitability fairly distributed on all the involved actors?
- Is the intended service feasible in terms of usability (scenario implementation)?
- Is the service easily understood and acceptable to all stakeholders?

In order to provide the answers to these questions we use requirement engineering as a process of developing requirements through an iterative and co-operative process of analyzing the problem as it was suggested by Gordijn, 2002 and Gordijn et al., 2003. The requirement engineering and conceptual modeling approach help us clear express, analyze, find, represent, validate and evaluate a current or a new value proposition. The motivation is modeling value proposition explicitly and so to contribute to a common understanding of the proposition by all stakeholders but especially stakeholders with technological knowledge or information technology interest. We hope that a conceptual value proposition model may help to understand the IoT ideas. It is much more about developing a business and technical framework for the sale of information products or services (how to explore and represent such a framework using requirements engineering and conceptual modeling techniques). e3-value ontology consists of a number of generic concepts, their relations, and rule on which a group of stakeholders reasonably can agree.

Following the methodology of e3-value three viewpoints will be created - the value viewpoint, the business process viewpoint, and the information system viewpoint. As that already has been mentioned above the methodology was presented and well described by Gordijn. Gordijn has suggested to apply the following steps in iterative manner:

Step 1: Have an e-commerce idea. The question is how to come from an innovative idea to one or more value models.

Step 2: Construct value model. The model should involve actors, object/-s of value created, distributed and consumed by the actors involved. It is baseline for finding alternatives as well as for evaluation. Value models are expressed applying e3-value concepts and scenario paths.

Step 3: Reconstruct or deconstruct a value model. Finding variations or searching for other value models (instead of previous models). Using deconstruction we split a value model into smaller parts, and reconstruction composes these parts in different ways. Value model, Value operational scenarios, Profitability sheet: revenue and expense perspective will be created and analyzed.

Step 4: Construct process and information system view. Develop other viewpoints: process viewpoint and information system viewpoint, where a number of viewpoints has to be explored, whereby the other viewpoints are explored only in relation to the value viewpoint.

Step 5: Evaluate e-commerce idea finishing in question of profitability (Is the idea profitable?)

Step 6: If profitable, than executive decision making takes place. Other way the process will be stopped or restarted again.

The whole methodology is then applicable in specific use case. Especially the second step is in focus because the value-model is being created there. e3-value modeling tool is a lightweight approach to carry out the value analysis in a limited timeframe; an economic value aware approach to capture and evaluate a value proposition; a multi-viewpoint approach to deal with a wide range of stakeholders; a graphical conceptual modeling approach to create a common understanding and rapid evaluation and value analysis of the e-Business idea with frequent updates to the underlying data foundation; a scenario approach to create a common understanding of an e-Business idea, to capture and present a value proposition; an instrument for evaluation the usability of the e-Business idea. The e3-value methodology has proven to be very useful for the exploration of e-Business ideas, because it can be easily communicated to business oriented stakeholders in order to enhance the common understanding of the idea. It has an ontological approach that specifies generic terms and definitions for important concepts and provides a vocabulary for the language used to handle information and operational data in scenarios. The e3-value ontology is organized in viewpoints, where actors exchange objects of value. The value exchange can be analyzed in terms of value proposition and profitability. The challenge is

to identify exactly what is the value in applications and what kind of value exchange can be expected in order to provide a real value proposition to actors.

3.2. Adapting e3-value Methodology with Focus on Value Model in Health Care Domain

The healthcare industry is also undergoing fundamental changes; one of the more important trends is self-management of chronic diseases. Especially the remote monitoring that can be divided into TeleHealth and TeleCare can generate significant improvement in life quality of an individual and also in effectiveness of the health care system (for evidence from Slovakia see Glova and Gavurova, 2012). Social networks and sensors networks can be combined to support independent living and health support for the sick and elderly. For daily living purposes, we can check the status of friends and relatives or help the elderly find nearby walking buddies to promote mobility. By using semantic representations of information from sensors, we can build on the idea of connecting people through shared activities and interests. More importantly, we can send alerts based on abnormal activity patterns. Through sensor readings of body position or health measurements, we can issue requests for attention not just to doctors or clinicians but to nearby friends in the elder's social network.

Numerous medical devices are now available which allows personal monitoring of vital signs like heart rate, blood pressure, glucose level, weight etc. The Internet of Things fits in well in these scenarios, where data is captured remotely by wireless devices and needs to be sent securely to some central service or hospital. Body-worn sensors, and body-area networks can be implemented using The Internet of Things to achieve closed-loop feedback systems for instance for continuous glucose monitoring, see figure. A difference between Machine-To-Machine (M2M) applications and personal health monitoring applications is that in personal health applications the devices are either wired or often based on short range radio technology like Bluetooth and ZigBee, as opposed to the GPRS/GSM-based devices which are the focus of M2M. This means that "the last mile" is usually not Internet-based communication. TeleCare usually refers to support elderly people to live independently at home by using devices and sensors such as fall detectors, movement sensor, and activity hubs. By using IoT technologies, TeleCare solutions can be efficiently implemented using open standard technologies, as opposed to previous vendor specific hardware and software solutions, that are incompatible with each other.

By adopting the ontology consistently over the business landscape, a complete value model can be developed. The e3-value method also allows for a complete mapping of dynamic value constellations, which again will form the foundation for the business cases. New models of business constellations will be explored including dynamic enterprise partnerships bringing together business partners in new constellations. Special emphasis will be placed on how to maintain ownership of data and share proprietary information across organizational barriers and secure handling of the flow of information and intellectual property. The business system can be seen hierarchical structure with four value levels. At each level, selected actors and stakeholders will been identified for further analysis:

- The Concept Owner licenses the right to use the concept to one or more industrial enterprises or service providers. The Concept Owner develops the concept in a suitable form, for end-to-end solutions in specific domain. In dedicated (proprietary) applications, concept owners may be found among industrial enterprises or organisations. In open systems, concept owners can be Service Providers providing cloud services to enterprises (see the Service Provider of Tele-HealthCare monitoring environment at the bottom of the Figure 1).

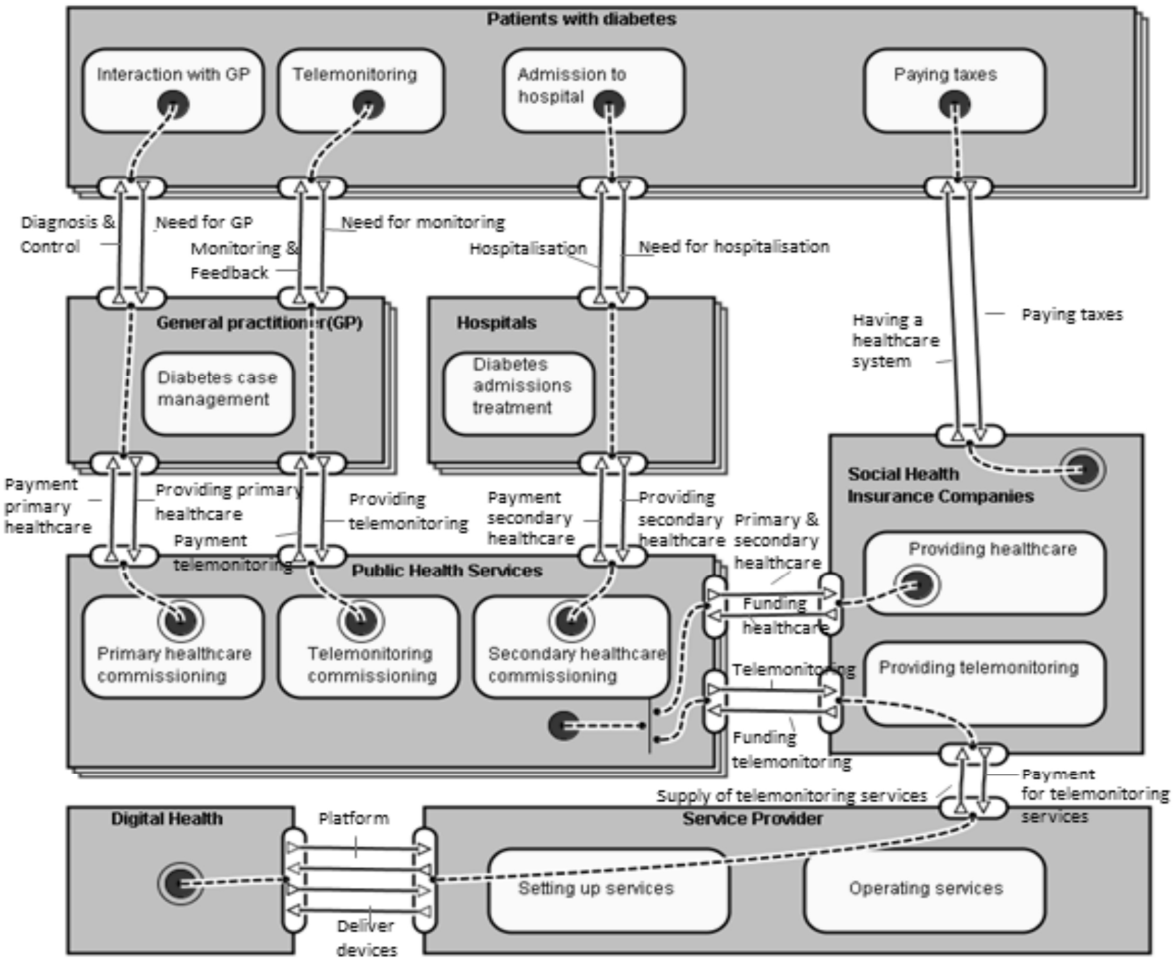

Fig. 1 Example of Value Model for a Tele-HealthCare System (worked out in e3-value editor)

- The Service Providers are organisations that establish the commercial platform and offer applications to enterprises or organisations as SaaS (Software as a Service), PaaS (Platform as a Servicer) or event IaaS (Infrastructure as a Service). The Service Providers may define his own revenue model which will reflect the value created for business stakeholders like patient, Social Health Insurance
- Business Partners are enterprises and organisations actually taking part and benefiting from the applications. The Business Partners' business processes are ubiquitously interwoven and interacting in the spaces and they create dynamic value constellations with the aim to optimizing and executing the business strategies.
- End-users are all the people, including business administrators, production workers, supervisors, maintenance crews, logistic crews, etc., that work and interact with the applications on a daily basis.

An example of the graphical representation provided by e3-value in Tele-HealthCare monitoring system elaborated for the conditions of the Slovak Health Care System is shown in Figure 1. It involves an e-Business service in Tele-HealthCare monitoring environment that has been bundled with other services provided by various stakeholders in a set of value constellations.

4. Conclusion

Our paper has shown the importance and usefulness of applying a value-based approach to business modeling of new solutions based on Internet of Things. We have focused on Health Care Services (Tele-HealthCare System for monitoring of patients with diabetes or elderly patients) and applying the e3-value concept we have shortly demonstrated how a sustainable business model can be developed for an IoT platform and how the value analysis can be used. It does not brings only detection of new value objects but also can bring an understanding how the emergence of new value objects can bring entirely new actors into the business system for improved sustainability and performance of the model.

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