Towards an Innovative Service Development Process in the Electricity Industry

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Abstract. The electricity industry is currently confronted with regulatory and technological change that leads to fundamental transformation of the value propositions and innovation processes of enterprises. New services are one possibility to compete in the new market environment. This paper proposes a service development process for the electricity industry that builds up on existing approaches. The process model was developed by means of an embedded research framework that combines qualitative and quantitative methods in a multi method approach. A first evaluation of the process was conducted with a partner of the electricity industry in Switzerland. Potential service areas resulting from literature research, expert interviews (N=19), and an Open Space event with lead customers (N=33) build the basis for a choice based conjoint study. Potential services could already be identified in a pretest study. The paper shows that co-creation with customers and experts, enables the service innovation process.

Keywords: Service Development, Electricity Industry, Conjoint Analysis.

1 Introduction

Despite the fact that about 70% of the world's gross value added can be attributed to the service sector, there is still an enormous need for research in this area to guide the service development process [1]. The structured and successful development of new and innovative services is a major task for companies and a critical success factor for enterprise profitability [2].

In contrast to the development of physical products, the development of new and innovative services is often executed ad hoc and not systematically [3]. However, knowing that new products that were launched during the last 5 years account for about 49% of the sales of innovative companies [4], the need for a systematical approach in the service development process becomes evident.

An industry where the need for new and innovative services is especially high is the electricity industry. Due to the fact that electricity may not be stored as easily and cost effective without bigger losses as other physical goods, the electricity industry has a special constellation of actors (e.g., network operators, electricity producers, power traders, service integrators, customers) that create value together. These actors

need to ensure that supply and demand in the electricity market are always in perfect equilibrium. Due to this special situation, the customers have beside the economical relation to their service integrator a physical relation to the grid operator who delivers the electric current. This leads to the situation that many stakeholders have to be integrated into the service development process. Furthermore, new ways of electricity generation and smart grid technologies demand for new and innovative service types. Enablers are for example new tariff model options on the billing side or new opportunities in the load management area.

The aim of this research is to provide guidance for service innovation in the electricity industry by means of a systematic series of actions, summarized in the service innovation development process.

The basis for this research lies in the notion of service dominant logic (S-D logic) as a contrast to the classical goods dominant logic (G-D logic) [5-7]. S-D logic is a paradigm in service science research that puts a focus on the exchange of competences as a basis for co-creation instead of production and distribution in the goods dominant logic system. This shifts the production process from producers to a co-creation process of value [6, 8]. The important difference lies in the new understanding of value creation through competences and processes rather than value as a physical product [5, 6, 9]. Lusch et al. [10] argue that enterprises have to think about how to support customers in their resource integration and value co-creation activities. "All enterprises should strive to be an effective and efficient service support system for helping all stakeholders, beginning with the customer, become effective and efficient in value co-creation" [10]. According to Lusch et al. the S-D logic is very useful in a highly networked world. In the electricity industry – a highly networked industry – customer could e.g., become co-creators of the production of electricity [10].

Since the basic aim of this research lies in the development of new and innovative services for the electricity industry, service science builds the starting point for the derivation of our service innovation development process. Service science uses the dimensions "people", "organization" and "technology" to understand, categorize and explain a variety of existing service systems [7], and to analyze how service systems emerge and actors co-create value [7]. To derive at our service innovation development process we expand the generic service development model of [1, p.169] consisting of the five phases Service Identification, Service Exploration, Service Idea Generation, Service Prototyping and Service Evaluation and exemplarily apply it to the electricity industry. The focus of this paper lies on the second and third phases of the generic service model [1, p.169]. We propose to iterate the Service Exploration and the Idea Generation phases by using different methods for service innovation.

Our research follows the Design Science Research (DSR) approach according to [11-13] and executes the design science process steps (problem identification, objectives of a solution, design development, demonstration, evaluation and communication) as introduced by Peffers et al. [14]. This paper covers the first four steps. The artifact is not yet fully evaluated, but exemplarily applied to the electricity industry.

The structure of the paper is as follows. In the Background Work section relevant process models for the development of services are presented and explained. We show what the advantages and disadvantages of the models are in respect to the development of innovative services for the electricity industry. The artifact – the service innovation development process – is presented in the section Service Innovation

Development Process. An exemplary application of the model is conducted in the section First Evaluation of the Service Development Process in the Electricity Industry. The section Conclusions and Future Work summarizes the results and shows further steps for future research.

2 Background Work

Aim of the service innovation process is to design the constituent parts of the future services. Input (Potential), Throughput (Process), Output (result) and the customer dimension [15]. In this section we give an overview over the existing process models for the support of service development and elaborate on their advantages and disadvantages.

We identified many different sources dealing with the generic development of services. Well established models such as the linear model of Edvardsson and Olsson [16] or the iterative service engineering model of Shostack [17] can be found in [18]. Some of these models reach back to 1989 and may be distinct into three different types of models: linear process models also called phase models, iterative process models and prototyping models [18]. The most models we found are linear models, this might be, because they are easier to understand and apply [18]. Examples for this kind of models are the model of Edvardsson and Olsson [16], the model of Scheuing and Johnson [19], or the model of Ramaswamy [20].

The model of Edvardsson and Olsson [16] is mainly focused on the quality aspect of the service development. Aim of the model is to support the service engineering from the beginning to yield a higher service quality. Quality means in this context “satisfying the needs and meeting the expectations of three main groups: customers, staff and owners” [16]. In this model the service is seen as a customer process and value is jointly co-created with the customer [16]. Customer needs are differentiated between primary and secondary needs. Successful companies have, according to this paper [16], more and better supporting services. The results of the service engineering model according to Edvardsson and Olsson is structured in a hierarchical order with the components *concept development* in the top layer, *process development* in a middle layer and *system development* in the technical layer [16]. The model has been developed and evaluated in cooperation with a Swedish Telecom enterprise [16]. The Model of Edvardsson and Olsson is an approach to structure the service development process and include the customer into this process. A disadvantage of the model is that it gives virtually no advice about the exact methods and techniques that should be used to identify new services. Another disadvantage of the model is the lack of iterations that would improve the service development especially in an environment with many actors like the electricity industry.

The model of Scheuing and Johnson [19] is another example for a linear model. The major contribution of the proposed model is its aggregation of existing models and the empirical foundation. The authors consider already published service engineering models of that time and conduct an empirical study with 66 respondents [19]. The disadvantages of this model are the missing concreteness and the missing iterations. Concreteness means in this case that the model does not present methods or techniques that enable the service development. As in the model of Edvardsson and Olsson there are no

iterations intended in this model. On the one side this makes it easier to understand the model, but on the other side this may lead to less grounded solutions.

The model of Ramaswamy [20] is a third example for a linear model. It consists of eight sequel steps that are differentiated between Design focused and Service Management focused. The Design focused steps conceptualize the new services that are then implemented in the management focused steps. The model is very competition oriented and may be used with an approach that maps requirements and minimal service standards of the newly developed services in dependence of the competitors services [20]. Beside the new service development part, this model focuses on the management and performance improvements by using controlling and measures and has therefore a more quantitative focus in the Service Management part. Even though the model gives more detailed information about the contents that shall be conducted as for example define design attributes or develop design details etc., there are no iterations between the different steps intended.

According to [1] and [3] the model of Shostack [17] is a representative of the iterative service engineering models. Shostack differentiates between product dominant and service dominant entities, where salt is an example of an extreme product dominant item and teaching is especially service dominant entity. The basic elements, the services and products that build up a value proposition should be modeled accurately by the use of methods as e.g., service blueprinting. The model of Shostack is primarily focused on a marketing view of the service development and the modeling of the services. Therefore the marketing mix components prize, promotion product and place (distribution strategy) play a major role in the developed artifact. Additionally, Shostack [17] gives no detailed advise on how to develop new services but presents only the service blueprinting and service modeling ideas.

An example for a prototyping model is the design thinking model [21]. It consists basically of two parts, the divergent and the convergent thinking part. The ambiguity, the number of ideas, is increasing in the first part and decreasing in the second part. The different stages are supported by specified methods and result documents [21]. From the authors perspective the major aim of the design thinking is the people enablement and not the process support or the further management of services.

Table 1. New Service Development Models compared

	Iterative steps	Empirically sound	The Model uses explicit Methods
Edvardsson's and Olsson's Model	X	(o)	X
Scheuing's and Johnson's Model	X	O	X
Ramaswamy's Model	X	(o)	(o)
Shostack's Model	O	(o)	X
Design Thinking Model	X	(o)	O

O = Yes X = No (o) = partially.

Table 1 summarizes the relevant approaches for service development known to the authors and mentioned above and shows that those models do not combine iterative service development with accurately explained methods in a structured process model. This is exactly where this paper contributes to the field.

3 Service Innovation Development Process

The aim of our Service Innovation Development Process is the integration of the co-creation of value idea into the service development process. As a basis, we follow the service design cycle according to [1, 3] and further extend the model by a detailed description of the interactions of the Service Exploration and the Service Idea Generation phases as highlighted in **Fig. 1**.

Fig. 1. Service Design Phases adapted from [1]

In the Service Identification phase, the targets of the service development have to be set. The aim of this phase is the identification of the basic conditions and the limiting factors for the development of services [1]. The Service Identification phase is the theoretical foundation for the following steps and therefore groundbreaking and of high importance for the right decisions in the next phases. In the Service Exploration phase, the customers with their needs and preferences stand at the forefront. The focus of the third phase, Service Idea Generation, lies in the development of new ideas to solve the problems previously defined in the Service Exploration phase. Some of the ideas are then implemented and pretested in the Service Prototyping phase. Central aim of the last phase is the evaluation of the user acceptance regarding the newly developed services. This happens in the fifth and last phase of the service design process. The repetition of the service design process potentially increases the quality of the developed services [1].

In this paper we concentrate on the Service Exploration and the Service Idea Generation phases and their interactions in order to support the process of service innovation (as highlighted in **Fig. 1**). To systematically identify potential topics for the innovation of services four dimensions of innovativeness can be differentiated: The structure dimension, the process dimension, the outcome dimension and the market dimension [1, 15]. According to [15] there are only few publications available that deal with the support of the four dimensions of service innovation through methods and techniques on a systematical and empirical basis. Here is where we contribute to the field, namely in defining a clear and structured process for service innovation in the electricity domain regarding all four dimensions. In this Service Exploration and Service Idea Generation phases the focus lies on the customer, his behavior and the development of new ideas for services [1]. The phases are separated in the process model of [1]. However, based on our experience we argue that this separation is artificial to a certain extend and claim that reciprocal effects between the two phases occur. To systematically identify the customer needs we integrate the customers from the beginning into our research approach and look at the two phases from a holistic point of view. We suggest to use multiple methods and follow therefore a strong pluralistic research approach as advocated by [22].The approach consists of a qualitative and quantitative part and six steps in total as shown in **Fig. 2**.

Fig. 2. Research Approach following a multi-method approach according to [22]

The main purpose of the qualitative part (phase 1, shown left in **Fig. 2**) of our approach is to open up the mind for divergent thinking and to generate more ideas for potential services. The first step of the qualitative part consists of a structured

literature research as presented in [23]. In a first step relevant journals and conference proceedings are identified. The literature is then electronically analyzed by using databases as for example EBSCOhost. The identified sources build a basis for the second step of the approach where potential service areas are identified by interviewing experts of related industries. The interests and ideas of customers are considered in the third step of the qualitative approach. To make sure that all ideas are optimally understood and controversially discussed, the use of a creativity method is useful. We suggest to use the Open Space method as explained in [24], since this method simplifies the structured creative working of the participants. The Open Space method works best if the following conditions are met [24]:

1. The topic is a real issue of concern
2. The topic is highly complex
3. Many skills and people are required to solve the problem
4. Very diverse stakeholder needs have to be addressed
5. A high urgency level

In the quantitative part (phase 2, shown right in **Fig. 2**), the focus lies on the selection of the most promising service ideas for the implementation. Therefore the used methods are focused on convergent thinking to decrease the number of ideas for potential services. The ideas for potential services that were identified in the qualitative phase are arranged in fields of interest that build the basis for the development of a questionnaire. We suggest to use a questionnaire that uses the choice based conjoint [25] design. This has the advantage that the willingness to pay for each service may be calculated. A survey with a conjoint analysis enables furthermore the evaluation and selection of the most promising services. A survey is therefore a good possibility to reduce the number of ideas for new services without using arbitrary selection mechanisms, but letting the market decide. In the quantitative part such a choice based conjoint study is executed, preceded by a pretest, to test the questionnaire. In the last step of the approach, the results of the questionnaire are analyzed by using statistical methods and simulation techniques to identify the most useful services that shall be implemented. We suggest conducting the analysis in two steps: In a first step the conjoint part-worth values should be calculated. These part-worths represent the customers preference for a specific attribute (in this case service) compared to other attributes. In a second step we hypothesize that fundamental differences between customer groups may occur. For the further analysis of the groups we suggest to use latent class analysis. According to [26] latent class is currently the best way to find homogeneous segments of customers within choice based conjoint data. A possible simulation scenario with the hereby generated data is for instance a *ceteris paribus* price increase in a market simulator. Furthermore we can calculate price sensitivities based on a broad basic population. The new service design steps we developed are shown in **Fig. 3**.

Fig. 3. Elements of the new service model

The requirements are the result of the *Service Identification* phase presented in Fig. 1. The following five steps: *Literature Review*, *Expert Interviews*, *Customer Interviews*, *Pretest*, *Survey* and *Result / Analysis of Services* are the core elements of the new service design procedure. As a last step the results are analyzed using for instance regression techniques. In Fig. 4 we present our process model that includes the five information gathering steps (literature research, expert interviews, customer interviews, pretest and survey) as well as the analysis step (all introduced in in Fig. 3) by using the one cycle view of design science research as introduced by Winter and Albani [27].

Fig. 4. Process Model for Service Innovation following the one cycle view of [27]

Inspired by the Spiral Model in software development [28] Winter and Albani [27] revisit Hevner's three cycle view [11] and argue that the design cycle of Hevner has rigor related and/or relevance related characteristics within each single iteration. They therefore proposed a one-cycle view of design science research, comprising alternating core activities design and evaluation. Winter and Albani [27] state that having the development and verification of the artifact not as a separate cycle in the Spiral Model underlined their conviction that the design, relevance and rigor cycles belong together and should not be separated. Further, having different types of artifacts that may be designed and evaluated in different cycles satisfied their need to restructure the design science Knowledge Base in order to better find the right means for each artifact type to derive at the desired ends.

As mentioned in [27], with every iteration, the understanding of the environment and the problem to be solved are enhanced. Additionally, every design iteration allows for revisiting the Knowledge Base in order to improve the problem solution. The cycle iterates until a sufficiently useful solution has been developed. When the iteration exits, a problem solving means has been developed and novel artifact components together with their related problem characteristics are added to the Knowledge Base. We apply the one cycle view of design science research in order to define the service innovation development process. Starting point for the development of innovative services are the requirements that were defined in the Service Identification phase shown in **Fig. 1**. These requirements build the starting state of the problem space. Relevant information for the service innovation development process stored in the Knowledge Base is the knowledge of the experts and customers, their methodological competencies, possible methods used to identify potential service candidates and the identified service candidates. The first three iterations consisting of literature review, identification of potential service areas with experts and identification of service candidates with customers represent divergent thinking that aims at increasing the number of potential service candidates. The two last cycles, consisting of the pretest and the main study, represent the convergent thinking, since they aim at reducing the total number of services that shall be pursued to the set of relevant service candidates. Having identified this set of potential services, the analysis allows for choosing the appropriate ones that need to be implemented by means of a prototype, as defined in the Service Prototype phase shown in **Fig. 1**.

4 First Evaluation of the Service Development Process in the Electricity Industry

Together with our partners in the electricity industry we have already executed the first four steps of the service innovation development process. This resulted in one exemplary service that will be introduced into the market prototypically in the first half of 2013. The service evaluation of the first service and the development of further innovative services are subject of our current work.

In this section we illustrate the steps executed to derive at potential service innovation candidates (see **Fig. 5**).

Fig. 5. Research Approach adapted from [22]

The literature review in the research approach shown in **Fig. 5** yielded only few publications considering electricity tariffs, product attributes or services. We discovered a gap between the need for new services and further growth in the electricity sector on the one side and the missing studies that evaluate the need for these services on the other side.

In the second step of our research approach we interviewed 19 electricity professionals from different parts of the electricity supply chain in Switzerland. The group consists of representatives of the electricity generation, distribution, marketing, electricity grid operators and electricity certificates trading. The participants were arranged in four groups for a group interview and had the main task to identify potential service areas in the field of energy consumption in households or the industry dependent on the group. The question was intentionally open formulated, since electricity can act as a substitute for energy of other sources.

The third and last step of the qualitative phase consisted of a group moderation session with 33 participants. In contrast to the first step, the attendees were this time customers and not professionals. The task was to identify interesting areas of electricity services from a customer perspective. The used creativity method was “Open Space” [24]. Due to the highly relevant topic and the active cooperation of the customers, interesting topics for future services have been identified.

From the expert and customer interviews seven relevant areas for innovative services and tariffing resulted. The areas are presented in **Fig. 6**.

Fig. 6. Areas for potential new services

Service possibilities that we identified in the visualization of electricity area are services that visualize the consumed or produced electricity of customers to enable a proactive handling of the electricity consumption. The visualization may for example be executed via in home display; through a web portal or smartphone app. Ideas in the area of energy autonomy were for instance a container battery to compensate voltage fluctuation in the grid or to enable higher electricity autonomy of a building. The area energy efficiency was especially interesting for the customers. Potential services in this area are energy consulting and hints for reductions of the electricity consumed. Possible channels for such hints are web portals or the bill. The area virtual power plants, is a starting point for services that enable a further integration of renewable energy into the grid. In this area it is especially interesting to what extend customers are willing and able to let utilities control their electronic devices. In the area of smart home we identified potential services that enable a comfortable control of home appliances. The area customer interaction is basically the service channel via that the communication between customers and the enterprise happens. Classic channels are for example the phone or the service center a newer channel is the internet. The tariffs area influences the pricing possibilities and the customer interaction and is therefore of special interest for the service development.

The expert interviews showed us that many concerns that are often divergent have to be considered when developing services for the electricity domain. We included areas for the service innovation in our approach that deal with grid problems as well as marketing and sales issues. Furthermore we noticed that the ideas for potential services reached a higher maturity level and concreteness due to the discussion of experts from different divisions.

The major learning's from the Open Space were that customers are willing to participate in many ways, but are facing several knowledge barriers that make it difficult for them to calculate the expected savings or benefits. Services that deal with analytical data or the visualization of energy consumed seem especially interesting for the customers. The utility was often seen as a general partner for energy and not only as an electricity provider.

The identified service areas that are shown in **Fig. 6** build the basis for the fourth step of the multi method approach. In a first conjoint study with 107 respondents we

tested service candidates for the main study. This shall preclude obviously unattractive services from being tested in the main study. Questions of every area are integrated in the study. Some questions e.g., questions regarding the customer interaction, are asked in every questionnaire, other questions like for example questions regarding the electronic appliance control are only asked if the customers are private property owners. Our aim is to identify the most wanted services through the main study, therefore we use the conjoint method. The data of the pretest is currently analyzed and used for the further development of the main study. The analysis of the pretest results is conducted in two steps. In a first step we calculate part-worth values of the Choice Based Conjoint (CBC) Analysis. These values represent the preference of a specific attribute compared to the other attributes in a conjoint study. In a second step we analyze the potential differences between homogeneous customer groups. This enables the identification of services that are only interesting for a certain customer group. To find such segments we use latent class, which is currently one of the best ways to find customer segments within choice based conjoint data [26].

In the fifth step we will conduct a large choice based conjoint analysis with the aim of about 1500 respondents. The results of the first four steps of the multi method approach all built the basis for this study, by delivering potentially interesting services that have already proven to be of interest for a smaller group that we addressed with our pretest. In **Fig. 7** we show a possibility of a choice-set that could be presented to the customers in the questionnaire of the main study. Every attribute is derived from a potential service area as presented in **Fig. 6**. As the pretest showed, all these attributes are important for the customer. The aim of the main study is to understand the exact importance of every attribute. The choice set presented in **Fig. 7** forces a tradeoff decision between the possible characteristics in every selection. From the selections chosen by a customer in the different choice sets we can identify the worth that a customer assigns to a specific attribute and its characteristics.

Attributes	Selection 1	Selection 2	Selection 3
Service channel	Internet only	Internet, phone and service center	Internet and phone
Presentation of the used electricity	Every Second	Every Second	Every Month
Services to enable energy savings	No Services	Efficiency portal	No Services
Price per person and month	40 CHF	70 CHF	50 CHF
	0	0	0

Fig. 7. Example of a choice-set

The sixth and last step of our research design consists of the deep analysis of the data that is generated by the main conjoint study. Central aim of the analysis is to show the exact impact of every attribute on the purchase decision of a customer.

In the Service Prototyping Phase (see **Fig. 1**), we plan to prototypically implement some services in the market. This enables a clearer valuation by the customers due to the concreteness of the offer [1]. The services used in this evaluation were developed by using the service areas shown in **Fig. 6** as a basis. Most services are tested with a questionnaire right now. One possible service that resulted already from the pretest will be implemented in the first half of 2013. It is a service that has been identified in the pretest. This tariff uses a variable tariffing approach and electricity visualization to incentivize customers to use the generated solar energy on their own instead of feed the energy into the public grid. This service shall prevent problems with peak load situations in the electric grid caused by solar panels.

The insufficient integration of customers into the service development process is according to Schneider et al. a major problem of many process models [3]. We took this into account and integrated the customers from the beginning of our service development into the process. The three formalized evaluation and exchange points with our customers are shown in **Fig. 5**: The Open Space with 33 customers, a questionnaire with 107 customers and a main study with a planned N of 1500. However, beside these feedback loops during the service development process a further evaluation of the newly developed services after their introduction into the market is crucial (see Service Evaluation Phase in **Fig. 1**). We plan to measure the customer acceptance after the market introduction of the product to evaluate its usefulness for customers.

The aim of this first evaluation of the proposed service development process was to test the ideas of co-creation in the innovation and the service delivery phases. We included the co-creation into the service innovation process through the use of expert interviews in an early stage and the further identification of potential service areas with lead customers through the structured method Open Space. The conduction of a pretest and the choice based conjoint study are two further elements that include co-creation aspects. Customers are not only included in the service innovation approach but additionally decide which services are implemented in the market through their answers in the questionnaire.

5 Conclusion and Future Work

Due to the deregulation and new technologies that enable innovative services in the electricity industry, the service aspects are becoming increasingly important in the next years. The transformation and innovation in the electricity industry can profit from structured approaches used by service science. This paper is a first step towards an industry specific process model for the development of new and innovative services and value propositions for customers in the electricity industry. The paper follows the five service development phases as introduced by [29] and refines the Service Exploration and Service Idea Generation phase by means of a multi method approach to derive at new and innovative services. With a partner of the electricity industry in

Switzerland we already tested our presented service innovation development process and went through the first four phases, Service Identification, Exploration, Idea Generation and Prototyping, in order to derive at new and innovative services that can be introduced into the market. One of the identified services will be introduced into the market in the first quarter of 2013. The fifth phase, the Service Evaluation is subject to our current research. For the future, our aim is to validate the presented service innovation development process with additional industry partners in Switzerland or abroad to prove its usefulness for the whole industry and not only for single players. The process should support service innovation through a structured approach. In this paper we focused on the service innovation in the electricity sector. To generalize the results, an application of the process model to other domains is necessary. From our perspective the service design procedures could be useful for other domains that use a physical grid or distribution facility for their business model. An example is for instance the gas distribution system. To use the model for the new service development in other industries the relevant expert groups for this specific situation have to be identified.

From our perspective, not only the development of services builds a value proposition for future co-creation but also the development process itself is subject to co-creation. Through a tight cooperation with customers we make sure that the developed artifact is both useful for the customers and also easy understandable.

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