INTERNATIONAL DESIGN CONFERENCE - DESIGN 2006
Dubrovnik - Croatia, May 15 - 18, 2006.

DESIGN 2006

AN OUTLINE OF AN INTERACTIVE DESIGN MODEL FOR SERVICE ENGINEERING OF FUNCTIONAL SALES OFFERS

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Keywords: service engineering, functional sales, design methodology, product design, service design

1. Introduction

It goes without saying that in the tertiary industry, service activities are a source of core value and are regarded as crucial. In addition, manufacturing industries have become more interested in services as well. Two kinds of trends can be pointed out as reasons for this. One is servicification of consumers' behaviors, which means a shift from customers' consumption of physical products to their consumption of softer or solution-based services. The other concerns environmental problems, which have been quite serious in some areas over a couple of decades. In line with such trends, the current manufacturing paradigm, which produces mass products and mass wastes, seems unsustainable. It has been shown that companies that are successful are able to develop customer value in innovative ways through the use of several perspectives such as logistics, offer delivery, product and service. Companies need to be open-minded towards what solutions need to be changed in relation to customers' needs. Understanding the customer's needs and values is crucial in order to deliver a satisfactory solution.

The transition to functional sales places new and more demanding requirements on product and service development and production, along with new requirements for companies in the way they meet customers. The skill to combine different types of products and service into a desired function becomes more crucial. For example, a warehouse company is not so interested in the single fork lift truck, but rather on how such equipment can contribute to its overall material handling system.

In order to be able to deliver, companies need to continually develop their value chains and the competence of their personnel. It is important to organize the company and develop the logistics to be able to deliver a solution and create opportunities for the take-back of products.

As a result, new concepts such as Functional Sales, Product-Service Systems (PSS), and Functional Products have been developed. For instance, the business concept of Functional Sales can be defined as *"…to offer a functional solution that fulfils a defined customer need. The focus is, with reference to the customer value, to optimize the functional solution from a life-cycle perspective. The functional solution can consist of combinations of systems, physical products and services"* (modified from [Lindahl 2001]. Common to the three concepts described above is an attempt to incorporate a service into the design space, which has traditionally been dominated by physical products in manufacturing industries. Motivated partially by the above-mentioned trends, service is receiving more and more focus in manufacturing industries. The authors' research shows that existing functional sales concepts are developed by the companies' marketing department and based on existing products optimized for traditional sale [Ölundh 2003, Sundin 2005b].

In parallel to these concepts, a concept named Service Engineering (SE) has been proposed [Tomiyama 2001, Arai 2004]. SE is a discipline to increase the value of artifacts and to decrease the

load on the environment by focusing on services. A service is defined as *"…an activity that a provider causes a receiver, usually on purpose, to change from an existing state to a new state that the receiver desires, where both contents and a channel are means to realize the service"*. Service contents are provided by a service provider and delivered through a service channel. Physical products are either the service contents or the service channel. Thus, selling physical products is also regarded here as a service. Note that SE has both analytical and synthetic aspects. SE aims at intensifying, improving, and automating this entire framework of service creation, service delivery, and service consumption. To increase the total satisfaction of receivers (customers), we can improve functions and/or quality of both channels and contents. Traditionally, engineering design has aimed to improve only function. The authors believe that a better function of a new product makes consumers satisfied. In SE, however, not only the functions of artifacts, but also meaning of contents, must be matched to the specifications given by receivers; by doing so, the satisfaction of receivers increases.
Thus far, a modeling methodology [Arai 2005], an evaluation methodology, a design methodology of services and a computer-aided design tool in a general form have been proposed [Arai 2004]. In addition, the above have been verified through several cases in various industries; two examples are a warehouse equipment supplier [Lindahl 2005] and a hotel in the accommodation industry. Verifications are now being conducted in Sweden, Germany, Italy, and Japan.
One of the most significant points of SE is that a computer-aided design tool named Service Explorer has been developed. This implies that those methodologies used to model, evaluate and design services, which have been implemented to form a part of the software, have also been proven to be rigorously logical. Having implemented a computer tool has brought two benefits: one is the ability to manage various types of information effectively; the other comes from taking advantage of the power of computing. For instance, a reasoning engine for abduction would be able to discover a good analogy in a different field to let designers notice some clues towards innovative ideas in the concerned field.
Since those proposed methods and tools have been in a general form, they have a benefit of wide applicability but a relatively lower conformity for a specific type of service design. For instance, appropriate design of service in B2C may be partly different than that in B2B regarding how service providers interact with receivers (customers).

2. Aim

The research has shown that, for companies to be able to develop products and services with increased customer value, there is major need for them to be able to visualize and verify their customers' needs. At the same time, a functional sales offer is by nature more or less context-related and unique for each customer. Therefore, companies need general methods and tools that can support the development of functional sales offers. Furthermore, functional sales is based on a life cycle perspective, implying that more parts of the value chain are considered in the optimization and in order to increase the focus on circular resource flows. A result is that focus is changed from producing products and services to producing functionality.
The aim of this paper is to present an outline of an interactive design model that can be used for Service Engineering of functional sales concepts. The aim is not to show all details and sub methods that will be needed within the model. The previous Service Engineering research has highlighted a need for a more overarching model, a model that covers more steps of the lifecycle. This paper also aims to show how the previous service engineering research relates to this new model.
The aim is that the model will enable more effective and efficient generation and realization of functional sales concepts/offers and support innovative thinking in the generation of functional sales concepts. The model will support companies' needs for internal and external communication. The product generation comprises customer need identification, concept generation, and concept checking with the customer. A further aim is also to verify the overall outline of the interactive design model.

3. Methodology

This study has been divided into two phases. The first one is a literature study based on previous research (e.g. [Lindahl 2001, Arai 2005, Lindahl 2005, Sundin 2005b, Shimomura 2006]) and

additional literature reviews carried out during 2005 to develop the model which is further described later in this paper. The model outline was developed through workshop discussions with two of the authors and other research colleagues with extensive experience from functional sales and companies' product and service development processes.
The second phase is to verify the model outline. This has been done in small workshops conducted during late autumn 2005 and early 2006 with eight companies (see Table 1). The participating companies have been selected based on the researchers' previous knowledge about them and their functional sales offerings. One aim when selecting companies was to find companies of different size and with different types of offers. During these workshops, companies have been able to provide comments and relate themselves into the proposed model. It has also been questioned if there are other parts that have been missed in the model.

Table 1. Companies involved in the workshops and their functional sales offers

Company name	Product/Service
Swepac AB	Compactors
BT Sweden AB	Forklift trucks
Proton Caretec AB	Beds for hospitals and care homes
Coffee Queen AB	Coffee machines
Saab Aircraft AB	Aircrafts
Polyplank AB	Various products made of a recyclable plastic composite material
Coor Service Management AB	Various services
Atlas Copco AB	Drilling equipment

4. An Outline of an Interactive Design Model for Service Engineering of Functional Sales Offers

Previous research studies have pointed out the need for strengthening internal and external communication in the process of generating functional sales offers. There is also a need for an extended perspective and responsibility for the offer. It is not enough to only focus on the production of products, since much of the value is created and the majority of the value is experienced during the use phase. This implies that companies need to incorporate new competence into their offers. The process of generating the offer must be a fully integrated process that comprises both physical products and needed service. This implies new challenges in the design process.
The outline of an interactive design model for Service Engineering of functional sales offers highlights and illustrates vital and crucial activities in their generation (see figure 1). The need for the different activities has been identified in earlier research studies and through literature studies, and the model is described below. The two-way arrows in the model symbolize the important communication needed between the different stakeholders within the lifecycle activities.
The model will be further developed in a 2.5-year-long major research project, a project with significant involvement and interest from industry. The project will focus on both development of methods that can support the model's different activities and on validation of the model and methods. The model and methods developed will be used by participating companies, thereby providing the base for validation.

4.1 Need and requirement analysis

The main issue is to start from the customer's needs and requirements in order to generate an efficient and effective business offer in conformance with the value constellation concept. The identified requirements should primarily be seen as requirements on the requested function.
In general, companies seem to be quite skillful in identifying and extracting customers' technical requirements for products. However, companies seem to be less experienced and skillful in identifying softer customer needs, i.e. service-related requirements. One reason for this may be that it seems that customers are more focused on expressing technical requirements on the products than on service issues. This was something the companies agreed on. In general, companies experienced an increased need for methodology support in this activity, and with focus on the softer parts, i.e. service-related

requirements. Companies that provide functional sales offers in B2B situations often face problems since their customers' financial economy systems and structures, for example, are not suited for this new type of business offering; instead, their systems are based on handling physical artifacts and their related costs.
Another problem mentioned was that some of the customers or actors at the customer that are involved in the selection of offers are not always the final users of the offer. Furthermore, the purchasing department or the person responsible for purchasing often tends to focus just on the purchasing cost and not on the overall cost, e.g. cost for use, maintenance and end-of-life treatment.
The different customer actors have different rationales for their actions and validation of each offer's value. What has been mentioned by the companies and also realized by the authors is that this implies that some of the traditional cost value analysis methodologies can be somewhat misleading, and that improved methodology is needed since the offers validated are more complex than more traditional offers. There is a strong need to understand the interaction between the actors at the customer. Related to this, it is also often hard to reach the actual users in order to learn their needs and requirements. An important thing is to get the customer to understand their benefits when signing a contract for a functional sales offer versus buying a physical product in the traditional sense. A major obstacle is to understand in the first place what the customer (or the actors at the customer) states as value, and in the second place transfer the value of the offer back to the different actors and get them understand and agree on the proposed value.
To summarize, in this activity it is important to have in mind that it is also crucial to determine needs, requirements and values for other stakeholders, e.g. the managing board, authorities and suppliers. The research has also highlighted a need for companies to be able to follow-up and compare the effect of the implementation of the functional sales offer. To do so, there is a need to find measurable customer-related parameters that will be changed due to the functional sales offer and measure the current status. It is also preferable if those measurable parameters are related to the customer's requirements. As described, this activity in the model needs more methodological support. The aim with the further research is to develop a suite full of methods that can support companies' work, based on existing methods for need, requirement and value analysis.

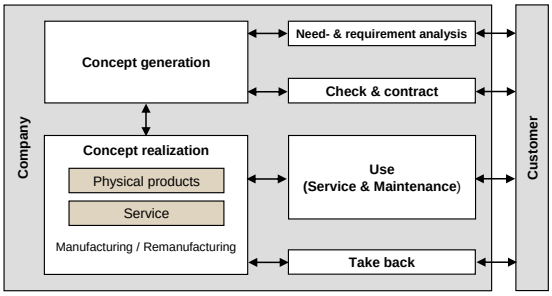

Figure 1. An Interactive design model for Service Engineering of functional sales offers. The two-way arrows symbolize the important communication needed between the different stakeholders within the lifecycle activities

4.2 Concept generation

As shown in previous studies [Sundin 2005b], functional sales offers often tend to be based on existing standard products and developed by the companies' marketing departments with little or no contact with the product development department. This image was strengthened by the participating companies' description of their own business. They also experienced that they needed to improve their ability to generate their concepts in a better way. It seems that all of them have understood the potential of functional sales and the need to change their current business to be able to fully gain from its potential benefits. However, some companies are facing a big challenge as far as changing their internal structures and breaking down traditional barriers concerning how a product should be designed and who should be in charge. Some companies are still very production-oriented, with strong

technical departments and weaker service-related departments, even though it is their service-related departments that are growing the most rapidly.
It is from development of methodological support for this activity that the proposed model has evolved. The concept generation methodology developed differs from traditional concept generation[1], since the ambition is to better highlight the need to generate concepts in an integrated way that from the beginning, and in a parallel processes, comprise both the offers for service and product content. The focus is on finding the best combination of products and services based on the validation of the different requirements stated for the requested function. The combination can be based on standard products and services but also on customized products and services. The previously developed Service Engineering methodology has in practical cases shown to provide strong support for this activity [Lindahl 2006].

4.3 Check and contract

It is not enough to have a good concept to offer the customer: the customer must also understand the value of the offer. Previous research and participating companies in this research have highlighted that the reason why companies have had problems making breakthroughs with their functional sales offers is the obstacle of communicating the benefits of functional sales offers to the customer[2]. The general opinion among the participating companies is that this is the key activity for making functional sales successful. If companies fail in this activity, it does not matter whether they are brilliant in any other functional sales-related activity. The responding companies highlight that they are facing two major interlinked challenges to achieve this success. One problem related to the obstacles to identify customer's needs and requirements is that customers in general have a traditional mindset. Since functional sales is still a novel concept, many customers are unfamiliar and have problems with understanding functional sales offers as well as how they should interpret the functional sales offer. Furthermore, since the concept also involves more actors from the customer's side, e.g. not only purchasing but also e.g. the maintenance department, the problem is also that many customer's organizations cannot handle or have major problems handling and validating these kinds of new offers, e.g. because of budget and bonus reasons.
In respect to this, customers tend to be conservative and choose the familiar in lieu of this new type of offer. This places extra high requirements on companies that wish to offer functional sales offers. Many customers are still very focused on the physical products and their cost, and less on the actual potential gain that the offer will provide. In general, they do not reflect on the total life cycle cost. Some companies believe that the solution to this problem lies more in marketing to and teaching their customers as well as their customers' customers. The other problem, assuming the customer understands the benefits and the gains, is how to make a balance so that the customer is satisfied and does not want to have too much of the gains, e.g. want too much of the providing company's gains from the reduced costs of providing the offer. Therefore, in this activity it is not only important to verify that customers understand what they will gain from the offer; it is also important to verify that the customer is satisfied with the offer. To do so, the determining factor is that the offer can be transcribed for the customer in an understandable format, e.g. with parameters and descriptions that the customer is familiar with and can interpret. One way to convince the customer of the gain is to use "need and requirement analysis" activity-identified parameters and compare the values from the use of the Service Engineering offer with the original values. It is also important to summarize the agreement in a contract as clearly as possible. The increased degree of service content, service often utilized long after the contract has been written, must be defined in order to protect both supplier and customer. It is also important to have the offer described as clearly as possible in order to be able to follow it up in the future, e.g. validate the gain for the customer. A well-defined contract also decreases the risk of conflicts that can cause both the customer and company unwanted costs and troubles. Since this is a

[1] See e.g. Sundin *et al.* (2005) and Ölundh's (2003) descriptions of how companies today develop their functional sales offers.
[2] This is related to the above discussion about the obstacle with customer's different actors and their different opinions of an offer's value.

key activity and proper methodological support is lacking, the aim is to develop a suite full of methods that can support companies' work and the work that is already in progress.

4.4 Concept realization

This activity is related to the concept generation. Companies in general experience that they are lacking good internal communication, since different departments are working on their own and valuable dialogues that could improve the offers are therefore few or non-existent.
When there is an agreement/contract of the functional sales concept, e.g. the function, the next step is to go from concept to realization of the offer, i.e. produce the different service and products needed for the offer. The existing service engineering methodologies support an improved dialogue between different stakeholders in this realization process.

4.5 Use, service and maintenance

It is during these activities the customer experiences the offer's value since the offers function is used; it is also during this phase that the service and maintenance is delivered. Some of the companies experience this as an underdeveloped channel for customer knowledge, knowledge that could support the companies' development of more successful offers. Some companies already have well-developed feedback from the customers' use of their products, service and maintenance. However, there is not always a good link back to designers, for example, and this is an activity that companies believe could be improved. It is important to monitor the customers' changed need and how to match this with new offers that satisfy the customer.
An active communication with the customer during this activity is a good opportunity for companies to learn more about their customers' need for service and how to better identify and fulfill customer requirements. Since the customer is focusing on utilizing the offer and therefore has a direct experience of the combination of products and service, it is easier to get an understanding of his/her experience with the offer. This activity also provides an opportunity to have a continuous dialogue with the customer in order to follow-up his need. If the need is changed, it also gives the company an opportunity to provide the service to help the customer to change his functional sales offer, i.e. the mix, so it fits the customer's need in a good way. Even this is an important part of the model, however forthcoming research by the authors will have less focus on this part since another ongoing research group at Linköping University is studying this.

4.6 Take-back

In functional sales, the products' ownership is not handed over to the user, and the products are therefore taken back when the user does not need the offer any more. Important to note is that the reason for abandoning a product or service is not always that the customer is dissatisfied; sometimes the need can be changed but the customer is still satisfied with the functionality of the functional sales offer.
For those companies that do not have any take back activity, they believe that this could be interesting to develop and improve, e.g. as a way to keep out second-hand products that could destroy their market for new products. Not all, but more than half of the companies in the research had an underdeveloped structure for product take-back. As shown in a previous study [Sundin 2005b], very few companies with functional sales concepts have a take back system. The advantages of combining functional sales offerings with a take back system (e.g. remanufacturing) have previously been explored by [Sundin 2005a].

5. The model in relation to earlier Service Engineering research

The proposed interactive design model for Service Engineering of functional sales relates to earlier research as shown in figure 2 [Arai 2005]. As seen in the right-hand side of the model, major research in the area has thus far been weakly or not at all covered by existing Service Engineering methodologies. This is, however, neither sensational nor strange since the research area is still in its infancy. Furthermore, the new areas have been identified and will be incorporated.

The activities in the left-hand side of the diagram, i.e. within the company, are mostly supported by existing Service Engineering methodologies and the existing software, Service Explorer. In the concept generation stage, designers begin with understanding a network of stakeholders utilized for the service, selecting a portion between one provider and one receiver, and identifying realization structures for the selected portion. Service Explorer helps designers embed a good balance of value and cost of those stakeholders in this stage, since services in general are delivered by multiple agents. Actually, Service Explorer allows designers to describe concepts with the terms of value and cost from the customer viewpoint. In the concept realization stage, means for the value and cost are generated, which are either physical products or service activities. This stage includes evaluating the service and modifying the service. The realized concept is then transferred to the process of manufacturing and further. These steps supported by Service Explorer will be a good basis for the steps of "concept generation" and "concept realization" in the newly proposed model.
In the stage of "Need- & requirement analysis", it is crucial to adopt the language of the customer. Hence, a model to describe what preferences customers have and how they behave in receiving the service is developed and implemented. To represent the customer's preferences, the concept of the Persona model was employed. This model is effective for determining the value and cost of customers. To analyze needs and requirements, methods such as Conjoint Analysis are employed. These modules will be partially helpful for the "Need- & requirement analysis" described in Section 4. However, methods are not yet developed for the steps of "check & contract", "use", and "take back".

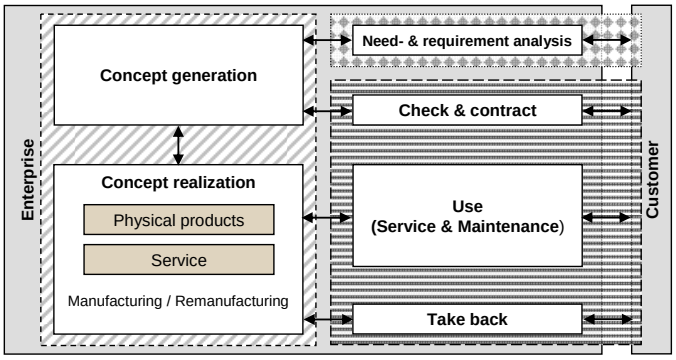

Figure 2. Description of how the proposed model relates to earlier Service Engineering research. Mostly covered by the existing Service Engineering methodologies and implemented in the existing Service Explorer software. Existing Service Engineering methodology in this area is weak and needs to be enhanced; however, it is covered by the existing software. Not covered by Service Engineering but will be covered in the future

6. Discussion and conclusion

The proposed outline of a model was discussed with the participating companies listed in Table 1, who in general felt comfortable with the proposed model and were able to see how the model could be used to describe and support their own businesses. The model also highlights activities the companies are working with and in general need to develop their knowledge in.
To conclude, this paper has presented an outline of an interactive design model that can be used for Service Engineering of functional sales offers, and further how the previous service engineering research relates to this model. The proposed model's overall outline has been confirmed by and discussed with companies and further supported by the output from the literature review, and seems to be relevant for different types of functional sales offers. Therefore, the conclusion is that the model in Figure 1 gives a relevant image of important lifecycle activities for Service Engineering of functional sales offers. However, now when the model is verified and appears to be general, the next needed step will be to further develop methodological support (as earlier described in a research project) for the model's different activities, especially the "need and requirement analysis", "check & contract", "use,

service and maintenance" and "take back" activities, since they have been found crucial for the success of functional sales offers.

Acknowledgements

The authors of this paper want to thank Gunilla Ölundh, Ph.D., Anna Öhrwall Rönnbäck, Ph.D., Professor Mats Björkman, Mica Comstock, Ph.D. and all participating companies for their support in the development of the model. This research was partially supported by Swedish Governmental Agency for Innovation Systems (VINNOVA) and a Research Fellowship Programme by the Alexander von Humboldt Foundation in Germany.

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