

New Service Development Method for Prosumer Environments

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Abstract—Prosumer environments are characterized by user participation in the service creation and provision processes. These services, which become increasingly important in recent years, have some peculiarities that differentiate them from the services that follow the traditional model of supplier-customer. However, there is little research on how to adapt existing business models to harness the prosumer's value and the implications of this new role for the company's business model. In this paper we design a methodology for the development of prosumer services by using the New Service Development approach to provide creation tools, used by prosumers to create final services. We pay special attention to the relationship between creation process participants by modeling this relationship as co-creation mechanisms. The proposed method is applied to a use case, based on prosumer interaction in the Future Intelligent Universe.

Keywords—new service development; co-creation; service composition; service customization; QFD

I. INTRODUCTION

A new service provision model is needed in a society in which individuals, companies and cities are related; and in which users contribute with his suggestions, interesting information and even his own services to the rest of the community. This paper focuses on a new environment for the current society, based on user participation, not only in information provision but also in the creation and composition of their services, called *Prosumer Environment*.

Users participating in this society, called *prosumer users* or *prosumers*, want to get involved in service development stages, but they are not experts in the use of traditional tools of service development. Companies are aware of the evolution of the society and they view their customers as important resources when they develop new products and services. Thus, they try to involve their customers in the co-creation and co-development of new services [14]. Currently, some projects focused on the figure of prosumer are appearing, such as iStockphoto or Lego Mindstorms, and the term prosumer begins to be used by companies such as Sony to describe video camera users, producers and publishers of multimedia content.

From our knowledge, there are no product and service development models that explicitly take into account the new prosumer role but only as customer involvement in the business process [15] [4]. Nor is there much information on the related work on how to adapt existing business models to

harness the prosumer business value and the implications of this new role for the company's business model.

The New Service Development (NSD) methodology is often used for the development of services that are new to the company, and that involve resources, processes and customer interaction [2]. In this paper, we extend the development model proposed by NSD in order to involve prosumer users, who wish to take responsibility for the creation and provision of services, in the service development process. The benefits of this new business model is perceived from the viewpoint of the company, which harnesses the power of the prosumer development to improve and test new products, and from the prosumers' point of view, which get involved in service development by using creation tools adapted to their experience level.

The rest of the paper is as follows. Section II describes the service provision prosumer model we want to achieve with our method and Section III analyzes and discusses the related work regarding service development with user participation. Section IV describes our proposed method through the NSD stages. Section V presents a scenario in which this methodology has been applied as a validation and Section VI presents the conclusions of our work.

II. PROSUMER MODEL

Internet has become a powerful distributed infrastructure that enables information to be widely available and its actors to interact with the rest of the world. Users require tools for providing their own services and consuming services published by others, and thus, transform the network into a collaborative infrastructure, adapted to different areas, such as social, personal and commercial ones. There are some initiatives to provide this type of tools, such as ICT-2007.1.6 challenges (14 projects) of the European FP7 program, focused on validating highly innovative and revolutionary ideas for new service paradigms.

The term *prosumer* [16] (as an acronym formed by the fusion of the words producer and consumer) is applied to those users that are at the same time consumers and producers of services or contents. The proposed prosumer model is shown in Fig. 1 and is described below. In the creation process, the prosumer, using his mobile phone or a computer, can design his services using the tools he has at his disposal. This is the most critical stage, because of the technical difficulty of transforming service creation ideas from a non-expert user to machine interpretable code. The *Creation tools* are oriented to a specific personal or

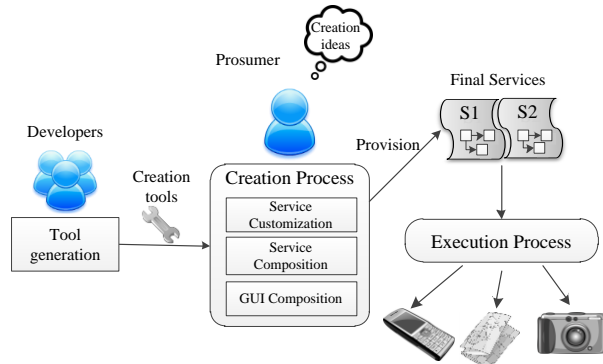


Figure 1. Prosumer model

professional domain. They are provided by companies or third-party developers, using the traditional software development paradigms. *Service composition* graphical environments have been developed to solve this problem, using different paradigms (automatic, semiautomatic, static workflow-based service composition [20], natural written language [19], etc.). *Customizable services* are service models that already solve most of the technical issues regarding service creation and they allow the prosumer to introduce some configuration and customization parameters, both in GUI and in the service logic. From the service presentation's point of view, the service composition paradigms that have proven to be more effective are based on User Interface Composition as some Mashup contributions [18] or those based on predefined templates [17]. The former allow greater flexibility in creation process while the latter usually have a more eye-catching look, providing that they have not been assembled by individual graphical blocks. The result of this stage is called *final service*, completely or partially created by a prosumer user and ready to be consumed.

Service provision and execution take place after the creation process. As these stages are very similar to those of traditional services we will not explain them in detail.

The complexity in the creation phase requires an infrastructure deployment to facilitate contact between the developers of creation tools and the prosumer user that will use these creation tools. A methodology is required to decide between different design strategies, according to the captured design requirements. Section IV explains the method we developed.

III. RELATED WORK ON SERVICE DEVELOPMENT

In this section, we focus on the related work about two key aspects developed in this paper: User participation in service development process and, specifically, the relationship between users and other participants in the NSD methodology.

A. Customer participation in service development

In recent years, companies have considered the importance of the presence of the customer in service development in order to understand customers' needs and wishes properly [21], evolving from the traditional model of

service development, which produces common failure to involve service personnel and customers [1]. The presence of the customer in the production process results in increased customer value, as the overall benefit perceived in the solution at the price the customer is willing to pay [22]. Customer value is an aspect of the service that must be continually revisited for the company so that it can anticipate an alteration in customer's needs (the customer's perspective on a service offering can change from being favorable to being unfavorable).

With the emergence of the Web 2.0 in the information and communications society, based on user participation, the user acquires a leading role in service development. Therefore, user involvement in the service production process is more justified. Some authors believe that users are the root of the service idea. Matthing et al. [23] illustrate that the consumers' service ideas are found to be more innovative, in terms of originality and user value, than those of professional service developers.

The role that the user plays is evolving from "content prosumer", who uses the Internet and other technologies to find information and also to produce content, to "service prosumer", which develop services and make them available to other users. The FIA (Future Internet Assembly) mentions this evolution of Internet users in his roadmap [27], defining prosumer as "a new kind of Internet user, playing both roles consumers of services as well as creators of added value services based on those consumed". In this paper we focus on this second type of prosumers.

B. Co-creation in New Service Development

NSD is a service development methodology that is often used in corporate environments [2][21][22]. Johnson et al. synthesized past service development research and created a general four-stage NSD process model involving the phases of design, analysis, development and full launch, emphasizing the interdependence on design and development as well as the cyclical aspects of the new service creation process [2]. The difficulty of finding flexible tools for creating prosumer services is covered with large number of tools that relate the prosumer with NSD. In this section we review the tools, methods and practices found in the literature.

In the design phase, related tools focus on identifying customer needs. Although there are tools that extract qualitative information on customer perception, as focus groups and face-to-face interviews, and stimulate the production of new ideas (brainstorming), other authors [6] consider that the best method to identify customer needs is to select the so called "lead users", which present strong needs. In our work, we define *domain-expert* as a lead user with good knowledge of his environment and who is aware of specific and general needs of the users it represents. Data mining techniques (artificial neural networks, decision trees, case-based reasoning, and multivariate discriminant analysis) [7] are used for classifying user need types for recommendation systems.

In the analysis phase, recommendation systems use techniques to analyze the information on user needs,

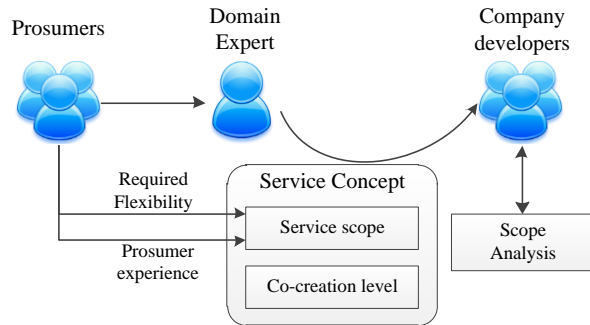


Figure 2. Design phase

processed in the previous stage in order to quantify its importance and thus, estimate the value of service for the target customers and the company. One of these techniques, the conjoint analysis [8], consists of a multivariate statistical technique which studies the joint effects of service components on consumers. This technique is often used along with the graphic technique of perceptual mapping [8], which helps marketers to visually display the perceptions of customers or potential customers.

Related to service development, Quality Function Deployment (QFD) [4] tools have been proposed to transform the needs of users into service design requirements, which are more easily understandable by developers. Once the service concept has been created, other service engineering models are used, which map, describe, and/or analyze the design of service processes and include the customer experience in form of interactions through the process [9]: blueprinting, SADT (Structured Analysis and Design Technique), STA (service transaction analysis) and IDEF3. Among these methods we highlight SADT, which proposes the involvement of NSD providers, project managers and customers.

Regarding the launching phase, the quality of the service being deployed and the customer satisfaction with the service once deployed is evaluated. Before service launching it may be necessary to identify potential failures in the service design or implementation. One of the most used techniques is the Failure Modes and Effects Analysis (FMEA) [10], which identifies failure modes based on past experience with similar products or services and provide corrective actions. The model proposed by Kano et al. [11] is often used, which complements the QFD to measure customer satisfaction and ranks customer demands with threshold attributes, in such a way that if a new service is not examined using the threshold aspects, it may not be possible to enter the market.

IV. PROSUMER NSD METHODOLOGY

In this work, we rely on the NSD model to define a New Service Development method in which the prosumer is present from service conception to the deployment of the infrastructure and the tools to personalize and provide services to other prosumers that consume them. The ultimate goal of this methodology is that users unfamiliar with traditional creation tools may be responsible for the creation of final services (through mechanisms such as composition or template customization).

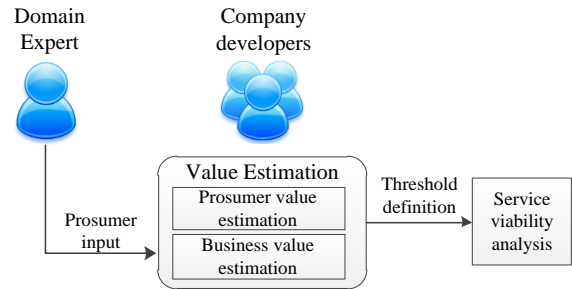


Figure 3. Analysis phase

Our methodology is based on the phase model proposed by Johnson et al. [2]. In this section, we describe our adaptation of the processes carried out at each stage in order to involve customers as service co-producers.

A. Design

As shown in Fig. 2, in this first stage we identify the target customer and choose a customer representative. We call him *domain expert* and he serves as a link between prosumers and company developers. To meet the prosumer involvement needs we have adopted a customer-centric approach and, using the technique of Quality Function Deployment (QFD) [4], we ensure that the dimensions most valued by customers are adequately captured and translated into objective metrics, as the main task of service development is to create the right prerequisites for the service [1]. To do this, the domain expert must acquire the best possible knowledge of the target customers (prosumer users) to feed QFD, and he should be able to appropriately translate customer expectations into design requirements.

A major challenge in this stage is to ensure that every decision is made based on delivering the correct services to potential customers. So, we first determine what type of service is going to be developed and the characteristics of the target customers. We define the *service concept* for prosumer environments as the combination of the *co-creation level* and *service scope*. The service concept helps to focus the relationship between customer needs and the company's strategic intent. The co-creation level measures the domain expert involvement in the NSD process. A low co-creation level means that the users are little involved in the co-creation process. We define service scope as the set of service requirements, covering both the design (functional and non-functional requirements) and the co-creation. The service scope is affected by two attributes: level of *flexibility* demanded in the service and *experience* level of the target prosumers regarding service creation. These attributes are interdependent, so that a lack of experience using creation tools will involve the development of creation tools with a lower degree of flexibility, which inevitably affects the service scope. Likewise, a service which requires a wide scope demands a high degree of flexibility and experienced target prosumers. As the service scope is defined by the target users, or the domain expert that represents them, the design phase analyses whether the relationship between service scope, flexibility and experience level of target customers is met. If the analysis fails some solutions are

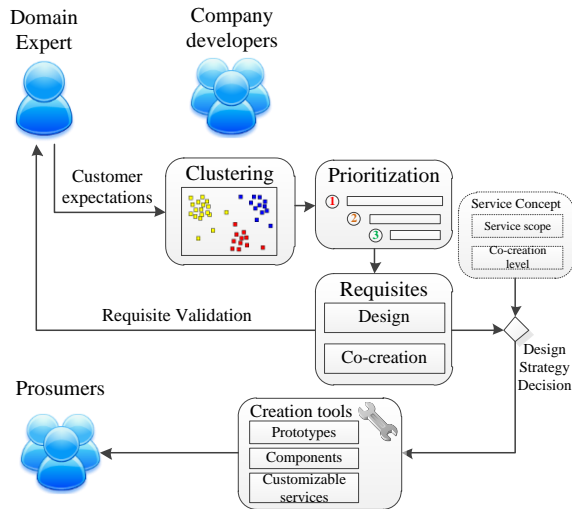


Figure 4. Development phase

sought, such as increasing user experience through training courses for prosumers or reducing the service scope by dividing it into several sub-services, whose combined scope makes up the full scope.

B. Analysis

In the analysis stage, organizations estimate the market-performance potential, strategy and financial prospects of the new service concept. The analysis phase, shown in Fig. 3, analyses whether the new service concept is aligned with the business strategy. Two simultaneous value calculation processes are produced, which determine the suitability of the service creation process: prosumer value and business value estimations.

We define *prosumer value* as the overall benefit perceived in the service solution at the price the prosumer is willing to pay. In the prosumer environment, users create and consume services as long as their perception (i.e., the prosumer value) of the service creation and provision tools is adequate. Prosumer value must be identified at early stages of the methodology by using customer input information. While customers may be able to provide some guidance, some of the most successful cases of value identification occur when a company provides a service that addresses a need that the customer was not aware of previously [3].

We define *business value* as the benefit experienced by the company for the acquisition of knowledge, experience and presence in the sector. The business model of prosumer service development has been exploited before, and is adopted by major online stores such as Android Market or Apple Store. These stores provide development tools, a service search and publication infrastructure and a control mechanism for published applications. In return, they benefit from a percentage of the applications’ selling price, which is estimated by the application creator.

We define a threshold below which the project is not viable. This threshold depends on the benefit margins of the project development and the business value mentioned above. These concepts will not be studied in depth in this paper.

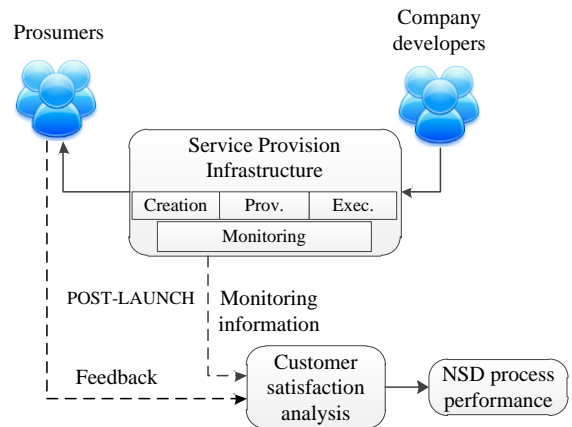


Figure 5. Launch phase

C. Development

The development phase is described in Fig. 4. In the model proposed by QFD, customer expectations are often described as verbatims, for example: “I want to have an on/off button in the main screen of my creation tool”. At this stage these verbatims must be converted to re-worded data using simple expressions as “higher customization” and “add control buttons”. These data are *classified into clusters* that share a common theme (e.g., interface customization, easy to use) and *prioritized*. The *house of quality* diagram [13] can be used for this task, which utilizes a planning matrix to define the relationship between customer desires and firm capabilities. The result of this classification and prioritization is a set of requisites (design and co-creation requisites). If the domain expert involvement is high it is advisable to validate with the domain expert the collection of customer expectations to meet the term *voice of the customer* [12], widely used in QFD to describe the in-depth process of capturing customers preferences and expectations. Once the requirements are validated, decision criteria are used to select *service design strategies*. The attributes affecting the service concept are used as criteria: *service flexibility* of prosumer tools demanded by customers and *experience level* in service creation for target customers. Fig. 6 shows the relationship between these two attributes and characteristics of the design strategies for the described use case.

A process whose objective is to develop a co-creation support system takes place once the design strategies are chosen. This system allows customers and developers to agree upon prototype evaluation, intermediate versions and co-creation requirements adjustment. Prototypes are used as proof of concept to demonstrate that the requirements of the prosumer are properly understood by the creation tools developers. Prototyping is considered a design strategy for environments with high involvement of the domain expert.

The outcome of this phase is a set of *creation tools*, templates, prototypes, atomic and customizable services as well as the mechanisms for monitoring the service life cycle.

D. Launch

The launch phase (see Fig. 5) is divided into two phases.

+ Prosumer experience -	WYSIWYG	Composition	
	Template configuration	Mashups	
	Creation wizards	Service prototyping	
	GUI customization	NWL interface	
	-	Flexibility	+

Figure 6. Design strategy decision criteria.

In the *pre-launch analysis* phase, the service provision infrastructure is designed, according to the developed services and the mechanisms for monitoring them.

In the *post-launch evaluation* phase, the information collected by the infrastructure and customer feedback is iteratively analyzed in order to evaluate the *prosumer satisfaction* for the service (NSD outcome quality). It also evaluates the process performance for the company (NSD process performance), from the point of view of the operational effectiveness and market-place competitiveness [5]. Measures to analyze this performance are divided into the prosumer satisfaction by the use of developed services (*NSD outcome quality*) and the process performance for the company (*NSD process performance*).

V. VALIDATION CASE

We present a scenario in which we applied this methodology for the creation of prosumer service delivery infrastructure in the Future Intelligent Universe, as part of the mIO! project [26], supported by the CENIT Spanish National Research Program (CENIT-2008 1019).

In this scenario the prosumer user, using his mobile phone, interacts with the elements (sensors, actuators, smart devices) that are around him in order to obtain their functionality. The prosumer user creates and shares services by following the prosumer model shown in Fig. 1. Our goal is to use our NSD method, defined in Section IV, to create an infrastructure for service creation, delivery and execution.

The first step is to select a domain expert (based on the concept of lead user [6]) to identify customer needs. We determine that the user experience is varied, because, although this environment is focused on non-expert users, some of them are familiarized with creation paradigms. Thus, if we want to achieve high flexibility, the scope analysis requires dividing the infrastructure design in several subsystems, to cover the service scope.

The viability analysis concluded with satisfactory results, thanks to high prosumer value and a sustainable business model for both the company and prosumers. The company business model is based on sponsored final services and the incorporation of advertisings and sponsorship in creation and execution tools. The business model for prosumers is based on applying the *Freemium model*, combination of free and premium services.

In the development stage, following the proposed QFD model, the ideas expressed by the domain expert are

processed and clustered. In total we extracted 104 requirements, divided into 9 clusters (Infrastructure, User and Subsystem Interaction, Security, Context, Personalization, Service Model, User Interface and Technologies) y 32 subclusters. For example, through this process, the user idea “I want to take my services on my mobile” was turned into the “mobile service provision” requirement, and was introduced in the subcluster called *Service Provision*, within the *Service Model* cluster.

We relate the prosumer experience level to the creation flexibility required in order to determine the most appropriate design strategy. Fig. 6 shows the considered decision strategies.

As prosumers in this scenario have a mixed experience for service creation we need to take more than one design strategy. The main determinant for the decision is the requirement of high flexibility. Thus, we discard the strategies that provide only a few customization options (*GUI customization*, *Template configuration*, *Creation wizards*), and also the *WYSIWYG* (What You See Is What You Get) paradigm, for being difficult to be used in a domain as general as mobile and ubiquitous sensor access. Regarding the remaining options, we discard the *Mashup* creation strategy for being somewhat less flexible than the choice of *Service composition*. Therefore we consider the development of tools to enable *Service composition* for experienced prosumers and Natural Written Language (NWL) creation interface for non-expert users. Thanks to a high domain expert involvement in NSD we consider advisable to use *Prototyping* as a strategy to avoid deviations in the design objectives.

After selecting the design strategies we proceed to the infrastructure implementation stage. Some parts of the implementation, such as service creation environment based on natural written language and sensor access can be seen in [24] and [25] respectively.

The launch phase is performed on a test group that studied the platform and we received several conclusions. Due to space limitation we only describe four of them:

- The creation mechanism for service composition is somewhat difficult to assimilate by non-experts, who have found the creation system based on natural written language [24] more intuitive.
- To really obtain consumer satisfaction we need to provide a large set of components so that composition is versatile.
- The limited display capabilities of a mobile terminal delegate the composition creation method to devices with larger screens, such as tablets.
- It is recommended to support service provision with the help of fixed infrastructure, to avoid provision issues due to lack of coverage or battery problems.

As conclusions of the analysis we believe that the application of our NSD method to the implementation of this scenario has been very helpful and the application of the defined design strategies has been successful.

VI. CONCLUSION AND FUTURE WORK

This paper proposed a tool development method for creating services for prosumer users, based on NSD. We evolve this methodology to cover the interrelationships of the different roles that traditionally participate in the creation process (company developers and customers) with the new *prosumer user* role. This prosumer user is the consequence of the evolution of information society, in which users are more participative and feel responsible for the generation of services and their publication into the user community.

In this paper, we develop a NSD method for prosumer environments. We review some concepts belonging to the service development process, such as *service concept*, *service scope*, *value estimation*, and we define other concepts, as *co-creation level*, *prosumer value* and *co-requisites*, which became contributions to the traditional NSD stages. As a validation, we show a service creation scenario for mobile prosumers and, following our proposed method, we develop some creation tools and a service delivery infrastructure.

We consider the implications in NSD of the new prosumer role as a contribution to the traditional service development process. This prosumer role reflects the current evolution of society towards a service provision model focused increasingly on the user.

Feedback from users allows us to identify future work on the proposed model, such as developing service composition tools for distributed service provision and task delegation and studying the characteristics of creation skills of non-expert prosumers thoroughly.

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