

Product-Service Systems across Life Cycle

Technology-based product-services for supporting frugal innovation

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Abstract

In recent years, European manufacturing companies are gradually applying innovative PSS (Product Service Systems), as strategic opportunity for differentiating from competitors, offering an integrated bundle of products and services, targeted on specific needs of different customers. At the same time, frugal innovation has also surged as a new business concept based upon an intelligent use of resources to fulfill region-dependent customers' needs. Both approaches bring forth rethinking of established business models, which in turn asks for an in-depth analysis of the implications on the company organization and infrastructure, at supply chain and plant levels, urging towards manufacturing networks and reconfigurable assembly lines. This paper presents a formalized framework to support product-service design and the related business model characterization, in the context of frugal innovation. The methodology is applied to three real industrial scenarios respectively in the aeronautics, the domestic appliances and the machinery industry, which are analyzed within the framework of the H2020 European funded project 'ProRegio'.

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1. Introduction

Recent findings of WTO [1] show that manufacturing global supply chains are shaped into regional blocks, i.e. European, Asian and North-American. This reflects on customer demands and requirements in product and services offering, which assume strongly different regional characterization. Mastering global production and distributed customer networks means addressing in a hub-spoke structure the different needs arising from markets, providing targeted products and services. It is the base of frugal innovation, which aims at exploiting the concept of intelligent use of resources, turning the related constraints into advantages and driver for products (and related services) innovation [2]. In fact, frugal innovation systematically works its way towards target customers' needs, addressing different requirements in terms of product design, functionalities, quality, prices etc,

which shows a regional dependency. Diverse implementation examples arise especially in emerging markets (see [3]), emphasizing the frugalization great potential; nevertheless industrial applications appear as fragmented and far from being structured. This asks for business approaches, which are able to provide locally adaptable offering, without losses in terms of efficiency, in a systematized manner. The development of product-related services with high technological content permits supporting the customer-driven innovation of frugal products, reducing time-to-market and delivery times, fostering the ability in dealing with distributed networks of customers and of production facilities. This is the idea on which ProRegio EU funded project is grounded. It aims at developing product-services, related advanced ICT and cloud-based tools for supporting frugal innovation, allowing the co-evolution of products (and services)-processes-production systems, according to localized

customers’ needs and production sites capabilities. It relies on manufacturing intelligence solutions (e.g. augmented reality) for integration and adaptation of shop floors and production networks, with ad-hoc re-design, based on active feedback and knowledge exchange among producers, suppliers and end-users.

Thus, this paper aims at presenting a formalized framework for the definition of technology-based product-services and related business model, for supporting frugal innovation. Within the context of ProRegio project, structured and semi-structured questionnaires, meetings and discussions are used to gather information from industrial partners in order to define product-services for the different application domains, i.e. aeronautics, domestic appliances and machinery industry, following a bottom-up and iterative approach. Hence, in Section 2 we discuss how the frugalization of the offering (either products, services or a combination of both) can be tackled within the product-services generation and business model definition, which is presented in detail in Section 3. It is followed by the presentation of the ProRegio product-services, their classification and the detailed analysis of one representative example in Section 4. Section 5 points out the main conclusions and draws possible future work paths.

2. Frugalization-oriented product-services

2.1. Frugal innovation in the context of product-services

Frugal innovation is a process of adapting goods and their production, tailored to the target customers’ requirements. It discovers new business models, reconfigures value chains and re-designs products, based on intelligent use of resources and high industrial efficiency [3]. Although the majority of works on this topic deals with emerging countries (e.g [4],[5],[6]), whose unsaturated, huge and fast growing economies reproduce the perfect conditions for the implementation of frugal innovation strategies, the developed economies can benefit from this approach successfully too. In fact, environmental and resource constraints can be drivers to innovate products (and services), increasing their affordability and sustainability performances during their design and [4], according to specific reference market preference. Since it’s a customer-centric perspective, the possibility to actively include users and offering providers products and services design and delivery, allows a co-creation of the value associated [7] and, definitely, the establishment of long-term collaborations. It matches perfectly the re-thinking of business models and value chains which characterize the product-service paradigms. They are often defined as “a mix of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling final customer needs” [5]. This implies the overcoming of the product-focused technical offering, based on transactional relations, towards a service-centered selling grounded on long-term relationships and value added proposition [6]. Operationally, these collaborative relations require innovations in business models and related technical enablers (advanced ICT solutions, manufacturing intelligence and

Internet of Things [7]), at different levels, i.e. plant and network level, in an integrated fashion. The implementation of such solutions reduces the innovation costs, enabling the accumulation of knowledge which has, in turn, scale effects. This promotes customer-oriented and less over-engineered product variants design and manufacturing and improves the optimal collaboration and coordination in the production networks.

2.2. Framework for supporting frugal innovations in products and services

The goal of frugalization in the context of product-services is responding to target market cluster needs with appropriate product-service packages. This is triggered by the definition of the target markets and their segmentation into clear clusters, using key characteristics (e.g. regional criteria).

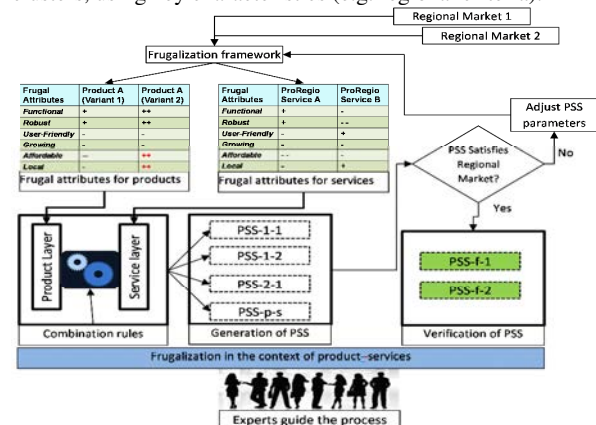


Figure 1 Frugalization in the context of product-services

Through the frugalization framework (Figure 1), each market cluster and related needs are transformed into frugal attributes, namely “functional”, “robust”, “user-friendly”, “growing”, “affordable” and “local” [3]. They represent the drivers for frugalizing products and services. These can be fulfilled by the product dimension (product layer) or by the service dimension (service layer), which shows mutual interdependency. For example, the selection of a product variant can impact on the associable service packages, and vice-versa. Combinations rules are needed to create feasible and optimal mix of product variants and services, thus defining product-services. The process can be automated or guided by multi-disciplinary experts. Using the combination rules, a list of candidate product-services can be generated. Each product-service plan is evaluated in order to verify if it meets the regional target market expectations. Expert evaluations are required on various aspects of the product-service offering, including financial benefits for providers and receivers. Therefore, during the verification phase, the final proposals are selected.

3. Framework for business model in ProRegio product-services

The constitutive elements of the product-service business model framework, proposed for ProRegio product-services,

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