

PRODUCT-SERVICE SYSTEMS DEVELOPMENT AND MANAGEMENT – NEW TREND IN SERVICIZATION

Anca Draghici

Politehnica University of Timisoara, Romania
anca.draghici@upt.ro

Adrian Mateescu

Politehnica University of Timisoara, Romania
adrian.mateescu@gmail.com

Hugo Weinschrott

Politehnica University of Timisoara, Romania
hw@bfc.ro

Ioana Sarca

Politehnica University of Timisoara, Romania
sarca_ioana@yahoo.com

Abstract:

Today, many manufacturing companies are moving towards the integration of products and services in order to achieve competitive Product Service System (PSS) that better satisfy customer needs (through innovative customization actions). Furthermore, the actual market dynamics push manufacturers to enriched and extend the products portfolio by their integration with adequate services, while the new product development approaches may require some changes and adaptation to this new design and marketing behaviour. This generate a new business model by the adaptation to the service development. The aim of this paper is to present an analysis based on the state-of-the-art regarding the new perspectives of Product Service System (PSS) development, design and engineering. In addition, some managerial aspects will be debated to underline organizational aspects and changes required when the new business model is adopted. The analysis done is supported by an example of good practice and experience gained by a research institute and university collaboration, both located in Romania. The research aims to discover and describe feasible ways for PSSs development and providing them on the market, in the context of a university and a research institute collaboration (supported by the open innovation approach). In this context, the structure of the presented paper consists of the following chapters: (1) Introduction – the new business environment specifics; (2) Actual trends for servicization; (3) Debate on the difference between physical - tangible product and service – intangible products (presented through a case study); (4) Conclusions. The research result is the basis of the strategy for the PSS development in the case of an organization that operate in the research field (research institute for welding and material testing).

Keywords: Product Service System (PSS) development; PSS design and management, innovation, business model, strategy

1. INTRODUCTION – THE NEW BUSINESS ENVIRONMENT SPECIFICS

Today's markets are characterized by high competition and dynamics. Thus organizations and their business models change, as well as the stakeholders' management, adapting continuously to their customers' needs and requests (Reim et al., 2015). In particular customers' needs are becoming more customized and companies are pushed to innovate for a full solution provision (Lingegård et al., 2012). This fact of global markets implies a stronger relation between customer and solution provider, and, from the solution perspective, together with new innovative ways to develop and deliver it (Oliva and Kallenberg, 2003, Lindhal et al., 2009, Baines, 2009). In addition, tendencies are supporting services development as the formula to cover all these aspects. Organizations willing to stay on the edge need to adapt their business processes to cope with the change (Oliva and Kallenberg, 2003, Morelli, 2006, Lindhal et al., 2009, Ulaga et al., 2011). Furthermore, the product portfolio needs to be enriched and integrated with services, while the new product development approaches may require some adaptation to the service development (Thompson, 2012, Maussang et al., 2009, Morelli, 2006).

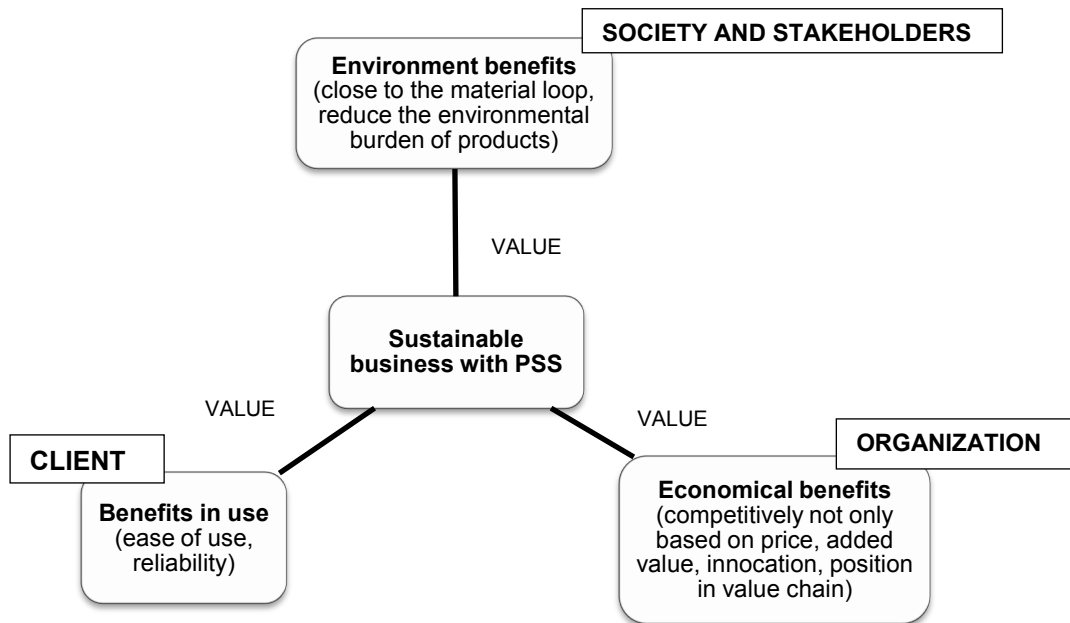
This new manufacturing and marketing behaviour of adaptation is required because services differ from classical products. One of the differences is due to the deep human involvement into the service delivery. It means that product development processes, when dealing with service-products, have to take into account this specific issue (Morelli, 2003, Maussang et al., 2009, Reim et al., 2015).

The aim of this paper is to present an analysis based on the state-of-the-art regarding the new perspectives of Product Service System (PSS) development, design and engineering. In addition, some managerial aspects will be debated to underline organizational aspects and changes required when the new business model is adopted. The analysis done is supported by good practices and experiences gained by different companies. The selected topics of the analysis (as main chapters of the paper) are: (1) Introduction – the new business environment specifics; (2) Actual trends of manufacturing servicization; (3) Debate on the difference between physical - tangible product and service – intangible products; (4) Conclusions. The research result is the basis of the strategy for the PSS development in the case of an organization that operates in the research field (research institute).

2. ACTUAL TRENDS FOR SERVICIZATION

Today, in the functional economy, user has a need at a certain moment. Industry must provide a service to satisfy this need. The user rents the service (paying only for his current need and economizing his/her expenses and investments amount). The service ends when the need disappears or it is completely satisfied. When the needs change, the services (and goods necessary) will change. The user does not have to be concerned about goods when they finish their life-cycle as they do not belong to him/her and they can be returned immediately after use. Furthermore, goods can be then used by another user.

Picture 1: PSS Benefits for the different actors linked with the organization (related to stakeholders' management)



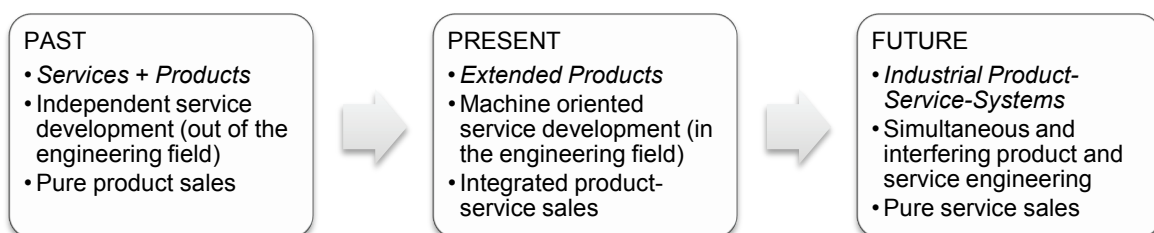
PSS strategies seek to sell services instead of products. The products remain the property of the producer. They can be let out or rented to users. The finality of PSS will be to sell the functionality instead of the product. PSS naturally represents a sustainable strategy. However, PSS can be more or less sustainable. It is necessary to check the effects on all the stakeholders (see Picture 1).

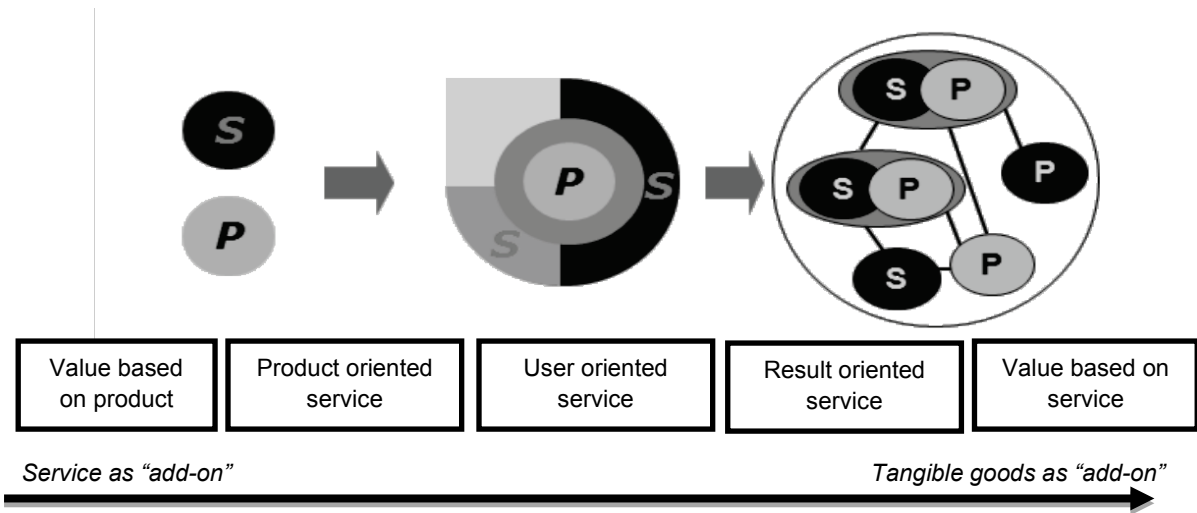
Product-Service-Systems result from the research outcomes in the last 20-30 years can be summarized as followed:

- Focusing on needs can be intrinsically more sustainable;
- Product-services are meant to create value instead of products (do not sell the product but sell the service);
- Creating value of use. PSS has offers some responsibility toward the producers and they are interested in an efficient delivery process. The consumers vision have been changed because they are much more focused on the real cost of the service;
- PSS has contributed to the creation of a sustainable value, considering the economic, social and environmental dimensions.

Nowadays, PSS is a wonderful candidate to a sustainable world by operating with strategies related to: sustainable development, remanufacturing, service design, service economy, product substituting service, dematerialization, system solution (Breuen et al., 2013). Traditionally, products and services have been treated separately in modern economies (Tukker, 2004). Services were developed independently from products, and product design does not take services into account. Often, today, services are simply added-on to products. This is an improvement from the previous sate. However, the product design does not change fundamentally or very slowly and technical services for products or machines are most common (Picture 2). In the future, consideration of product and service aspects at the same time will be able to achieve radical innovation. Interchanging products and services will greatly reduce material and energy consumptions. Thinking will become more systemic and the nature of the products and services will evolve tremendously (Lee et al., 2012, Reim et al., 2015).

Picture 2: Synthesis of the PSS evolution and integration in industry. Future trends

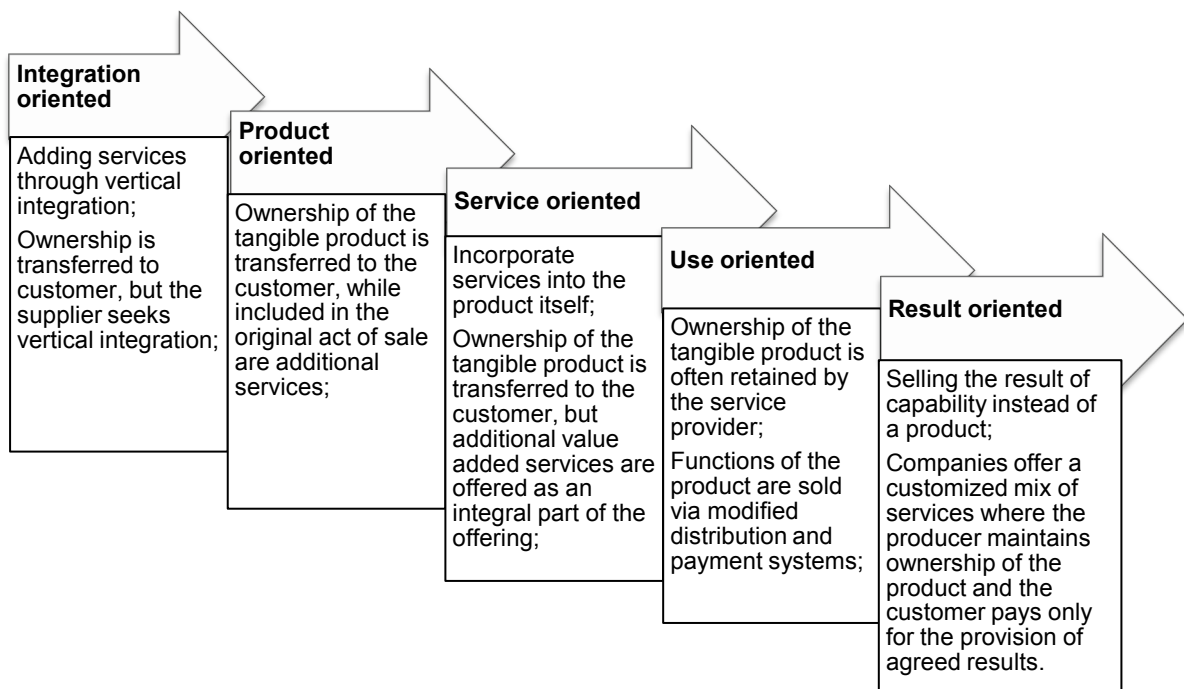




Source: extended from (Boudreau et al., 2008).

As it has been synthesis in Picture 2, there is an increasing shift from the product-based business to the servicization as a core of the business model. What is observable is that non-service based organizations are pushing towards an integration of physical products and services, enriching thus their portfolio with hybrid offering (for example, PSS). The servicization type differs depending on the service content. A classification is shown in Picture 3. As it can be seen, PSS embodies a transition from “well-being based on the product” to “well-being based on the access to the product”.

Picture 3: PSS types in their evolution



3. DEBATE ON THE DIFFERENCE BETWEEN PHYSICAL – TANGIBLE PRODUCT AND SERVICE – INTANGIBLE PRODUCTS

3.1. Preliminary considerations for the experimental research

The premise of the research done is based on the most accepted definition of PSS that considered it is “an innovation strategy, shifting the business focus from designing (and selling) physical products

only, to designing (and selling) a system of products and services which are jointly capable of fulfilling specific client demands” (Manzini & Vezzoli, 2003). Substantially, products and services are different by their physicality and they can support marketing strategies both B2B and B2C (Table 1).

PSS consists of a *hard* sub-system and a *soft* one (Muller and Sakao, 2010), thus as for pure services, they can be considered as services enabled by a physical product. Though they might be considered as standing in between pure products and pure services, even in the Product-Service oriented class of the product-services continuum (Tukker, 2004), the characteristics of pure services must be considered as well for the development and operations purposes. That is the human resources factor has heavy weight and should be taken into account in all the PSS development and delivery.

Table 1: Comparison between products and services (literature synthesis)

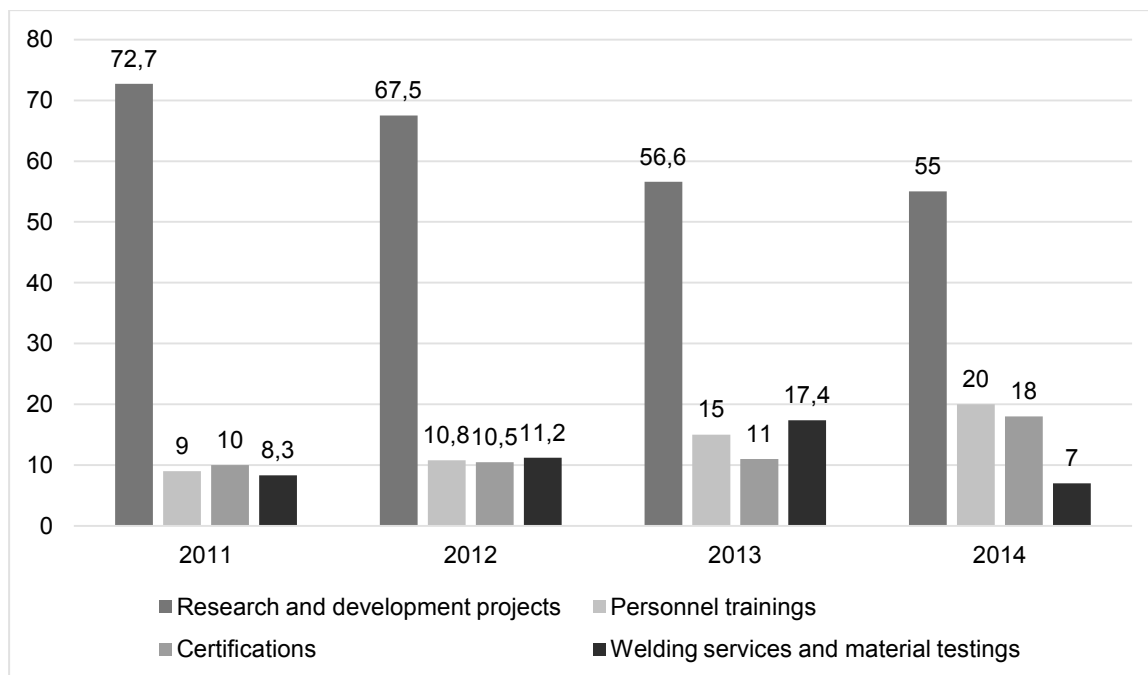
Criteria of differentiation	Product	Service
Final destination (purpose)	Designed in order to satisfy customers' needs	
	Eco-products and the end-of-life techniques can satisfy sustainable consumption (with high costs)	Viable solution (AS IS or as they are developed) for sustainable consumption
Physicality	Tangible	Intangible
Storage	Can be storage	Cannot be storage
Customer – Producer relationship	Production is decoupled from consumption; is low criticality of producer personnel	Consumption is concurrent with production; is high criticality of producer personnel (qualifications, skills)

3.2. Experimental investigation

The research result is the basis of the strategy for the PSS development in the case of an organization that operate in the research field (a research institute for welding and material testing, located in Romania West Region) that has the objective of services system portfolio development in the framework of the collaboration with an university, based on an open innovation approach. Both organizations are important actors on the national research market in their field of competencies and expertise and their main scope was to generate more added value for their customers (industrial organizations) simultaneously with the focus to sustainable development.

The research institute is currently involved in the national and European research programs, being member of the International Institute of Welding (IIW, <http://www.iiwelding.org/>). Additional to the research activity the institute has developed and provide industrial services as: professional training and certification in welding and non-destructive testing of personnel and companies (Picture 4). According to the presented data, the research institute objective is to create a balance between its main activities, in order not to be highly dependent on the national research funds (usually gained through national competition but that has been developed with smaller budgets each year).

Picture 4: Main activities developed by the research institute and their dynamics (2011 – 2014)



Source: data provided by the research institute annual reports

The organizational structure of the research institute consists of three departments: the Research and Development Department, the Industrial Services Department and the third is the Economic Department (assures the support activities as: human resources management, financial and accounting, contracts, supply and sales). On the same hierarchy level is the Technological Transfer Centre which objectives are to elaborate and implement strategies, measures for technological transfer and innovation in the field of welding, of allied procedures, of material testing and examination, in compliance with the European practice. The organizational structure is considered well defined in order to support the changes of the institution business model (the new one should be focused on PSSs).

Services development and providing are activities high criticality of the research institute personnel. The general personnel reduction in 2011 and 2014 was determined by retiring, transfer in other working places and persons dismissed because of insufficient performance. At the date of evaluation (September 2015) the institute has 46 employees and 35 of them are working in R&D area and in personnel training, certification, material testing laboratory and in workshop; 8 persons were working in administrative and support activities. From research personnel dynamics there have been discovered that the number R&D personnel with high expertise was low decreasing mainly by voluntary changing the working place (because of the research activity diminishing and the low rate of attracted funds).

The preliminary analysis of the research institute activity and its collaboration capacity was the basis for the research done in order to discover potential cases of PSS development (with high potential of being designed in partnership with the university). Table 2 synthesizes the results of the *focus group* done within the group of 13 *specialists* from the research institute and the university (specialists from the Department of Materials and Manufacturing Engineering).

Table 2: Potential PSS that were suggested by the group of specialists

Basic services provided by the research institute + PSS definition	University added value to enriched the existing services	Average score (calculated based on the 13 specialists' opinions)
Fundamental and applicative research in the field of welding and material testing + regular advertising of the research results (local, national level) PRIORITY 1	Cooperation for PhD programs support and partnerships in research projects (national and international) – co-finance of the research; assure personnel for research	4.333 (score influenced by the decreasing number of students enrolled in industrial engineering and material science specializations)

Dissemination of scientific and technical information + together with workshop with practical demonstrations PRIORITY 1	Support the scientific events; co-organization of scientific events – co-finance the dissemination events	4.333 (the big score is the results of the quick accepted action/service that have to be co-created by both institutions)
Constructive development of welding equipment and material testing equipment + define clearly PSSs with specific options for equipment rent (technical upgrades or environmental concerns interventions, entail constant surveillance and meticulous documentation of the functionalities) + selling the result of capability instead of the equipment PRIORITY 2	Add specific industrial services for the equipment; extend the market to the regional, international level	4.000 (score influenced by the diminishing budget of the R&D activity at the national level and the economic crisis)
Certification and quality assurance at personnel and manufacturer level + regular advertising of the services provided (on the local, regional, national and international market) PRIORITY 2	Transfer the activity as a mandatory one for graduates in the field of welding and materials science (assure transferable credits recognition) - – co-finance of the students practice	4.000 (score influenced by the need of practical skills gained by the graduate students)
Training of welding and non-destructive testing personnel + providing training materials on-line and for practical exercises PRIORITY 3	Support training programs with additional teaching staff, capacity and know-how (demonstrations in own laboratory); transfer the activity as a mandatory one for graduates in the field of welding and materials science (assure transferable credits recognition) - co-finance of the students practice	3.867 (score influenced by the need of practical skills gained by the graduate students)
Scientific counselling, expertise, prognosis, failure analysis, inspection + regular advertising of the services provided PRIORITY 4	Subcontracting for testing and validation of the university research results	3.733 (score supported by the expertise of the existing teaching and research staff of the university)

The opinions collected were quantify and for each PSS there were obtained a score that show the most attractive (5) and less attractive solution (1) proposed.

The average scores were calculated as following:

$$S = (N1 \times 1 + N2 \times 2 + N3 \times 3 + N4 \times 4 + N5 \times 5) / 15 \quad (1)$$

where N1, ..., N5 are the number of the responds given by all 13 participants in the focus group, to the related scores of the Likert scale: 1, ..., 5. The calculations were supported by Excel application. Based on the results, the potential PSS, provided by the research institute in collaboration with the university, were included in a hierarchy in order to establish the strategic priorities (Table 2 presents the final hierarchy of the priorities as the analysis result). This preliminary analysis was the bases for the future PSS strategy developed in partnership by the institute for welding and material testing and the university.

4. CONCLUSIONS

Today, many manufacturing companies are moving towards the integration of products and services in order to achieve competitive PSS that better satisfy customer needs (through innovative customization actions). Furthermore, the actual market dynamics push manufacturers to enriched and extend their

existing products portfolio by their integration with adequate services, while the new product development approaches may require some changes and adaptation to this new design and marketing behaviour. This generate a new business model by the adaptation to the service development.

In this context, theoretical concept definitions and methodological approaches for PSS development could stand as excellent frameworks in order to support feasible organizational strategies in the field. The presented actual trends for servicization have proofed the benefits of PSS for clients, society and stakeholders and for the organization itself. References in the field has recognized that PSSs implementation are viable solutions for organizations' sustainable development and they also, determine sustainable consumption (as customers, client behaviour). Furthermore, the presented synthesis of the PSS evolution, integration in industry and trends demonstrate that there is an increasing shift from the product-based business to the servicization as a core of the new business model.

The literature review together with the PSSs tends have been considered as the basis for the experimental research. In the literature, PSSs are considered, debated and analysed only in the case of industrial products and organizations. We didn't find any extension of the PSS researches in the case of institutions as research and development one. The case study has shown that based on the well accepted PSS definition and typology (as presented in Picture 3) there have been planned and conducted a focus group with specialists from a research institute and university in order to discover new opportunities of common actions for the PSS development. The collaboration (in open innovation) between the considering institutions will be in their reciprocal advantage, considering the co-creation of the added value based on sharing costs, capacities and human resources, with impact on their incomes and the market prestige increasing. The debates and argumentations of the specialists has underlined the immediate solutions that could be considered for the PSSs development, but also their opinions have been contributed to the prioritization of their future common actions (Table 2).

The PSS mapping has a great contribution for the future strategy and the new business model of the research institute. A change in business strategy require changes in the way the research institute's human resources perceive their activities. PSS approaches implementation call for increased integration of the development activities within the organization (behaviour adjustments and incremental changes) and within its networks of institutions and industrial companies. In the future, researches and investigations have to be focused on how these development activities are to be coordinated and managed in order to better support the new PSS business model.

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