

Product-Service Systems across Life Cycle

The Last Border for Servitization

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Abstract

The search for flexibility in the new product development (NPD) entails an increasing need for integration of services and products (servitization). Hence, companies aim at maximizing the customer perceived value, which may demand new capabilities development, besides marketing, engineering and manufacturing. This paper suggests that the ‘customer service’ functional area has a central role in this context, since it deals with customers’ problems in a front-end position, and its knowledge can help other functional areas to develop required capabilities for servitization. Moreover, the level of knowledge transfer (KT) among different functional areas is also proposed as an essential activity to improve the servitization process. Thus, the aim of this paper is to investigate the moderator role of both the customer service area and the KT activities in the impact of the NPD related functional areas on servitization performance. For this purpose, the paper presents a cross-industry survey with 83 Brazilian companies, analyzed by means of an Ordinary Least Square (OLS) regression. Results show that the last border to transcend the servitization barriers in NPD is the integration of the customer service area to the other main functional areas of NPD. Moreover, our findings indicate which areas are the most critical ones in order to address an intensive KT activity to enhance the servitization performance.

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1. Introduction

Traditionally, the inter-functional integration in new product development (NPD) has been approached from three complementary perspectives: (i) marketing, (ii) engineering and (iii) manufacturing [1,2,3]. However, in last decades, the NPD process has evolved through flexibility increase according to the offer (i.e. adaptability to specific customers’ needs), and by means of services aggregation to maximize the customer perceived value [4,5]. This services’ aggregation process is understood in this paper as the servitization process of NPD activities [6]. In this context, the aforementioned three functional areas’ perspectives may have narrowed the contribution for servitization development, since they are restricted to the traditional NPD business model.

Therefore, there is another input that should be considered in cross-functional NPD teams: the Customer Service area. This area presents an important role, since it deals with the front-end customer’s experience and product utilization [7]. The application of the knowledge attained from the interaction between customers and products may help other functional areas to develop new capabilities in order to better integrate products and services’ solutions during NPD. Moreover, prior literature recognizes that the intensity of knowledge transfer (KT) among different functional areas is essential to improve innovation [8,9]. Therefore, this paper also proposes that inter-functional KT is an activity that enables to enhance the contribution of different functional areas to servitization performance, since it provides a shared vision of the servitization requirements.

Thus, the aim of this paper is to investigate the moderator effect of both the customer service area and the KT activities in the impact of the NPD related functional areas on servitization performance. The proposed method comprises a cross-industry survey which was carried out with 83 Brazilian companies. The outcomes of this research allow determining which functional areas have customer service area and KT activities as central moderators towards the achievement of a better servitization performance. Therefore, this paper offers a new perspective of inter-functional knowledge transfer by proposing that companies should look inside their processes to consolidate knowledge about customer experience in the customer services area and apply it to the NPD process. These inputs are key for servitization and may reinforce the initiatives on KT activities in order to promote better servitization performance.

2. Theoretical background

The service contribution for NPD has been confirmed in product-service system (PSS) and servitization literature. Both streams highlight common contributions, such as: product customization [10], adaptability, expandability and customization of the offer [11], improvement of customer's loyalty [12], extension of perceived value in products' offer [13] and change of the interaction with customers from transactions to relationships [14]. Due to a widely deemed relevance of services' inclusion in products, researchers have proposed several strategies to accomplish this offer integration.

Based on a bibliometric study, Oliveira *et al.* [15] identified four distinct theoretical streams applied to this matter: (i) servitization, business model and uncertainties in implementing PSS; (ii) technical aspects (production planning, Radio-Frequency Identification and industrial PSS); (iii) sustainability and PSS; and (iv) service engineering. The first and the fourth streams aim at proposing processes that allow the development of successful product-service joint solution. However, the first one focuses on strategy and capabilities [16], which are the main inputs of NPD; while the second one studies the actors for Integrated Product Service Offer (IPSO) [17], service engineering and design methods [7].

In order to combine both perspectives, the following topics of literature review focus on establishing a better understanding about the knowledge integration of the customer service area in the NPD process for servitization.

2.1. Customer Services role in Servitization Strategy

Customer Service is defined here as a specific functional area of the company responsible for providing customers with information and solutions during the product utilization. According to Tukker's [18] classification of services, this area may have the following responsibilities: (i) product orientation (e.g. product-related service and advice and consultancy); (ii) use orientation (e.g. product lease, product renting or sharing and product pooling); and (iii) result orientation (e.g. payment per service unit). Thus, this area has

an important contribution to the company's servitization process, since it plays a front-end role with customers.

Baines *et al.* [6] understand servitization of products as the process in which a company moves from a product offer to a PSS by adding services to products. Meanwhile, Tukker [18] sees it as a process in which the orientation of the offered service changes from just supporting products to being result oriented and the main component of the offer. This definition is aligned with the idea of Vargo and Lusch [19], who state that every product delivers a service. In both cases, the company starts with a pure product offer and needs to add service competences to its body of knowledge aiming an increase on customers' value perception.

In this sense, the service offering and customer experience knowledge is part of the company competences and, as suggested by Cohen and Levinthal [20] in absorptive capacity theory, could be the key to recognize the value of new external opportunities in the services domain, and apply it to commercial purposes. Within servitization context, the servitization performance is measured in terms of its capacity to promote products. The scale proposed by Raddats *et al.* [21] is representative of this point of view, since they consider the following services' achievements: (i) selling new products to existing customers; (ii) winning businesses with new customers; (iii) retaining existing customers; and (iv) enhancing products' performance.

2.2. Customer Services role in the Servitization of NPD

The NPD is a continuous [22] and multidisciplinary process in manufacturing companies that expect to be innovative [23]. It includes different disciplines and functional areas in order to make the strategy explicit and to meet customers' needs [24].

Initially, the engineering area was considered the first responsible for product innovation in a generation marked by technology push, in which the most significant investment was in R&D programs. Next, marketing gained space as a source of ideas for products and with a strategy focused on growth and diversification; this stage was called 'market-pull'. With regards to the manufacturing area, it has always been present since industrial revolution. It provided technology to enable the production of developed product and to obtain productive performance. Additionally, it became important in the scale economy for cost reduction [23].

A strong marketing orientation emerged from the need for customer services development based on experience creation [23]. In 1977, Shostack's work, "Breaking free from product marketing", highlighted the need to involve marketing in NPD processes, which triggered researchers attention to the influence of this functional area. This new field defended that, to be efficient, service marketing should demand an opposite view from conventional NPD practices [25]. Customer Services aimed at covering such gap in companies.

Information derived from servitization has been emphasized as one of the future sources of firm's revenue [26], and customer services' knowledge can provide it to the servitization strategy during the initial steps. Outsourcing this activity may present risks and deviate from market

orientation. It results in an open cycle of knowledge about product performance and customer’s experience. Comparing the traditional product value chain and the demand-supply service chain, the interaction with customers provides a stronger feedback for offering continuous improvement [27] and knowledge inter-temporal integration in NPD.

The traditional structure of NPD usually associates marketing to market (product strategy), engineering to creation (product design), and manufacturing to making (product building) [28]. These areas are frequently studied as the main parts of the NPD process. Customer service is commonly dedicated to the post-development activities, i.e. allocated at the end of the NPD process; since it is responsible for providing customers with information about the product for solving eventual problems during its usage, and for developing customer experience by means of service provision. Therefore, this area acts reactively to marketing and engineering decisions. However, since it has a front-end role with customers, this area could provide important insights and solutions for the integrated product-service solutions that could be developed by the other NPD areas. Thus, the following hypothesis is proposed:

- H1: The customer service area participation in NPD projects moderates the effect of marketing, manufacturing and engineering on the servitization performance.

2.3. Inter-functional Knowledge Transfer in NPD

Customer service orientation (market orientation) has showed a direct effect for superior performance achievement in business operations [13]. Market orientation is defined as the generation, dissemination across departments and responsiveness of a company to market intelligence [29]. However, the availability of this knowledge does not assure its success alone.

The inter-functional knowledge transfer has been broadly studied through marketing, engineering and manufacturing integration perspective in NPD [e.g. 30]. This topic is most related to collaboration, communication [31], cooperation, interaction [30], continuous learning [32], dissemination and information use and gather [33]. On the other hand, the results obtained with knowledge transfer are related to product success [34,35], product innovation [36,37,38,39], new product sales performance [40], product development cycle time reduction [41] and organizational performance [42].

Therefore, since servitization is a multidisciplinary field, including service and product approaches in the same solution, it requires a strong interaction among the NPD functional areas. Such interaction consists in transferring and sharing useful knowledge from all fields to obtain the integrated solutions. Thus, the following hypothesis is proposed:

- H2: Inter-functional knowledge transfer activities within the company moderate the effect of marketing, manufacturing and engineering on the servitization performance.

3. Method

To investigate the moderating role of customer service (CS) area and KT activities in the effect that the NPD areas have on servitization performance (Figure 1), we carried a cross-industry survey in 83 Brazilian companies. The questionnaire was consolidated based on constructs proposed in prior researches, as shown in Table1.

Figure 1 represents our expectation that customer service area participation during NPD positively impacts the contributions from marketing, manufacturing and engineering in developing services for product performance and improvement. Complementarily, we hope that KT will positively contribute to the success of service offer development within the servitization context [3].

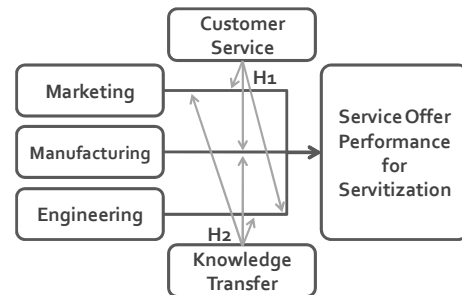


Fig. 1. Proposed framework

The questionnaire was sent by e-mail to 109 Brazilian companies that are involved in a Lean Manufacturing research network coordinated by two Federal Universities. The questionnaire considered topics regarding the company’s characteristics, portfolio composition, knowledge transfer capability and servitization performance (Table 1). As result of the application, 83 useful questionnaires were returned, representing a response rate of 76%. This high response rate is because of the existent network commitment among the studied companies. According to Table 2, the sample is mostly concentrated in the initial stages of the servitization offer (more products than services). However, the sample presents respondents from all portfolio distribution.

Table 1. Questionnaire

Company characterization			
Industrial Sector			
Number of Employees			
Market	() national	() international	
Clients	() individuals	() legal person	
What is the extent that each of the following areas contribute to knowledge consolidation applied to New Product Development Process?			
Marketing %	Engineering %	Manufacturing %	CustomerService%
Portfolio composition			
How is the company’s portfolio distributed? __%Prod.__% Serv.			
Please indicate what percentage extent your business is geared to each of the following services.			
	% Support the technical aspects of the product		
[18]	% Products offered in the form of services to the customer		
	% Based Services client outcomes		
Knowledge Transfer			
[43]	The company culture is oriented to the internal transmission of knowledge that people and areas hold		
[44]	There is an environment of trust for exchange of knowledge between areas		
[45]	The language and information used in each area are understandable to other areas		

- [36] The company widely uses practices that facilitate the integration of areas of expertise
- [34] The knowledge shared by other areas is often applied / used by the receiver

Servitization Performance

- [21] The services offered make it easier to sell new products to existing customers
The services offered allow to reach new customers through existing products
The services offered help to retain customers
The services offered contribute to the continuous improvement of products
- [46] The services offered help to develop new products to the market

Table 2. Demographic profile of the sample (n=83)

Industrial Sector	Firm Size			Business Focus		Portfolio Distribution		
	S	M	B	B2B	B2C	P>S	P=S	P<S
Manufacturing	21	4	6	11	19	2	19	1
Food	9	2	2	5	5	4	9	
Construction	9	3	3	3	1	8	9	
Logistics	9	2	3	4	9		1	8
Furniture	7	6	1		3	4	6	1
Health	5	3	2		5		4	1
Retailing	5	1	1	3	3	2	4	1
IT	4	2	1	1	4		2	2
Metallurgical	3			3	3		3	
Education	2			2	1	1		2
Naval	2		1	1	2	2		
Others	7	2	1	4	4	3	2	3
	83	30	25	45	71	31	71	5
	%	%	%	%	%	%	%	%

“Knowledge Transfer (KT)” and “Servitization Performance (SP)” were measured as composite variables (see Table 1). Thus, the constructs of these composite variables were tested and validated by means of confirmatory factor analysis using Stata 13.0®; further, it was used the comparative fit index (CFI) and root mean squared error of approximation (RMSEA). The validation results indicated a good suit of the constructs (CFI_{KT} = 0.977; RMSEA_{KT} = 0.075; CFI_{CS} = 0.997; RMSEA_{CS} = 0.046). To test customer service and knowledge transfer in servitization performance, the variables were standardized and a multiplicative score for the moderator effect was created. Ordinary least square (OLS) regression was used in Stata 13.0® to verify the proposed hypotheses. We also included the following control variables: firm size (number of employees), business focus (B2B - *business to business* or B2C - *business to customer*) and portfolio distribution (P>S or 2 - *more products than services*, P=S or 3 - *equal distribution of products and services*, P<S or 4 - *less products than services*).

4. Results

Table 3 shows the results for both models. Model 1 tests if Customer Service (CUST.SERV) moderates the relationship between NPD functional areas and servitization performance (H1), while Model 2 tests whether Knowledge Transfer (KT) moderates relationship between NPD functional areas and servitization performance (H2). Table 3 presents only final results, where all variables and moderators are included. For Model 1, the regression model explains 20.7% of the variance and Model 2 explains 23.3%.

As shown in Table 3, when the three traditional NPD areas are considered without an integration with the customer

service area (i.e. without the moderator effect), they have a negative effect on servitization performance. The same happens in Model 2, when the three areas are not focused on KT activities. Therefore, the results indicate that when these areas have strong independency in the NPD process, the service integration strategy is harmed.

However, in Model 1, when customer service works integrated to the other NPD areas (moderator), engineering has a significant positive effect on servitization performance. In this sense, H1 is partially supported, since we obtained evidence of customer service as a moderator only for one of the three areas.

On the other hand, Model 2 shows that the other two NPD areas (marketing and manufacturing) change to a significant positive effect on servitization performance when moderated by KT. Therefore, H2 is partially supported because we obtained evidences for KT as a moderator in two of the three cases.

Table 3. Results – NPD areas impact on servitization performance.

	Model 1 (H1)	Model 2 (H2)
Marketing	-0.472***	-0.286**
Manufacturing	-0.398**	-0.232*
Engineering	-0.436***	-0.385***
CUST.SERV X Marketing	0.063	
CUST.SERV X Manufacturing	0.142	
CUST.SERV X Engineering	0.255*	
KT X Marketing		0.311**
KT X Manufacturing		0.288**
KT X Engineering		0.164
C1 Employees	-0.197*	-0.184*
C2 Business focus	-0.029	-0.032
C3 Portfolio	0.213*	0.181
F-value	3.381***	3.492***
R²	0.294	0.327
Adj. R²	0.207	0.233

*p < 0.1; ** p < 0.05; *** p < 0.01

The obtained results indicate that for a higher performance on servitization, the engineering area should work together with the customer service in a single product-service design. Additionally, marketing and manufacturing must have an open process focused on knowledge transfer with all the other areas, entailing an improvement on servitization performance.

Regarding the control variables, Table 3 shows that the lower the number of employees and the more service is part of the portfolio distribution, the higher the servitization performance is. This suggests that small companies are stronger in product-service integration, since they tend to offer more services in their product to become more competitive before large companies.

5. Discussion

5.1. The moderator effect of Customer Service

The impact of the engineering area on servitization performance was associated to a stronger integration of this area with the customer service. This result is aligned with Ordanini and Parasuraman [46] who found significant and positive relation between the collaboration with contact employees and service innovation volume.

Specifically, for the customer service and engineering interaction, it is understood that knowledge gained from failures can be critical for subsequent project success [47]. Further, the iterative process of problem solving in NPD activities helps to define and propel the development of new capabilities [48], which are attributed to customer services during the post-sale NPD phase.

This conclusion points out a potential inter-temporal integration provided by customer services area. In this case, through the acquisition, retention and effective use of knowledge of customer's preferences from prior related products, the time to market can be reduced and the proposition of new products can be more proactive [49].

5.2. The moderator effect of Knowledge transfer

Marketing importance on product and service development is incontestable. This area is responsible for the deep understanding of market and customers' needs [49], and for the company's strategy and capability exploitation. The fact that knowledge transfer is a significant and positive mediator means that it must be capable of interpreting the strategy, transforming into an offer and transferring this understanding for all NPD team in order to improve the servitization performance. Therefore, our results indicate that marketing cannot be an independent starting input for the servitized NPD process, as it happens frequently in traditional product development. Contrarily, marketing inputs must be based on the knowledge and insights from the other NPD areas.

Manufacturing has been highlighted for providing essential input concerning what is or is not feasible, as well as for developing expertise needed to move beyond current capabilities [50]. Its negative effect on servitization performance reflects the fact that, generally, manufacturing is concerned only with the 'physical' product and not with the whole offer. However, we showed that when moderated by KT, manufacturing has a positive effect on servitization performance. Manufacturing relevance on servitization performance, although less clear, is closely aligned with a higher endurance required from the product (to support more than one client with a service) and attend customization promised by service provision. Moreover, quality, delivery, flexibility and cost (critical success factors in manufacturing) are also needed in service organizations [51]. Therefore, manufacturing area needs to acquire knowledge from the other NPD areas in order to comprehend how to contribute for service purposes, instead of only receiving a final product specification to be manufactured.

6. Conclusion

This paper has shown that, to increase the servitization performance, company departments should not work independently. Manufacturing and marketing must share knowledge and integrate inter-functional knowledge with other NPD areas in order to increase the servitization performance; while engineering may strongly work together with customer service area, developing a single solution in order to have a positive impact on servitization performance.

When all these functional areas work in the traditional linear sequence of the NPD process (i.e. marketing, engineering, manufacturing and customer service), they could have a positive effect on product performance, but not on servitization performance (in which such approach showed a negative effect).

Therefore, by means of our results, we show that the last barrier to transcend the initial stages of servitization of the NPD process is the integration of customer service knowledge to the other main functional areas of NPD; as well as the knowledge integration of different areas. The positive impacts are related to being able to sell new products to existing customers, current products to new customers, retain customers and develop and improve continuously company's products through customers' inputs.

Moreover, we address relevant approaches for researchers who want to analyze the inter-functional knowledge integration in the servitization of the NPD process, and for managers interested in the design of the NPD organizational structure focused on servitization. As a proposal for future studies, we suggest to investigate the relation of post-sale integration with inter-temporal knowledge integration in NPD, as well as the impact of customer service participation in the different stages of new product and service development when considering different servitization levels.

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