Antecedents of service innovation in manufacturing SMEs: an empirical research

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Services have become an increasingly important competitive lever for manufacturing firms. Service innovation, therefore, emerges as a critical capability also for manufacturing companies. An empirical research was carried out in business-to-business markets, based on the "InnoScore© Service" methodology, developed at the Fraunhofer IAO. Through the analysis of collected data, the paper aims at understanding the role of antecedents of service innovation, such as the company strategy and the existence of a service oriented culture. These factors should support the definition of processes, tools and organizational practices for service innovation and end up in improved business results. The evidence obtained through the data analysis, described and discussed in the paper, support these claims.

1. Introduction

Service sectors are dominating the economies of the developed world: for instance, over 80% of people employed in the UK and the US work in the service sector (Spohrer and Maglio, 2008). Also in manufacturing supply chains, however, services related to physical products, and in particular durable goods, acquired an ever increasing role in the last years. Manufacturers, especially those faced with shrinking markets and increased commoditization of products, are, in fact, adopting service provision as a new path toward profits, growth and increased market share (Rothenberg, 2007; Oliva and Kallenberg, 2003; Allmendiger and Lombreglia, 2005; Koudal, 2006), or as a way to increase customer satisfaction and loyalty (Goffin, 1999). As well, an integrated product-service offer may be a source of competitive advantage, in particular against competition from low-cost countries, since it is difficult to imitate (Baines et al, 2009b).

In this paper we consider a product-centric servitization (Baines et al., 2009b), where the product offering remains central to the provision of an integrated set of services, in particular in business-to-business environments. Capital goods industries experience a trend towards the integration of the product and service offer, named servitization (Vandermerwe and Rada, 1988; Baines et al., 2009a). However, there is no clear evidence on whether and how moves towards servitization are going to be suc-

cessful (Neely, 2008; Baines et al., 2009a). In addition, researchers agree that a strategic, cultural and organizational shift is required to manufacturing companies undertaking the route to servitization (Oliva and Kallenberg, 2003; Gebauer et al. 2005), but Baines et al. (2009a) also note that little research exists on the organizational approaches to servitization. Researchers are therefore called to answer many open questions. Among them, a major issue concerns the role of service innovation and the development of service innovation capabilities in traditional manufacturing firms. When products or services become more homogeneous, in fact, or an original competitive advantage cannot be sustained, service innovation is an effective way for a company to accelerate its growth rate and profitability (Berry et al., 2006).

The objective of this paper is to provide and empirical analysis of the relation between the inclination to innovate services by manufacturing firms operating in business-to-business environments and strategic and organizational factors. To pursue this objective, a survey was carried out over a sample of over 120 german firms in operating in the machinery and equipment industries, within the "Innoscore© Service" project at Fraunhofer IAO. The paper is structured as follows: the next section will provide some background on service innovation in manufacturing contexts. The third section presents the research project and describes the research methodology. The fourth section illustrates the findings of the analysis over the collected data. Finally, some concluding remarks will be drawn in the last section.

2. Service innovation in manufacturing

Manufacturing companies are increasingly viewed as systems vendors and integrators. They provide their customers comprehensive solutions, which also contain more and more product-related services. Studies show that, through the development of their service business, these companies not only increase the customer loyalty, but also generate much higher profit margins: the innovation capability (ADL, 2004) is considered among the main levers to increase business profitability and growth.

Service innovation, in fact, may lead to benefits both internal and external to the firm. According to van der Aa and Elfring (2002), "Innovations provide opportunities to increase the efficiency and quality of the service delivery process, both in the front and the back office, whilst also facilitating the introduction of new service concepts". Menor et al (2002), referring to Story and Easingwoo (1999), identify as potential benefits of service innovations: (1) enhancing the profitability of existing offerings, (2) attracting new customers to the firm, (3) improving the loyalty of existing customers, and (4) opening market opportunities.

Edvardsson et al. (2005) make a parallel between the test-drive of a car, and similar experiences to be developed prior to the purchase of a service. They report as an example the case of IKEA, and indentify a set of expected benefits of pre-purchase services, namely: i) to add unique and personalized value to the service; ii) to connect with the customer through exposure to the organization's norms and values; iii) to learn more about the customers' needs and desires to be used in service development and quality improvement efforts; iv) to increase loyalty; v) to create a unique identity; vi) to manage customer expectations and quality-in-use; vi) to improve sales. Moreover, Edvarsson et al. (2006), through a research review, point out a set of criti-

cal success factors for service development and launch. Among them (Edvarsson et al., 2006): 1) Develop a thorough understanding of the customer and of the elements that create value for the customer; 2) Create a customer-centric service culture within the company; 3) manage internal and external communication; 4) appoint a project leader; 5) focus on the whole integrated customer solution and the total customer experience. Frambach et al. (1998), resorting to previous literature, list a set of adopter-side variables influencing adoption decisions by customers. Among them, the perceived innovation characteristics (relative advantage; compatibility; observability, etc.); the adopter characteristics (receptiveness; age; size and organization structure for business customers); the network participation (interaction between the members of a social system); the competitive environment. The *supplier-side variables* considered, that are also empirically investigated by Frambach et al. (1998), are: the marketing strategy (positioning innovation in the marketplace; risk reduction for early adopters; winning market support for the innovation), and the innovation development activities by the supplier (e.g. perceived customization). The empirical test performed in a Business-to-Business context supports the influence of suppliers' marketing strategy on service adoption. Chen et al. (2009) identify innovation orientation, external partner collaboration, and information technology capability as the antecedents of service delivery innovation, and analyze the impact of service delivery innovation on firm performance. A survey carried out in the financial sector supports their hypotheses. In particular, the results suggest a crucial influence of *innovation orientation* and *information technology capability* on service delivery innovation.

Indeed, along with the strategic one, a technological argument deserves attention when dealing with service innovation. The rate and modes of service innovation are enhanced by ICTs and the Internet. The Internet, in fact, has enabled a wide variety of new services: companies can deliver service products electronically to individual customers almost anywhere and at any time (Collis et al. 1997; Rust and Oliver 2000). This "expands the number and variety of customer touch points and service delivery channels" (Hill et al., 2002). As a further element, technology may influence a firm's ability to create value through the way customers interact with a service offering. Therefore, IT capability has been acknowledged as a factor influencing service innovation (Bharadwaj 2000; Chen et al., 2009): in particular, IT infrastructure, human IT resources, and IT-enabled intangibles could help companies to assess customers' needs, share integrated resources across units, and carry out technology-driven service delivery innovation (Chen et al., 2009). Finally, a third argument regards the link between service innovation and operations. The design of the service process and the service delivery systems is crucial for a successful service implementation. The service delivery system can be defined as "the totality of activities, that combines to carry out the specifications of the service concept" (Chase and Hayes, 1992). Given the presence of the customer in the service process, it is important to differentiate the elements of the system that typically involve direct contact with the customer (front-office activities) and those that do not (back-office activities). Goals of back-office and front office activities (e.g. resource efficiency or productivity vs. delivery effectiveness) influence their design, planning and execution. However, "the question of how to go about service process design is relatively unexplored in Operations Management" (Kwortnik et al., 2009)

One of the most interesting aspects concerns the relation among *technology*, *service standardization* and *service customization*. On one hand, customers ask for service products that are tailor-made to their specific requirements; on the other hand, achieving standardization increases the efficiency of service providers. The notions

of mass customization or modularization, derived from manufacturing research, fit also for services: customer-fitted services may consist of combinations of well-defined elements which can remain unchanged (Drejer, 2004). Studies focusing on innovation strategies (Kolling et al., 2008) also point out the dimensions of service standardization and individualization as critical success factors for new services. The definition of high standardized processes takes to lower risk and uncertainty for both the firm and the customer and to a cost reduction for suppliers (Kolling et al., 2008). On the other hand, customization emphasizes and creates its value through the interaction with the customer. Technology is a main lever to facilitate customer interaction and at the same time to reduce service cost.

According to Gebauer (2005; 2008) most relevant organizational design elements for a successful service orientation in manufacturing companies include: Service orientation of corporate values and employees behaviour; Service orientation in human resource management (including personnel recruitment, training, assessment/compensation); Service orientation in organizational structure including the distinctiveness between product and service business as well as proximity to customers; service development, which includes formality of service development process and customer involvement in the service development process. Anyway, to achieve success, the service strategy of manufacturing companies should fit with the existing environment. Finally, the elements of external partner collaboration and buyer-supplier relationships, thoroughly addressed by research on manufacturing contexts, has been rather neglected in service innovation research (Chen et al., 2009).

3. The empirical research

3.1. Research methodology

In 2009, Fraunhofer IAO's launched the research project "InnoScore© Service", with the aim to develop an easy to use software tool to assess the innovation capability in product-related services. By product-related services (in the following product services) we mean, in line with the definition by Mathieu (2001), either services which supports the supplier's product (such as, repair, spare parts or after-sale services), or services which supports the client's action in relation to the product (e.g. a training service). Building on the successful established tool "Innoscore©" for assessment of innovation and benchmarking, "InnoScore© Service" expands the existing methodology with service-specific metrics and evaluation methodologies.

In detail, the project pursues the following objectives: (i) to develop a methodology for measuring and assessing the innovation capability in product-related services; (ii) to build a database and develop an easily manageable tool for benchmarking companies through a self-assessment; (iii) to give improved advice to industrial customers through the development of an integrated consulting approach with best-practice examples.

As part of the project, an integrated assessment methodology was developed, based on the state of art of the research and previous works in the areas of evaluation of the innovation capability and Service Engineering. Several statements and questions

were formulated to describe the factors that supposedly support service innovation within manufacturing companies. In the first phase, 25 statements for assessing the innovation capability and the service engineering are integrated into a questionnaire. To validate the relevance and clarity of the statement and the efficiency of the methodology, a pre-test was conducted with four selected companies. Based on the feedback received by the four firms some statements have been adapted to increase their understanding. The final version of the questionnaire contains a total of 31 statements / questions. The questionnaire in its final version includes three main parts:

(1) general questions, composed of five questions about general characteristics of the respondent company (i.e. dimension, sector, country, postal code, foundation year)

(2) questions related to product-service innovation, composed of 23 statements; it is the central and more important part of the questionnaire. To all these questions, four response very available, ranging from “strongly disagree” (then converted in the numeric value 1) to “strongly agree“(then converted in the numeric value 4)

(3) service parameters questions, where three numeric data are requested.

Appendix A1 show the list of 26 items derived from the two last parts of the survey. Most companies did not fill or only partially filled the general question part (that was facultative), so those variables are not included in the analyses.

The questionnaire was sent to 3830 German companies with 50 to 250 employees, operating in the manufacture of machinery and equipment, of which 124 returned the survey questionnaire. This results in a return rate of 3.2%. Of the 124 returns, 25 arrived through the internet portal.

The successive phase of data collection involves the data analysis and the processing of results and was performed using the software SAS®. First of all, a descriptive statistical analysis was performed on all variables (frequency of responses, average values, standard deviation). These analyses allowed to give an overall picture of the service innovation orientation and practices within the sample, illustrated in section 4.1. Then, a cluster and a regression analysis allowed to look for homogeneous behaviors within the sample and to analyse the relationships between the three groups of variables that we called respectively: i) antecedents of service innovation, ii) processes, and iii) outcomes. The underlying model will be presented in section 4.2, and the results of the analyses in section 4.3.

3.2. Sample description

As stated above, the sample size was of 124 companies. All the sample companies manufacture and sell machinery and equipment and employ between 50 and 250 people, and can therefore being considered medium enterprises according to the European Union segmentation. No turnover data are available for most of the sample companies.

Some data about the role of services within the sample are reported below. As shown in figure 1, one third of the responding firms attain from 5% to 15% of their overall revenue from services, while 40% achieve less than 5% of their turnover from the sales of service. The average value is 14,4%.

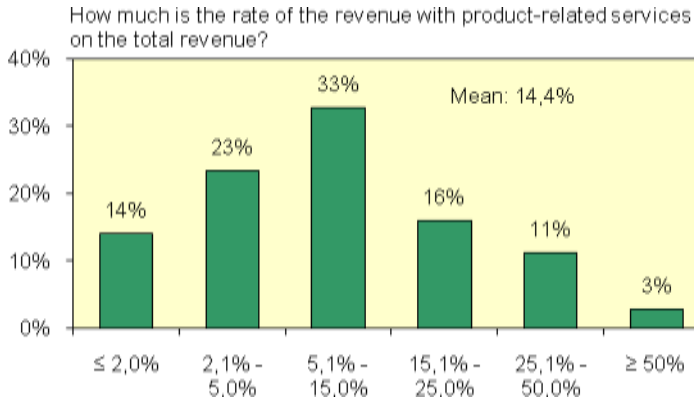

Fig. 1: Distribution of service revenue in the sample companies

Another descriptive information concerns the share of R&D expenditure that the companies devote specifically to product services. 53% of the sample spend less than the 5% of the total R&D expenses for the development of services (figure 2). On average, 10% of R&D expenditure targets new service development. Although this figure does not give a representation of the absolute importance of service R&D in the studied companies, it reveals that the weight of service R&D over the companies' R&D is relatively low.

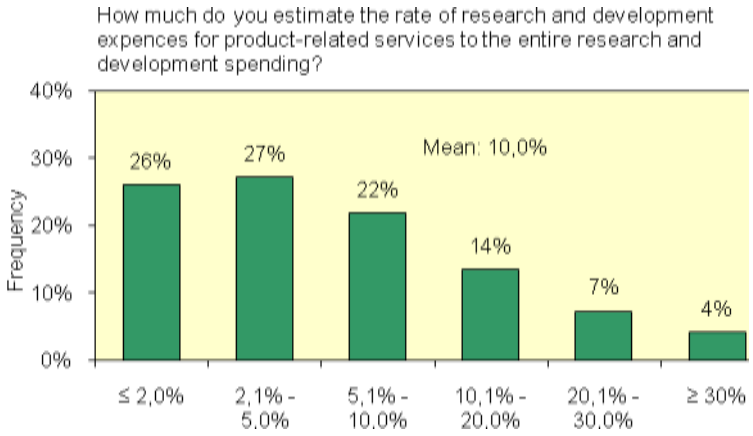

Fig. 2: R&D service expenditure on total R&D expenditure

4. Research findings

4.1. Descriptive analysis

Figure 3 and 4 illustrate some of the main descriptive findings from the survey. The average of responses on a 1 to 4 scale and the % of firms having declared to "agree" or "strongly agree" to the relative statement (translated into a score of 3 or 4 respectively) are reported for the main survey questions.

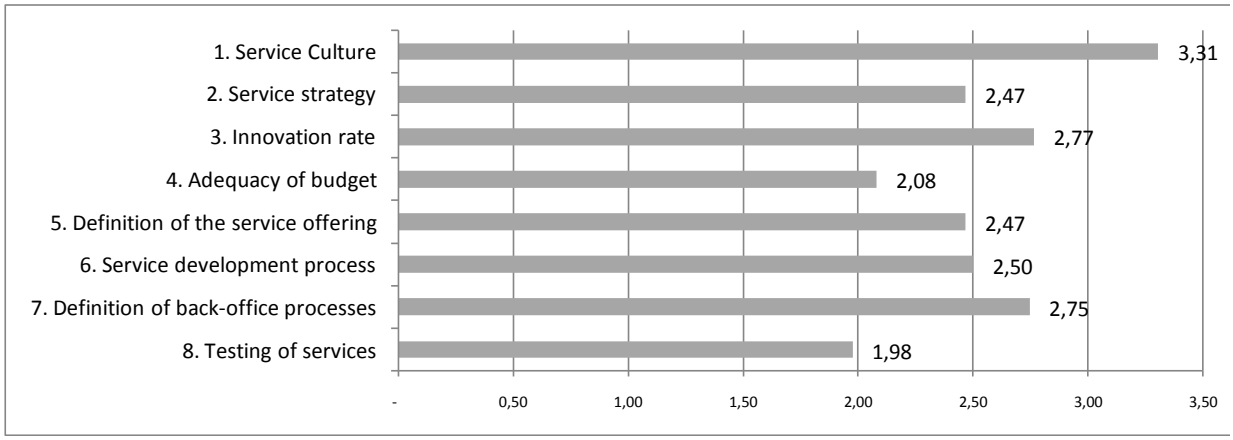

Fig. 3: Average sample score on some key questions

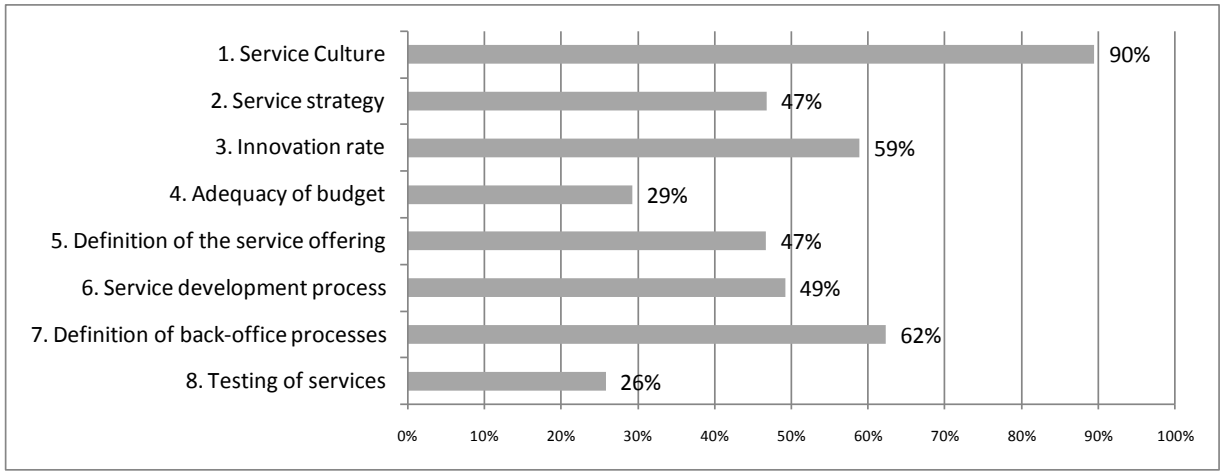

Fig. 4: % of firms declaring to „strongly agree“ or „agree“ with the proposed statement on the key questions

The descriptive analysis allowed to assess the relevance of some aspects for the innovation and development of new product services, and how they are perceived and implemented within the sample companies. First, an innovation-oriented culture for services is often present in the environment of manufacturing firms, as shown by the average value of the “service culture” variable in figure 3 (3,31) and by the 90% of companies declaring to “agree” or “strongly agree” with the statement “*There is in our company a strong service culture, in which the employees in contact with customers have a sufficient freedom of action*”. In general, this is actively supported by the top management that allows a sufficient freedom of action to the employees in contact with customers. This should be linked with the definition of a strategy for services, considered in literature to be one of the most important factors affecting service innovation. However, only less than half of the firms (47%) have an explicit strategy related to the service offer. As a consequence, only 59% of the sample declares to introduce frequently new services for their customers („innovation rate“ item in figures 3 and 4), and as few as 29% of the sample believe to devote an adequate budget to the development of product-related services. In addition, the detailed definition of the service offering is neglected by almost half the sample, as well as the

interaction between customers and front-office employees and the planning of back-office activities. This could cause customer dissatisfaction due to an inefficient service delivery.

From an organizational point of view, the development process is often scarcely systematic in the definition of responsibilities and workflows, but rather planned ad hoc. Although this may be due to the intrinsic heterogeneity of services, it can easily lead to inefficiencies in development and after-launch failures, especially if the interface between services and products is not adequately established. Finally, prototyping and testing activities are very rare.

In addition, making a few segmentations on the collected data, it was possible to notice consistent behaviors among firms. This leads us to decide to test statistically the significance of specific relationships among variables. A model was built, based on the questionnaire items. The model and the results of the statistical analyses are reported in the following sections.

4.2. Service innovation model

The high number of variables makes the statistical analysis rather complicated and dispersive, preventing us to focus on the underlying messages hidden in the data. For this reason, it is necessary to reduce the number of variables in a meaningful way, exploiting the common features of the questions from an exogenous point of view, and the internal correlations among data from an endogenous point of view. This way, we end up with a model based on a set of aggregated variables, as we shall see in the following.

As a first step we classified the variables presented in appendix A1 in three macro-categories, based on the role of the variables in contributing to the service innovation. In this step we excluded items 24, 25 and 26; the reason behind this choice was that these variables are not qualitative but quantitative, and therefore have different psychometric properties and can bring misleading results if examined altogether with the other variables. Future work will include these variables too. The three macro-categories are:

- *Antecedents of service innovation*. These are the factors that come prior to the development of product-related services and that in different ways enable the necessary steps to innovation. These factors can be of cultural (positive firm approach to innovation), strategic (favorable competitive firm strategies) and economic (adequate budget) nature.

- *Processes and infrastructures for service innovation.* These variables include all the means used to achieve innovation, from the training and knowledge to the development, testing, offering and delivering of new product-related services.

- *Outcomes.* The achieved results in terms of innovation rate and effectiveness of the new services.

Within each macro-category we tried to reduce the number of variables and to find significant latent constructs, using the Principal Components Analysis (PCA, Joliffe 1986). Due to the strong correlations, anyway (the Cronbach alpha for the variables in each group was over 0,90), PCA did not yield meaningful results, as nearly all the

variance of the groups was retained by the first component only. To overcome this problem, we decided to aggregate the variables on the basis of the common features of the questions, thus forming 10 new sub-groups within the three categories (3 for the antecedents, 6 for the processes and infrastructures, and one for the outcomes). In order to aggregate the variables in each sub-group, we performed PCA on the single groups, thus forming the 10 new variables that enter our model. The list of aggregated variables obtained through this step is presented in appendix A2. Good internal consistence of the construct was assured by high values of the Cronbach alpha within each group.

Through this process we built the interpretative model and variables represented in figure 5. According to the model, the antecedents can influence the setting up of adequate processes and consequently lead to innovation. Conversely, the innovation rate can enhance or lower the cultural and strategic attitude, thus acting on the antecedents and, on a cycle, on the processes.

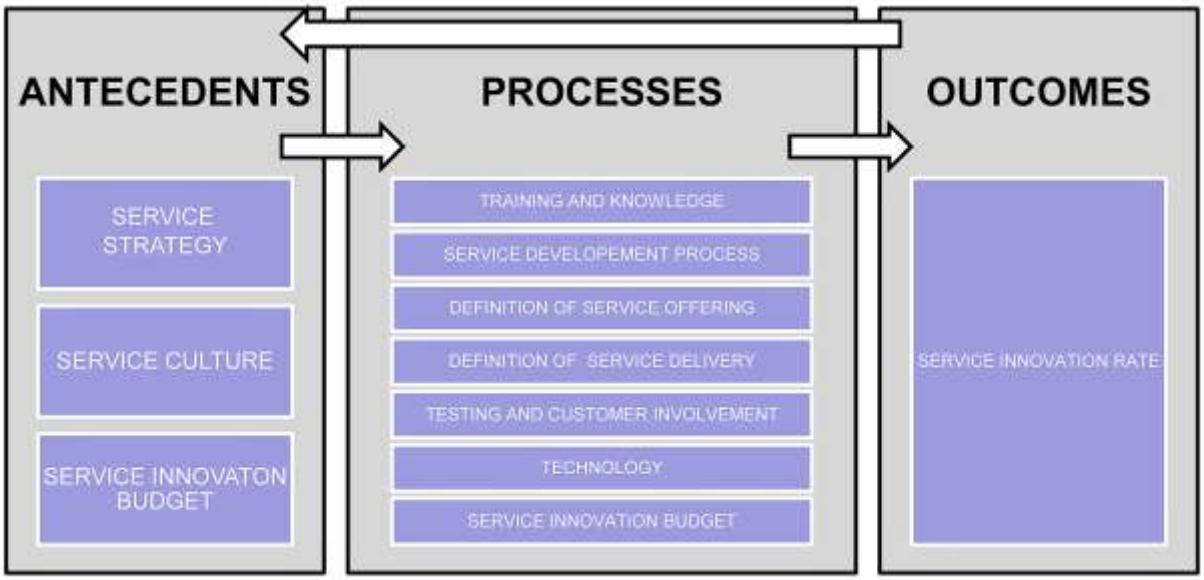

Fig. 5: The interpretative model

4.3. Results

4.3.1. Cluster analysis

The aim being to assess the relationships among antecedents, processes and outcomes, we used as a starting point of our analysis the variables belonging to the antecedents group.

First, a cluster analysis allows to identify homogenous groups of companies with consistent combinations of the Antecedents variables. Thus, we performed a cluster analysis with the k-means method using Service culture, Service strategy and Service innovation budget as taxonomic variables. All the variables were standardized in order to have the same scale for the cluster analysis. We obtained the four clusters described in Table 1. We checked the meaningfulness and predictive validity by using Analysis of Variance (ANOVA) with multiple Scheffé contrast tests in order to ex-

amine differences in the Processes and Outcomes variables among the different clusters. The four clusters obtained in this way appear coherent for what concerns the three clustering variables (as described by Table 1), thus implying that, on average, the responses of the firms are consistent on the three Antecedents.

CLUSTER	Degree of service orientation	# of firms	% of firms	Description
CLUSTER 1	HIGH	39	31%	High values for all the three variables
CLUSTER 2	MEDIUM	12	10%	Close-to-average values for the Service culture and for the Service strategy, high values for the Service innovation budget
CLUSTER 3	MEDIUM-LOW	31	25%	Medium values for the Service culture, medium-low values for the service strategy, low values for the service innovation budget
CLUSTER 4	VERY LOW	42	34%	Low values for the Service culture and Service strategy, medium-low values for the service innovation budget

Table 1: Overview of the clusters

The next step in the analysis was to check whether the clustering yielded similar configurations concerning Processes and Outcomes and if the firms' responses in terms of these variables were consistent with the values of the Antecedents. The Scheffé tests yielded positive results: all the groups of variables presented significant differences among the clusters, leading to a clear configuration and classification of the responding firms, as shown in Table 2. We should remind here that, being the variables standardized, positive values represent above average results, while negative values are below average performances.

Category	Sub-group	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Antecedents	Strategy	1,22	-0,17	-0,39	-1,29
	Service Culture	0,85	-0,03	-0,01	-2,05
	Service Innovation Budget	0,67	0,58	-1,06	-0,19
Processes	Training and knowledge	0,73	-0,03	-0,37	-0,57
	Definition of service offering	0,75	0,03	-0,41	-0,80
	Technology	0,46	0,11	-0,18	-1,04
	Service development process	0,79	0,00	-0,27	-1,19
	Definition of Service Delivering	0,60	-0,05	-0,19	-0,83
	Testing and customer involvement	0,86	0,04	-0,39	-1,16
Outcomes	Service Innovation Rate	0,73	-0,07	-0,18	-1,10

Table 2: Mean values of the variables in the four clusters

In the following, we summarize the characteristics of the four clusters, concerning the Processes and Outcomes.

Cluster 1: High values for all the variables belonging both to the Processes and the Outcomes groups. These are companies with a strong innovation attitude, both cultural and structural-infrastructural, and that are able to achieve the desired results.

Cluster 2: Values for all the variables belonging both to the Processes and the Outcomes groups are very close to the sample average. These are companies that allocate an adequate budget for the development of new product-related services but are not so incisive in terms of cultural attitude and strategy, and thus do not spend much effort towards the actual implementation, obtaining average results.

Cluster 3: Medium-low values for all the variables belonging both to the Processes and the Outcomes groups. These are companies with a low interest in the development of product-related services, that reflects in poor results in term of innovation rate.

Cluster 4: Low values for all the variables belonging both to the Processes and the Outcomes groups. These are companies that apparently are not interested at all in service innovation, and consequently do not achieve any significant result in this field.

4.3.2. Regression analysis

In order to assess dependence relationships among the three macro-categories in our model, we carried out regression analyses based on the interpretation model. The aim was to check whether the outcomes are influenced by the antecedents and processes, and how, using the macro-categories as a whole.

To this end, we proceeded to build up an aggregate variable out of each macro-category, using again the PCA; we then obtained three macro-variables, named Antecedents, Processes and Outcomes respectively. Then we performed regression analyses, always using the Outcomes as a dependent variable: the rationale behind this choice is that, according to the model, antecedents and processes serve respectively as the basis and the means to achieve service innovation rate (the outcome).

The three regressions are listed below.

R1. Antecedents (predictor) vs. Outcomes (dependent variable)

R2. Processes (predictor) vs. Outcomes (dependent variable)

R3. Antecedents and Processes (predictors) vs. Outcomes (dependent variable), to test mediation effects.

The results are presented in Table 3, and allow us to make the following observations.

	Outcomes *vs.* :		
R1	**Antecedents**	β_0	0,01
		β_1	0,59
		R^2	0,36
R2	**Processes**	β_0	0,00
		β_1	0,59
		R^2	0,35
R3		β_0	0,01

	Antecedents	β_1	0,37
	Processes	β_1	0,29
		R^2	0,40

Table 3: Results of the regressions

The value of R2 in the three cases can be considered satisfactory, supporting an acceptable fit of the regression line to the data. The first regression (R1) shows a linear dependence between Antecedents and Outcomes, thus suggesting that a positive attitude towards service innovation, a focused service strategy and an adequate budget devoted to service innovation lead to positive results in terms of innovation rate.
Moreover, regression R2 supports a linear dependence between Processes and Outcomes: a strong infrastructure including all the components of the service supply chain, from the training to the project, development, testing and offering of product-related services, is functional to successful service innovation.
The Processes variable acts as well as a mediator (Baron and Kenny, 1986) in the relationship between Antecedents and Outcomes. When the Processes variable enters as a predictor together with the Antecedents in a multiple regression model with the Outcomes as the dependent variable, in fact, the dependence between Antecedents and Outcomes becomes weaker: b_1 for Antecedents only is equal to 0,59 (regression R1) and to 0,37 when considered together with processes in regression R2. This means that the causal relationship between Antecedents and Outcomes can be partially explained by the role of the Processes, consistently with the hypothesis in our model.

5. Conclusion

The InnoScore© Service project allowed to carry out a survey on a sample of 124 German firms operating in business-to-business environments about the innovation management for product-related services. Both the descriptive analysis and the critical evaluation revealed some recurring commonalities and needs for the firms, such as defining a clear service strategy, creating a service culture and establishing a clearly defined service development process.

Extending the service business requires a market-oriented service development. A market orientation, particularly the systematic identification of customer needs, constitutes an indispensable prerequisite for developing new and successful services (De Brentani, 2001). Successful companies systematically collect and record customer needs. These firms changed the focus of customer interaction from a transactional to a relational basis, through the integration of customers into the service development process (Gebauer et al., 2005). The customer integration, allows not only a better analysis of requirements and feedback collection, but also empowers the definition of the service offering, and consequently the resource planning for the service delivery. In fact, having the customers inside the company system, makes this more transparent and compels the development team to be clear about what they are going to offer with the new service.

Together with the market orientation, systematic procedures support the successful development of new product services. Manufacturing companies have normally a clearly defined product development process, but they lack a sufficiently defined service development process as found in traditional service companies. Then, extending the service business requires an empowerment of new service development processes, that should be precisely defined. To this purpose, the discipline of service engineering may help to optimize the development processes.

A detailed definition of the service offering, as well as of the front-office and back-office processes are in the praxis often neglected, and influence negatively the phases of service design and implementation. As well as the service development, also an extended and precise service offering should be based on a clear service strategy. The criteria for selecting innovative services must be derived from the service strategy in order to ensure an alignment with corporate goals (Gebauer et al., 2005). The survey showed that companies with low service revenues have not a clearly defined service strategy and, therefore, they fail to build up services which generate sustainable customer benefits. Conversely, successful companies have a clearly defined service strategy which focuses on regularly establishing and promoting new services.

One of the most important aspects that enhance service innovation is the development of an accepted service culture and of the necessary knowledge and competences within the companies' environment. These should be supported by the top management through training activities and allowing a sufficiently freedom of action to the front-office employees, in order to better understand and satisfy the customer needs. Moreover, new ideas can also arise through a bottom up process starting from customers and employees, instead from the top management.

Activities of testing and prototyping are still not sufficiently exhausted and require specific competences and, sometimes, technologies that can be procured only by companies with an high level of research and development expenses for services. The R&D activity for product services seems to be particularly useful to support the innovation both in the processes of development and delivery, and in the ideas for service concept. Moreover, this function may enhance the use of IT systems and technologies, supporting the whole service development process and delivery and reducing the time and the effort currently required.

Concluding, there are several aspects to take into account, that support service innovation. These regard both the general organization of a company like the service strategy and culture, and more specific fields of the service business. At the currently state of the practice, data suggest that in many manufacturing firms some gaps exist, to be filled to increase service innovativeness and success through the delivery of product services.

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Appendix

A1. List of the questionnaire items

1. In the last three years we have continuously introduced new product-related services for our customers.
2. In my company there is an explicit strategy for product-related services (both for new and existing services).
3. The established goals for the product-related services are regularly reviewed
4. The product-related services introduced in the last three years met the expectations
5. The top management supports actively a service culture focused on the customer
6. There is in our company a strong service culture, In which the employees in contact with customers have a sufficiently freedom of action (e.g. freedom of decision and own budget).
7. The training of employees (technical and social skills) is an important part of the development of product related services.
8. The development of product-related services is clearly described from an organisational perspective (responsibilities are clearly defined).
9. The development process for product-related services is clearly described (the process sequence is clearly defined).
10. The interfaces between the development of service and product are clearly defined.
11. The development of product-related services includes the detailed definition of the service offering (e.g. service levels).
12. The development of product-related services includes the detailed definition of customer-employee interaction processes.
13. The development of product-related services includes the detailed definition of back-office processes (processes without customer contact).
14. The development of product-related services includes the detailed planning of the necessary resources (employees and equipment).
15. Prototypes are used to identify requirements for new services (e.g. Demonstration prototypes, virtual reality, test environments).
16. Both customers and employees are involved in the requirement identification for new services.
17. Customers provide feedback on the designed service concepts (service offer, service process).
18. The product-related services are comprehensively tested prior to the market launch.
19. The development of product-related services is almost always completed within the planned time.
20. There is a large enough budget for the development of product-related services
21. The value propositions (costs and prices) of the service business are transparent.
22. Our IT infrastructure and IT tools provide optimal support for the development and delivery of product-related services.
23. In the development of product-related services we work closely with universities or other research institutions.
24. How much is the rate of the revenue with product-related services on the total revenue?
25. How many months pass in your company normally between the beginning and the end of a development project for product-related services (for the development of new product-related services)?
26. How much do you estimate the rate of research and development expenses for product-related services to the entire research and development spending?

In the following, the list of items obtained through the survey. Variables from 1 to 23 are evaluated on a four-level scale (from “strongly agree” to “strongly disagree”); variables 24, 25 and 26 are numbers provided by the respondents.

A2. List of the aggregate variables

In the following, the aggregated variable obtained through a PCA are reported, an the variables from which they come from (taken form the list presented in appendix A1)

Macro-category	Sub-group	Original variables
ANTECEDENTS	SERVICE CULTURE	Var. 5, 6
	STRATEGY	Var. 2, 3
	SERVICE INNOVATION BUDGET	Var. 20
PROCESSES	TRAINING AND KNOWLEDGE	Var. 7
	SERVICE DEVELOPEMENT PROCESS	Var. 8, 9, 10
	DEFINITION OF SERVICE OFFERING	Var.11
	DEFINITION OF SERVICE DELIVERING PROCESS	Var. 12, 13, 14
	TESTING AND CUSTOMER INVOLVEMENT	Var. 15, 16, 17, 18
	TECHNOLOGY	Var. 22
OUTCOMES	SERVICE INNOVATION RATE	Var. 1, 4

Table 1. List of the aggregate variables

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