

# Organizational design for service innovation development

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**Firms increasingly servitize, thus selling functionality instead of or in addition to products. Despite various qualitative studies little quantitative evidence exists on how firms should organize for effective service innovation. This paper presents results from a quantitative study on servitization in the German manufacturing sector. We focus on performance effects of three distinct organizational design element: autonomy of the service business, service innovation orientation in the innovation strategy and formalization of a service specific innovation process. We analyze how these organization design elements are contingent on service innovativeness.**

**Our results are based on hierarchical regression analyses of data compiled through a multi-item scaled questionnaire completed by two informants from 72 firms. The findings show that organizing for new service development in a separate business unit and formalizing a specific service innovation process positively impact service business success in general. When testing for moderating effects we find that the results are contingent on technological and organizational innovativeness of the new services that firms develop. However, when service units occasionally work on radical innovation projects such organizational design seems to be sub-optimal. We discuss how firms can counteract sub-optimality by specific remedies.**

## 1. Introduction

Firms increasingly servitize, thus sell functionality instead of or in addition to products (Wilkinson, Dainty et al. 2009). For example, firms offer “flawless mobility” instead of selling vehicles, “cleaning services” instead of cleaners, and “room temperature” instead of radiators (Mont 2002). Manufacturers may develop different types of service innovations. These may include direct complementary services (e.g., financial services), services around products

(e.g., maintenance), rather autonomous services or product based service solutions (e.g., product service systems). Firms’ organizational transition process is often labelled as “servitization” (Baines, Lightfoot et al. 2009; Baines, Lightfoot et al. 2009; Visnjic Kastalli and Van Looy 2013).

During the transition process firms encounter a decreasing fit of the service business with the previously optimized product oriented organizational design (Van de Ven and Drazin 1984). Developing a new organizational design that fits with the increased service orientation is however not without challenges and firms face severe obstacles when attempting to change organizational structures during the transition phase (Hou and Neely 2013), (Gebauer,

Edvardsson et al. 2010). Particularly with focus on organizational design these pertain to the introduction of new organizational procedures, new distribution channels, innovative business models and the need for service specific competences (Feldman 1989; Gebauer and Putz 2009; De Clercq, Thongpapanl et al. 2011). Despite various qualitative studies (Vladimirova 2012), and descriptive results on the servitization phenomenon (Neely 2007; Neely, Benedetinni et al. 2011; Dachs, Biege et al. 2012) little quantitative evidence with regard to the required organizational and strategic settings exists. For first few exceptions see e.g., Gebauer, Friedli et al. (2006).

This paper contributes to the servitization and service innovation literature by presenting results from a quantitative study on servitization in the German manufacturing sector. We emphasize organizational design challenges within firms' innovation system when attempting to servitize. Applying a contingency perspective, we account for contextual factors with a particular emphasis on service innovativeness. We determine service innovativeness by two dimensions. Innovations might require technical components and functionalities that are new to the firm (technological newness). Innovations might also require that firms adapt organizational routines, processes and structures (organizational newness).

We focus on two research questions: Which is the optimal organizational design to support new service development in manufacturing firms? To what extent does the optimal organizational design depend on service innovativeness? Based on prior literature on new product and service development, servitization and its performance effects we focus on three organizational design elements: organizational autonomy of the service business, extent of a service innovation orientation of the firm and existence of a service specific innovation process. Hypotheses are derived from the literature as well as through expert interviews and tested with hierarchical regression analyses of data compiled through a multi-item scaled questionnaire completed by two informants within 72 German manufacturing firms.

The paper is organized as follows. The next section presents the conceptual basis for this research, focussing on the servitization phenomenon, organizational design research for service innovation and the degree of innovativeness. The research frame is then presented in the next section where we also develop our hypotheses. The following section focuses on the research design including data collection and measures. The result section presents descriptive and regression results with emphasis on moderator results for service innovativeness as contingency. We then discuss inconsistent results, conclude and derive managerial implications.

## 2. Conceptual background

### *Servitization of manufacturing firms*

The research stream that focuses on firms' increased emphasis on service development in the manufacturing context is often referred to as servitization. According to Neely (2009) servitization was first discussed by Vandermerwe and Rada in the late 1980s, but has received relatively little attention. Servitization definitions in the literature highlight adding value to products through new services (Vandermerwe, Matthews et al. 1989; Verstrepen, Deschoolmeester et al. 1999; Robinson, Clarke-Hill et al. 2002; Desmet, van Dierdonck et al. 2003). Adding services to products improves the product offering and delivers additionally product functionality (Ren and Gregory 2007; Martinez, Bastl et al. 2010). This work perceives servitization as the phenomenon of change through which manufacturers increase their share of service revenues by implementing new and valuable services. Servitization can be conceptualized on a continuum. One the one extreme, firms may only add add-on services to existing products. On the other extreme firms may transition from product based firms to solution providers. These firms develop products to use them in integrated service offerings, sometimes labelled as product service systems (Tietze, Schiederig et al. 2013) or complex service systems (Neely, McFarlane et al. 2011). An example is the power-by-the-hour concept, today also known as "Total Care" of Rolls Royce.

### *Organizing new service development*

Compared to the product development, new service development (NSD) is different. One reason lies in the nature of services. Services are different from products. They are often characterized as being intangible, heterogeneous, inseparable and perishable (IHIP) (Zeithaml, Parasuraman et al. 1985). Despite critics to that definition, in practice it has proven to be helpful (Moeller 2010). Scholars continue to argue for finding a widely accepted service definition, however it is commonly agreed that services are different to products.

Services are often even more incremental in nature than product innovations (Hipp and Grupp 2005). The development of services is associated with lower levels of R&D investments, is less technical-driven, and is less characterized by the need for highly qualified personnel (Hollenstein 2003). Even new services as small improvements, which arise straight from the practical delivery process, are often not recognized as innovations in service companies (Toivonen and Tuominen 2009). Hence, service companies often lack dedicated R&D departments (Djellal and Gallouj 2001).

The NSD process is often more complex than the corresponding NPD process. It is "more fluid and evolutionary" (Lyons, Chatman et al. 2007). It is less formal

and faster than in the manufacturing business (Griffin 1997), and more ad-hoc (Toivonen and Tuominen 2009). Because the process is of a more collective and unstructured nature (Sundbo and Gallouj 2000) NSD needs more organic structures with collaborative elements for innovation than NPD (Calantone, Harmancioglu et al. 2010). Developing services requires stronger and more active customer involvement than NPD (Edvardsson, Johnson et al. 2000; Kirner, Kinkel et al. 2009). The complexity of NSD increases in particular when customers or network partners are integrated into the development process, wherefore NSD incorporates the whole organization (Djellal and Gallouj 2001).

To account for differences between service and product characteristics, hence NSD and NPD firms have different organizational design options to archive an optimal organizational fit with their business model. We focus on three design elements: First, firms can decide whether to integrate NSD in the existing product business or separately in an autonomous organizational unit. Second, firms can emphasize service development more or less in their innovation strategy. Third, firms can formalize a separate innovation process specifically for service development. We argue that the organizational design choices are contingent upon the service innovation degree.

### Degree of innovativeness

Earlier conceptualizations of innovativeness categorize products dichotomously as being either radical or incremental (Ettlie, Bridges et al. 1984). More recent studies rather regard innovativeness as a continuous construct that relates to the degree of technological newness embodied in new products with incremental and radical as the extremes of the scale (Green, Gavin et al. 1995; Gatignon, Tushman et al. 2002). Recent research furthermore conceptualizes product innovativeness as a multidimensional and continuous phenomenon relating not only to technological, but also to market, organizational, and environmental innovativeness (Avlonitis, Papastathopoulou et al. 2001; Danneels and Kleinschmidt 2001; Garcia and Calantone 2002; Schultz, Salomo et al. 2013).

In this paper we focus particularly two innovativeness dimensions (technological, organizational). Technological innovativeness is high if a product or service is based on completely new technological principles that require a new knowledge base, if the architecture of a technological system is changed fundamentally (Henderson and Clark 1990), or if completely new components and materials are used (Gemünden, Salomo et al. 2005; Kock, Gemunden et al. 2011). Consequently, new services with high technological innovativeness are characterized by the use of fundamentally new technologies (at least new to the firm) for delivering the service. For instance, when a medical technology firm that has been developing devices for cardiologic monitoring servitizes to become a telemedical solution provider it needs to equip its products with telematics technologies for

enabling data transmission from the device to the service center. Hence, the firm may need to establish know-how and competences about telematics technology. Organizational innovativeness relates to the internal changes that result from implementing the innovation induced by the innovating unit (Avlonitis, Papastathopoulou et al. 2001). Organizational innovativeness therefore covers the degree to which existing strategies, structures, incentive systems, resources, processes, routines and competences are appropriate for the development of an innovation and the necessary organizational changes (Avlonitis, Papastathopoulou et al. 2001; Danneels and Kleinschmidt 2001; Jordan and Segelod 2006). New services with high organizational innovativeness hence require firms to substantially adjust the existing organizational design to enable service delivery. For instance, a transition from a medical device manufacturer towards a telemedical service provider may require different distribution channels. Instead of selling products to whole sale shops, the firm rather leases the products directly to hospitals and practices, wherefore it needs to reorganize its sales force and adjust the accompanying process routines.

### Research framework and hypotheses development

The unit of analysis is the manufacturing firm that is performing new service development. We focus on three relevant concepts when organizing for effective service development (Figure 1). On a structural level, firms need to distinguish whether an existing department is also responsible for service development or whether a separate organizational entity should be in charge. On the strategic level firms need to decide to what extent they emphasize and prioritize service development activities in their innovation strategy. On a process level, firms need to decide to what extent a separate service innovation process is described and formalized. We are interested to contribute to a better understanding of how these three organizational design elements impact service business success and how service innovativeness as contingency moderates these relationships.

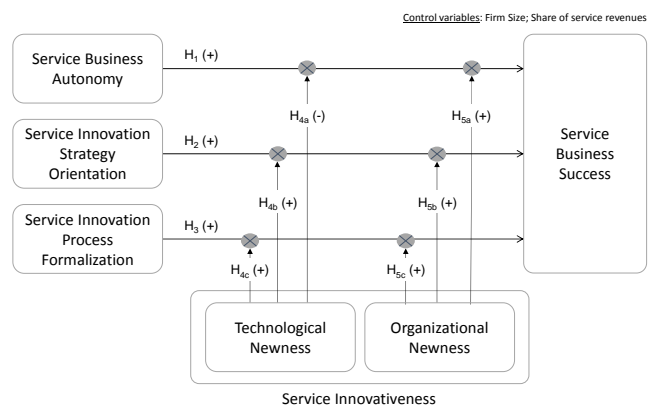


Figure 1. Conceptual framework.

Case studies already describe the beneficial effect on business success of a separate service organization in the context of manufacturing companies. The advantage for manufacturers of having a separate service organization is to avoid conflicts with the existing product business and its resources (Olson, Walker et al. 1995). Management is more independent in its decisions and is able to allocate human and financial resources more freely, which also increases process effectiveness (Moenaert, Souder et al. 1994). Also the possibility to specialize on services drives performance (Lievens and Moenaert 2000) and cumulative learning and experience (Damanpour 1991). As organizational measures do not need to be aligned with the existing product portfolio and organizational structures, the response to new market needs is faster and more efficient. Furthermore, the separate unit is able to form its own culture within the greater organization. In particular, this may be less hierarchical and more fluid (Lyons et al., 2007) and thus fit with the NSD process. Hence, a separation from the NPD activities avoids cultural friction between them. Conflicts due to different mind sets and working styles between employees are more likely if service operations are integrated in the existing department structure which in the end may hinder service performance (Song, Montoya-Weiss et al. 1997).

H1: Increasing organizational autonomy of service operations positively impacts service business success.

Different studies show the positive impact of an existing innovation strategy on firm performance (Shayne Gary 2005; Burgelman, Christensen et al. 2009). An innovation strategy provides orientation to different departments guiding them in adapting, integrating and reconfiguring its technological capabilities, managerial capabilities and resources endowment particularly appropriate in a changing environment, allowing it to maintain and enhance sustainable innovation (Song and Dyer 1995; Fiegenbaum, Hart et al. 1996; Dess, Lumpkin et al. 1997; Song, Droge et al. 2005). Hence, a strategy can be perceived as communication instrument that reduces coordination costs. Various authors have investigated the relationship between innovation strategy and performance in depth (Dess and Robinson 1984; Dess 1987; Dess, Lumpkin et al. 1997; Therrien 2003). The existence of a strategy signals top management commitment and its content provides orientation for future directions of the innovation process. Evidence shows that the direction of a firm's innovation strategy impacts the future route a firm will take (Therrien 2003). Hence, one might suspect that firms who make explicit statements in their innovation strategy on developing services will create a higher awareness and commitment among the R&D team to develop successful service innovations. Such strategy reduces coordination costs among departments when they need to cooperate for developing service innovations.

H2: Increasing service innovation strategy orientation positively impacts service business success.

Above we have shown why services are different from products. In order to successfully support the development of innovative services, a service-specific innovation process is needed that accounts for the service specific characteristics. Empirical evidence provided supports the argument that a service innovation process spurs service innovation (De Brentani and Ragot 1996). Due to the characteristics of services and their intangible and abstract nature, ideas about new services are harder to grasp. For managers, it becomes more difficult to evaluate both the potential benefit and barriers of new service ideas. With a formalized service-specific innovation process, new service ideas are treated without being discriminated against new product ideas within the company. Particularly in the case of manufacturing companies, Gebauer, Fleisch et al. (2005) underline the contribution of an established service-specific innovation process for service success.

H3: Increasing service innovation process formalization positively impacts service business success.

#### *Service Innovativeness - Moderator hypotheses*

We study service innovativeness as contingency for effective organizational design with particular emphasis on two dimensions. Service innovations can be based on more or less new technologies. Furthermore, innovations can require more of less new organizational routines, process, capabilities, and partners (e.g. require a reconfiguration of a firm's value network). For instance, a firm that develops a maintenance hotline service might do this by hiring a professional call center and train their employees. Such a service innovation hardly requires any new organizational routines and relies on well-established technologies. On the contrary, the implementation of a new remote maintenance service may require new information and communications technology (i.e. telematics systems) to monitor the customer's machines online, as well as organizationally new responsibilities and internal processes to handle upcoming machine breakdowns (Oliva and Kallenberg 2003). Any firm developing such highly innovative services may be faced with high uncertainty and risk that such innovation project may fail (Avlonitis, Papastathopoulou et al. 2001).

#### *Technological innovativeness*

In manufacturing firms, the use of advanced technology for delivering innovative services plays a substantial role (Quinn 1992; Gallouj and Weinstein 1997; Gustafsson and Johnson 2003; Panesar and Markeset 2008), particularly if technologically innovative services create new value for customers (Van den Ende and Wijnberg 2001; Hipp and Grupp 2005). For instance, information technology can increase service efficiency and ensure service quality (Miles 2008).

If service innovation teams develop new services that rely on technologies unknown to the firm we can distinguish two cases (high technological newness). Services that rely on new technologies could be either those supported by ICT technologies. These services may largely lack a tangible product component. Alternatively, newly developed services might be product based. When firms servitize offering the latter type of services they rather offer these based on their own existing products. However, in order to offer services, their product design, which was optimized for selling them may require modification (Tietze and Hansen 2013). For instance, for delivering modern, free-floating car-sharing solutions, such as Car2Go by Daimler or DriveNow by BMW, OEMs need to equip their vehicles with telematics systems. If jet engine or wind turbine manufacturers want to remotely monitor their product maintenance status they need to adjust the product designs by embedding sensors and data transmission technologies. If the necessary modifications demand embedding new technologies that are unknown to the firm, product engineers need to build up knowledge about such technology internally. Alternatively, the knowledge can be insourced (acquired) from external partners. However, both options commonly require substantial efforts.

Assuming that a service unit is in charge for developing service innovations. When product modifications are necessary, the service team needs to cooperate internally with the product engineers. Such inter-departmental cooperation requires the exchange of information and the coordination of activities across units (Cuijpers, Guenter et al. 2011). When technologies are necessary that are unknown to the firm, the service team even needs to convince the product engineers establish that knowledge. However, product engineers might be reluctant to invest time and resources for establishing that knowledge, for instance, because of the not-invented here syndrome (Katz and Allen 1982). Instead of pursuing ideas brought to them from the service unit they might rather dedicate resources to pursue own ideas and spend their resources on developing future product generations.

Being separated from the product business, an autonomous service team faces several inhibitors preventing efficient collaboration with the product engineers and other departments. These include uncertainty about the product engineering team, hardly know who is responsible and lacks strong ties to easily access and trust to convince them to cooperate. The only existing weak ties between the involved actors hamper information sharing and collaborative learning (Rost 2011). Hence, if they need them to modify products and learn about a new technology, the engineers need to be at best co-located with the service unit (Chong, Eerde et al. 2012). Where technological innovativeness is high, gatekeepers with strong ties are helpful linking the service unit to other organizational units. Consequently, in cases where firms develop service innovations with high technological newness an autonomous service unit might not show the expected benefits and may even have a negative impact on the service business success.

H4a: The degree of technological innovativeness negatively moderates the relationship between service business autonomy and service business success.

Above we have hypothesized that firms with a strong strategic service orientation are likely to be more successful in service business. However, similarly to the case made just above, the importance for having a service orientation also depends on the technological innovativeness of the services that the service innovation team develops. We have argued that innovating a new service that relies on new technologies that are unknown to the firm requires the service unit to engage in inter-departmental cooperation, e.g. the product engineers (Cuijpers, Guenter et al. 2011). If the service unit needs to collaborate with other departments, innovation projects evolve towards complex multi-person decision processes.

To engage other departments with the necessary commitment in a inter-departmental innovation projects and equip the service unit with the necessary authority for decision making, top management support is supportive. Strategies are an effective communication measure to convey messages across organizations to operational units (Gilles 1998). Top management support for service development is signalled through a specific mentioning of service orientation in the firm's innovation strategy or even a separate, dedicated service innovation strategy (Connelly, Certo et al. 2010). A service innovation strategy contains the message that service development is among the firm's priorities, wherefore all departments should collaborate to jointly achieve service success. An explicit strategy creates a joint mindset that results and aligns different departmental incentives. As such it functions as a guideline that secures the coordination of inter-departmental and cross-functional innovation projects (Griffin and Hauser 1996). A firm with a low level of strategic attention to service delivery might run the risk that other departments cannot be convinced to collaborate with and support the service team, which is particularly important for technological advanced services.

H4b: The degree of technological innovativeness positively moderates the relationship between innovation strategy orientation and service business success.

For developing services with high technological innovativeness, where the service team needs to engage in inter-departmental collaborations product development engineers or with outside actors when externally acquiring new technical knowledge, the innovation process is characterized by higher complexity than for new services that rely on technologies that are known to the firm. These projects not only involve more people across different organizational units and from external partners, but are also characterized by high uncertainty, high costs and high risk of failure (Dougherty 1992). To counteract for increased complexity, an innovation process needs stricter rules and governance structures (Cooper 2008). For coordinating the different actors, formal review meetings might be held more

often to ensure that in case of increasing risk the project can be terminated in time. Stage and gate like systems are commonly used tools in highly complex innovation processes (Schultz, Salomo et al. 2013). Hence, a definition and formalization of a service specific innovation process is of more importance for service development projects characterized by high technological innovativeness than for service innovations that rely on known technologies.

H4c: The degree of technological innovativeness positively moderates the relationship between innovation process formalization and service business success.

#### *Organizational innovativeness*

Service innovation teams may develop new services that fit very well into the existing organizational structure, its routines, strategies, etc. Hence, implementing and launching such incremental service innovations can be done relatively easy with few conflicts and little resources, e.g. by small modifications of existing processes. On the contrary, innovative services might be rather radical requiring substantial organizational adjustments. For instance, firms might need to implement completely new routines, reallocate resources and may substitute existing with new organizational processes. Firms may also need to fundamentally realign networks with external partners along their value chain. Implementing these changes is usually more complex, complicated, and consumes more resources. Because such radical organizational changes face organization inertia and path dependencies senior management involvement is needed to cope with these organization-wide consequences (Sydow, Schreyogg et al. 2009), (Schreyogg and Sydow 2011). The question arises whether service innovation teams that operate distinct from the rest of the firm are better positioned to initiate and successfully achieve substantial organizational changes than a team that is closely integrated within the firm's organization.

Employees working in integrated service units can be assumed to be well linked to other stakeholders within the firm (e.g. to other departments). This enables them to efficiently initiate small, incremental organizational changes that are supported by colleagues and aligned with their interests. Building on trust, internal reputation and local knowledge they can facilitate incremental changes as long as they do not conflict with the interests of internal coalitions. Radical organizational changes are more difficult, complex and resource consuming requiring collective actions, hence joint involvement of all relevant departments and key actors (Leifer, McDermott et al. 2000). Due to well established links to other departments internally organized service units might be able to utilize their contacts for organizing the necessary consortium for the required collective actions. However, fundamental changes often face resistance and require political restructurings in which opponents of strategic changes are either enticed to support them or blocked from

obstructing them (Gray and Ariss 1985; Greenwood and Hinings 1988). Such inertia is one of the most fundamental counterforce against radical organizational change (Weick and Quinn 1999).

Integrated service units are quite likely to experience such resistance. Due to their links with other departments, they are involved in internal politics, i.e. part of intra-organizational sub-networks of individuals based on mutual dependencies. Fundamental organizational changes require reorientation of these interconnections in terms of establishing new relations and cutting off established relations. This is often not in line with individual's private interests. Hence, service employees in product oriented departments would be biased and reluctant towards implementing radical organizational changes, particularly if their power is at risk (Ginsberg and Abrahamson 1991) or the face the fear of potential cannibalization (Chandy and Tellis 1998). For instance, a department head may be reluctant to automating product maintenance through the use of ICT systems if this leads to obsolescence of his own department and laying off employees to which he might have close personal relations.

Independent service units are less involved and entangled in internal politics and dependent on the willingness of colleagues to cooperate. A separated organizational unit has less mutual dependencies with internal colleagues and external partners, hence is more open towards the substitution of old partners and establishment of new partnerships, the adjustment of external networks and value chains. Information asymmetries on organizational difficulties might also bias a separate unit in a positive way. It might not foresee all organizational difficulties along the implementation process which would deter insiders from pursuing a project. Furthermore, an independent service unit might be in a better position (if equipped with authority, power and resources) to counteract cultural and political obstacles (Ginsberg and Abrahamson 1991).

Changing organizational routines is a difficult undertaking due to path dependency and inertia (Schreyogg and Sydow 2011). We conclude that the risk to suffer from organizational inertia is lower for a separate service unit. Hence, independence from the traditional business enables a service unit to break with current operations and facilitate the implementation of service innovations that are characterized by a high degree of organizational newness. This is in line with the findings from (Govindarajan and Trimble 2005), who claim that separate service organizations are more effective to implement radical organizational adaptations and implement new organizational structures. For efficiently facilitating incremental changes a separate unit might however lack ties to key actors within the firm.

H5a: The degree of organizational innovativeness positively moderates the relationship between service business autonomy and service business success.

Similar to service innovations with a high technological newness those that require substantial organizational changes (e.g., implementing new business routines,

establishing relations to new network partners) are likely to involve multiple departments such as product development, marketing, sales, production and supply. As already argued above, explicit top management support and strategic guidance are necessary to convince the other departments to cooperate. A dedicated service innovation strategy signalizes top management support and equips the service innovation team with the necessary authority to realize even fundamental organizational adjustments.

H5b: The degree of organizational innovativeness positively moderates the relationship between innovation strategy orientation and service business success.

If fundamental organizational changes are necessary, more people are likely to be involved. Adjustment of processes and routines might involve other departments, such as marketing and sales, but also production and supply. Hence, these projects are more complex, involve more resources, are characterized by higher uncertainty and hence require a good coordination of inter-functional contributions. Similar to the argumentation above for the effect of technological innovativeness we argue that a formalized and service specific innovation process facilitates the success of service innovations.

H5c: The degree of organizational innovativeness positively moderates the relationship between service innovation process formalization and service business success.

## Research design

### *Data collection*

The study employs a cross sectional, two-informant design, where primary data was collected from two key-informants via a survey. We test our hypotheses with data from the German manufacturing industry. The industry is characterized by small-medium sized enterprises, where eight of nine firms have less than 250 employees (VDMA 2011). We selected manufacturing firms with an emphasis and interest in new service development, i.e. that follow a transition towards service provision ("servitization"). Using industry directories such as the Hoppenstedt database and an internal database provided by Fraunhofer IAO we selected 517 manufacturing firms where managers with responsibility for the service business could be identified. These firms are from three manufacturing sub-sectors (surface processing; machinery and equipment; pre-manufactured goods). We contacted all firms via phone to ensure that they met the required conditions. 258 firms agreed to participate in the study.

As remedy against common method bias we use a multiple informant design (Homburg and Stock 2004; Walker and

Enticott 2004). As we had no access to secondary objective data for measuring the dependent variable, we used different respondents for measuring the independent and dependent variables, similar than be done by others (Talke, Salomo et al. 2009). Hence, each participating firm was asked to nominate two interviewees, one from top management and one manager in charge of services, typically with a job title such as service operations director, service manager, or marketing manager. Querying multiple informants increases the reliability and validity of the reported results (Bagozzi, Li et al. 1991; Golden 1992; Wagner, Rau et al. 2010).

Before distributing the survey its accuracy was pre-tested using feedback from eight manufacturing companies in order to ensure content and criterion validity (Sekaran 1992). We received 195 questionnaires from 113 firms. 101 respondents were general managers and 94 service managers. This represents a response rate of 44% for the mailed survey. For the analysis we only considered complete pairs of questionnaires. For 82 firms, we were able to rely on two respondents. Due to missing data, we were eventually able to analyse 72 complete pairs. To test for non-response bias, we conducted a wave analysis checking for all constructs for differences in the responses between early and late respondents (Rogelberg and Stanton 2007). T-tests yielded no statistically significant differences between early and late respondents.

### *Measures*

To maximize content validity measurement items are based on existing literature, but to some extent combined with self-developed items (Carmines and Zeller 1979; Haynes, Richard et al. 1995). These result from five workshops conducted with a total of 71 participants including internationally-known researchers, managers from leading industrial companies, and representatives of public and private institutions. Additionally, interviews were conducted with manufacturing companies in an exploratory study prior to the survey.

The appendix lists all relevant items and the psychometric properties of the scales. Measures for the constructs were primarily developed using multiple items and Likert-type scales from 1 to 5 (1 = "strongly disagree" to 5 = "strongly agree"). A literature review on servitization and success helped to identify relevant concepts and previously operationalized scale items.

For construct validation we compare the square root of the average variance extracted (AVE) for each construct with the correlation to other constructs (Fornell and Larcker 1981). The criterion is fulfilled because the average variance extracted exceeds 0.60 for all constructs with the highest correlation between constructs being 0.37. Construct reliability is checked using Cronbach's alpha (Table 1) that serves as an indicator for internal consistency (Cronbach 1951). Five out of the six  $\alpha$ -values are above 0.7 and can be regarded as adequate (Schmitt 1996; Tavakol and Dennick 2011). With 0.64 the  $\alpha$ -value of Service Innovation

Orientation must only be regarded as acceptable. Indicator reliability is determined by the factor loadings, which should ideally exceed 0.7 (Chin 1998) but can be acceptable when they are larger than 0.4 (Hulland 1999). Indicator loadings are higher than 0.6 for all constructs and higher than 0.7 for most of the constructs (Table 1).

The dependent variable “service business success” was measured by three items based on scales by Matear, Gray et al. (2004) and Lonial, Tarim et al. (2008). Very few firms report publicly their profits, revenues and market share separately for the service business, but rather only figures on aggregated firm level. Hence, we decided to use data provided by the top management respondent to measure how profits, revenues, and market share of the service business differ to the figures of the previous year.

All independent variables rely on data provided by the service manager. The construct “service business autonomy” uses two items based on the studies by Gebauer, Edvardsson et al. (2010) and Gebauer (2010). The items measure the extent to which the service organization unit is organized separately from the product-based business and to what extent that service unit is responsible for its own profit-and-loss statement. The construct “service innovation orientation” results from interviews conducted with workshop participants. Two items measure to what extent a manufacturer’s innovation strategy explicitly focuses on developing new services and to what degree the firm concentrates on developing services independently from its products. A low extent indicates the development of add-on services for the existing products, whereas a high extent indicates the development of totally independent services from the existing product business. “Service innovation process formalization” is measured by four items, which are based on the studies of Cooper and Kleinschmidt (1995) and Tatikonda and Rosenthal (2000). Respondents were asked to rate the extent to which their firm employs a documented process for the development of new services, to what extent the NSD process is accompanied by dedicated project meeting, where decisions are sought whether to proceed or kill projects, to what extent formalized rules, project management tools, etc. are used to govern NSD projects and to what extent NSD teams actually adhere to the formalized project management rules.

The innovativeness contingency with its two dimensions of technological and organizational newness are linked to the notions of technological and organizational innovativeness in the NPD literature (Garcia and Calantone 2002; Salomo, Talke et al. 2008). They measure the extent of changes, which are necessary to implement new service ideas based on an average new service development project in the period of the last two years. “Technological newness” is measured by two items. Respondents were asked to what extent the services use new technologies that increase their performance and to what extent the services are characterized by technologies which were particularly developed for that specific service innovation. “Organizational newness” is measured by four items. It was assessed to what extent service innovations induce a substantial change in the firm’s organizational

structure, to what extent they require a new field of competence, to what extent they require the implementation of new internal processes for service operations and to what extent they require the integration of new networking partners.

We employ two control variables. We control for firm size, measured by the number of employees. The share of revenues generated by services in comparison to the overall revenues of the firm serves as an indicator for the servitization degree (Gebauer, Fleisch et al. 2005) and is based on the study of Fang, Palmatier et al. (2008) who showed the usefulness of this indicator, which they label ‘service ratio.’

## Results

### *Descriptive results*

Table 1 reports descriptive results. On average 18.6% of the firms’ revenues come from service delivery (left skewed; median=15.0%). Compared to three years before, on average the share of service revenues increased by 1.5%. The firms in our sample seem to be overall successful. On a 5-point Likert scale the average service business success is 3.51, hence our sample represents quite a number of firms that have increased profits, revenues as related market shares in recent years resulting from innovative services. With technological newness of 2.8 and organizational newness of 3.2 our sample includes firms that develop service innovation with a moderate degree of innovativeness.

The sample includes 50 firms from the machinery and equipment sector, 12 firms from the pre-manufactured goods sector and 10 firms from the surface processing sector. 72% are medium-sized firms with less than 500 employees, 18% are large firms and 10% are small with less than 50 employees. The average firm in our sample has 1,625 employees. 53% of the firms were older than 60 years. 35% were older than 20 years, but younger than 60 years. 17% of the firms were 20 years or younger. The remaining firms did not provide information about their age.

On average, respondents to our survey have 11.2 years of professional experience working with service and service development. Respondents from the top management have slightly higher experience with 12.3 years. On average, respondents worked since 13 years for the firm. Managers with service responsibility worked for 2.5 years less for the firm than their top management counterpart.

### *Regression results*

Our data was analysed using hierarchical regression procedures. The metric scaled nature of the dependent



Table 1. Descriptive results.

	Mean	SD	1	2	3	4	5	6	7	8	AVE	Cronbach's Alpha
1 Service Business Success (A84-A86)	3.58	0.60									0.734	0.820
2 Service Innovation Process Formalization (B45-B48)	2.36	1.12	.327**	<i>1.294</i>							0.822	0.920
3 Service Innovation Orientation (B39-B40)	2.09	0.88	.119	.320**	<i>1.183</i>						0.792	0.640
4 Technological Newness (B54-B55)	2.75	1.05	-.106	.295**	.200	<i>1.194</i>					0.740	0.720
5 Organizational Newness (B57-B59,B61)	3.18	1.00	.093	.156	.073	.203	<i>1.129</i>				0.709	0.860
6 Service Business Autonomy (B71-B72)	3.05	1.34	.373**	.226*	.051	-.076	.053	<i>1.140</i>			0.614	0.720
7 Firm Size (AB106)	1625	4811	.238*	.122	-.113	.048	.106	.135	<i>1.112</i>			
8 Share of Service Orientation (AB100)	17.90	17.25	.126	.193	.170	.188	.131	.274*	.207*	<i>1.216</i>		

Notes: n=72; Pearson correlations, Variables 7 and 8 are control variables; Numbers on the diagonal (shown in italics) are the variance inflation factors (VIF)

variable allows to employ OLS models (Hair, Black et al. 2009). Table 2 presents the regression results with the dependent variable “service business success”. Model 1 includes only the control variables. Model 2 includes the three direct effects variables and both control variables. Model 3 further includes the direct effects of the two moderators and represents our baseline model (Ref3). Model 4 to 6 then include the interaction effects. Model 7 includes only those moderator effects that have been significant in the previous models. The variance inflation factors (VIF) indicate that multicollinearity seems to be not present in the data (Hair, Black et al. 2009; Cohen 2010).

The goodness-of-fit tests indicate that the chosen models fit the data increasingly well. When the direct effect variables are added to Model 1, R<sup>2</sup> increases from 8.2% to 26.4%.

When the interaction terms are added, R<sup>2</sup> further increases to 38.8% (Model 4), respectively 35.8% (Model 5) and 34.9% (Model 6). Including only the significant interaction terms in Model 7 results in a R<sup>2</sup> of 42.3%. All models but one (Model 3) show significant F-changes.

We find that service business success is higher for larger firms than for smaller firms. However, the service business success does not depend on the share to which firms have already servitized. With regard to the direct effects, the results show that both service business autonomy and service innovation process formalization have significant positive effects on service business success. Hence, firms with a separate service unit seem to perform better. Also, firms seem to benefit from formalized service specific innovation processes. Service autonomy is significant in all of the six models in which the variable is included. Service process

Table 2. Regression results.

	Hypothesis	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept		3.458 (.095)***	2.723 (.219)***	3.080 (.299)***	3.123 (.286)***	3.122 (.302)***	3.198 (.301)***	3.163 (.281)**
# 1000 Employees		.027 (.015)*	.025 (.000)*	.026 (.014)*	.024 (.013)*	.025 (.014)*	.025 (.014)*	.025 (.013)*
Share of Service Revenues		.004 (.004)	.000 (.004)	.001 (.004)	.003 (.003)	-.001 (.004)	.003 (.004)	.001 (.004)
Service Business Autonomy (AUTON)	H <sub>1</sub>		.150 (.050)***	.135 (.050)***	.094 (.050)*	.159 (.050)***	.115 (.050)**	.117 (.050)**
Innovation Strategy Orientation (ORIENT)	H <sub>2</sub>		.047 (.077)	.061 (.077)	.031 (.074)	.009 (.082)	.106 (.080)	-.013 (.076)
Service Innovation Process Formalization (PROCESS)	H <sub>3</sub>		.109 (.059)*	.140 (.060)**	.113 (.059)*	.110 (.061)*	.144 (.060)**	.089 (.059)
Technological Newness (TECH NEW)				-.121 (.064)*	-.140 (.061)**	-.113 (.064)*	-.150 (.066)**	-.130 (.060)**
Organizational Newness (ORG NEW)				-.031 (.065)	.033 (.067)	-.015 (.065)	-.056 (.06)	.040 (.066)
AUTON x TECH NEW	H <sub>4a</sub>				-.127 (.058)**			-.114 (.057)**
AUTON x ORG NEW	H <sub>5a</sub>				.134 (.062)**			.124 (.061)**
ORIENT x TECH NEW	H <sub>4b</sub>					.159 (.074)**		.136 (.071)*
ORIENT x ORG NEW	H <sub>5b</sub>					-.010 (.066)		
PROCESS x TECH NEW	H <sub>6a</sub>						-.077 (.064)	
PROCESS x ORG NEW	H <sub>6b</sub>						-.097 (.068)	
F (df)		3.065 (69)	4.723	4.075 (64)	4.369 (62)	3.833 (62)	3.696 (62)	4.465 (61)
ΔF		3.065**	5.449***	2.053	4.044** (Ref.3)	2.375* (Ref.3)	1.946 (Ref.3)	4.026** (Ref.3)
R <sup>2</sup>		0.082	0.264	0.308	0.388	0.358	0.349	0.423
Adjusted R <sup>2</sup>		0.055	0.208	0.233	0.299	0.264	0.255	0.328
ΔR <sup>2</sup>		0.055	0.025	0.178	.066 (Ref.3)	.031 (Ref.3)	.022 (Ref.3)	.095 (Ref.3)

formalization is significant in all models, except Model 7. These results appear to be robust and thus supporting H1 and H3. In our sample, strategic service orientation has no significant effect on service business success. As such, we do not find support for H2.

We also find that a high degree of technological newness hampers service business performance consistently across all models, what is in line with the finding of prior research (Kock, Gemunden et al. 2011). We do not find any indication for an effect of organizational newness on service business success. Three moderator hypotheses find support in our data. The effect of autonomous service units becomes weaker for higher degrees of technological innovativeness (H4a) and is emphasized by substantial organizational changes (H5a) related to service innovations. If the service innovations come along with new technological components, a specific service innovation strategy is important for service business success (H4b).

As the effect of the moderator effects of technological and organizational newness can hardly be interpreted from the regression result table alone, complementary simple slope analyses are used to visualize them (Aiken and West 1991; Frazier, Tix et al. 2004). Simple slope diagrams are plotted using procedures suggested by Aiken & West (1991) and Dawson and Richter (2006).

Figure 2 displays the moderating effect for technological newness and service business autonomy. That interaction effect is significant and negative. The slope diagram reveals that firms only profit from autonomous service business units if they are developing service innovations with low technological newness. If technological newness is high, firms perform better if the service unit is integrated within the existing product oriented organizational structure. That finding provides support for H4a.

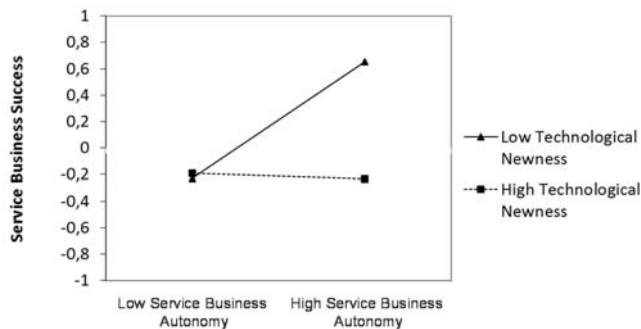


Figure 2. Interaction effect for service business autonomy and technological newness.

Figure 3 displays the interaction effect of service innovation orientation and technological newness that was shown to be significant in Table 2. When firms develop service innovations that are characterized by high technological newness for the firm, these firms perform better if they make service innovation orientation explicit in the firm's innovation strategy. That finding supports H4b. Moreover, the simple slope analyses reveals that an explicit

service innovation strategy may even have a negative effect on success if technological newness is low. That result is thought-provoking and may be explained by the low value of such non-technological services, which imply also a high work force demand and relative low profit rates (Neely 2009).

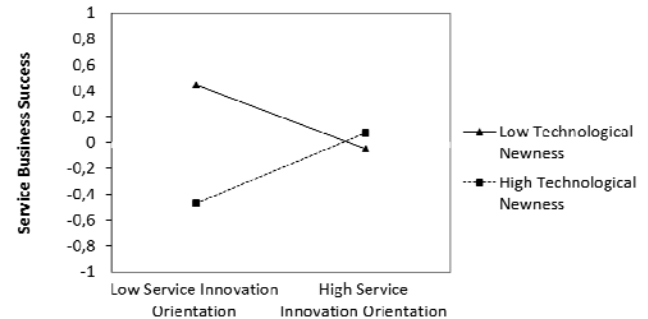


Figure 3. Interaction effect for service innovation orientation and technological newness.

Figure 4 displays the slopes of the moderator effect for organizational distinctiveness and organizational newness. The visualized finding supports H5a. Separate service innovation units are more successful when service innovations confront firms with the need for substantially different organizational structures and routines. On the contrary, service innovations that require relatively few changes in organizational structures and routines should be preferably implemented by service innovation teams that are embedded in the primary organization.

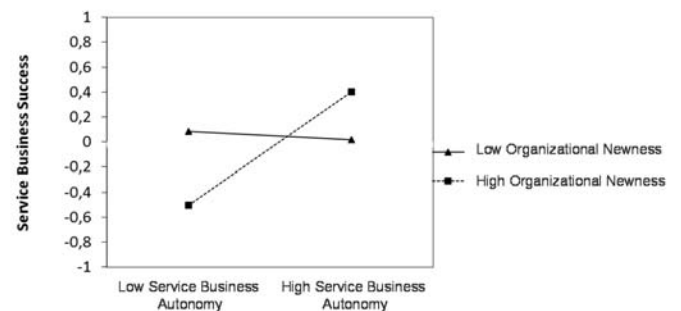


Figure 4. Interaction effect for service business autonomy and organizational newness.

## Discussion and managerial implications

When manufacturing firms servitize they need to make decisions in order to select the most effective organizational design for their service innovation operations. In general, our results suggest that successful manufacturing firms organize their service business separately from the product business and employ a formalized innovation process. However, the

results imply that on average firms do not need to emphasize the importance of service innovations particularly in the firm's innovation strategy.

The results furthermore show that the optimal design is contingent on the innovativeness of the new services that firms develop. Hence, firms need to consider the types of service innovations when deciding on the optimal organizational design. Our results reveal that firms need to differentiate between both innovativeness dimensions. The slope diagrams suggest that for technological incremental innovations firms should organize the service unit separately from the product business, but do not need to emphasize services explicitly in the corporate innovation strategy. Also service innovations with a high organizational newness profit from autonomous service units. We conclude that for service innovations with a high extent of new competences, processes and cultures, but a limited degree of technological alterations firms may set up separate organizational entities.

When firms develop innovations characterized by a high degree of technological newness and relatively little organizational changes the optimal organizational design looks different. For developing service innovations with a high technological newness, firms benefit from a specific emphasis of service innovation importance in their corporate innovation strategy. That will provide the necessary strategic support and guidance. Service autonomy does not play a positive role for this type of innovation. Due to the required high efforts for implementing new organisational structures firms should refrain from autonomous service units.

However, firms should detach service innovation from their product based mother organization, if organization newness is high and should develop and communicate an explicit service innovation strategy, if technology newness is also high. While the correlation between these two innovativeness dimensions is not significant, radical innovations are likely to be new on both dimensions. Taking in account the direct positive effect of service autonomy on service business success we conclude that for radical innovations the service unit should be separated from the product business. However, most service innovations are incremental in nature (Hipp and Grupp 2005). These type of innovations can be assumed to have low degrees of technological and organizational newness. The results suggest that also these services may benefit from service autonomy. They seem not to fit with the potentially technology oriented product departments and may not been hampered by separate service departments. This means installing a separate service unit with a formalized innovation process, but without the need for specific emphasis of service innovation within the corporate innovation strategy may be the "base-case" when servitizing.

However, firms should be aware that this organizational design is sub-optimal for effective developments of service innovations with differentiated degrees of newness. Occasionally, when working on technological advanced service innovation projects with low levels of organizational newness the firms might not be able to establish separate service units, however can employ measures to remedy for

the sub-optimality to some extent. They can try to compensate the lack of internal coordination and specialization of service business by informal measures like knowledge communities. Firms that set up separate units for technological advanced services need to compensate the limited coordination with the technology oriented mother organization. They may involve relevant stakeholders that have the possibilities to bridge between the separate service unit and other departments that need to be involved. These gatekeepers should be well connected within the firm with strong ties to the different departments. Moreover, our results suggest that when developing technological radical service innovations it would be preferable having the importance of service innovations being stressed in the corporate innovation strategy. This would signal top management support in order to convince necessary other departments to cooperate. For instance, a top management member could act as project promoter taking a leading role in the radical service innovation project team. The effectiveness of these measures has not been subject to empirical analysis in this study and hence need to be left for future research.

## Conclusions, limitations and future research

We performed an empirical study among German manufacturing firms to understand how successful firms organize their service innovation activities. Our results suggest that any service unit should have a formalized innovation process, independent from the innovativeness of the new services that the unit develops. Furthermore, firms should organize service units preferably separate from the product business. In most cases there is no particularly need to specifically emphasize the importance of service innovations in the corporate innovation strategy. However, when service units occasionally work on radical innovation projects such organizational design seems to be sub-optimal. Firms might then counteract sub-optimality by specific remedies. These include, for instance, the development and communication of a project based service innovation strategy, top management involvement in the project team to signal importance and involving gatekeepers with strong ties to relevant internal departments. However, the effectiveness of particular remedies remain to be evaluated by future research.

As any piece of research this study is subject to limitations. Internal validity could be improved, if more control variables are included. However, the relatively small dataset permits not to include more variables. This limitation leads directly to a suggestion for future research. Repeating the study with a larger sample broadening it also to other sectors and countries would not only improve its external validity but also allow to control for more contextual influences. Furthermore, the remaining two innovativeness dimensions might be covered in future studies, which might also differentiate service success on project on not only on firm level. Possibly, future studies might employ objective

secondary data for their dependent variables to increase validity. Similar to other studies we measure service success solely based on economic performance indicators (profits, revenues and market share). Due to the increasing need to account for environmental and social impacts of innovations, future research should develop a multi-dimensional innovation success measure that also accounts for these two dimensions.

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## Appendix

Sources	Facets and items
Gebauer et al. (2010); Gebauer (2010)	<b>Service Business Autonomy</b> AUTON1: Service business is separated from the product business AUTON2: Service organization runs with its own profit-and-loss responsibility
Workshops, interviews	<b>Service Innovation Strategy Orientation</b> ORIENT1: The innovation strategy focuses on the development of new manufactured goods vs. the innovation strategy focuses on the development of new services ORIENT2: The innovation strategy focuses on the development of value added services for the manufactured goods vs. the innovation strategy aims to develop service offerings independent from manufactured goods
Tatikonda and Rosenthal (2000); Cooper and Kleinschmidt (1995)	<b>Service Innovation Process Formalization</b> PROCESS1: Our firm uses a formal new service development process PROCESS2: Formal progress reviews are held for new service development projects PROCESS3: Project management rules and procedures formalized via documents are used for new service development projects (e.g. project plan) PROCESS4: Formal project management rules and procedures are actually followed for new service development projects
Salomo et al. (2008); Garcia and Calantone (2002)	<b>Technological Newness</b> TECH NEW1: New service innovations use technologies, which allow significant performance enhancements TECH NEW2: New service innovations can be characterized as being based on very new technological components
Salomo et al. (2008); Garcia and Calantone (2002)	<b>Organizational Newness</b> ORG NEW1: New service innovations necessitate the adjustment of the pricing policy/business model ORG NEW2: New service innovations induce a significant change in our company's organizational structure ORG NEW3: New service innovations require new fields of competence ORG NEW4: New service innovations require the implementation of new internal processes for service operations
Matear et al. (2004); Lonial et al. (2008)	<b>Service Business Success</b> SBS1: How did the profit of your company's/business unit's service business develop in 2010 compared to the year before? SBS2: How did the revenues of your company's/business unit's service business develop in 2010 compared to the year before? SBS3: How did the market share of your company's/business unit's service business develop in 2010 compared to the year before?