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The measurement of servitization degree: literature review and recommendations

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Abstract

This study reviews systematically the literature on the measurement of the firm-level degree of servitization. The results show that servitization measures are inconsistent across studies, even among those investigating similar research questions, and that a theoretical reference for their appropriate use is still missing. Focusing on these shortcomings, this study theorizes the firm-level servitization degree in three classes, i.e. "extension", "infusion", and "orientation". Hence, measures to operationalize each class are derived from the literature review and, subsequently, discussed with a panel of experts. In addition, servitization measurement is conceptualized other than as firm level degree, as measurement at regional, product, and individual employee levels.

This study is the first to provide a systematic review on the topic and to develop a general conceptualization and operationalization of servitization measurement. Furthermore, this research is the first to employ an international standard classification of economic activities as a basis to identify objectively firms' service offerings. This research supports both scholars and practitioners because it brings consistency across studies and applications, thus fostering assessment and comparability of servitization experiences.

Keywords: servitization, service infusion, service orientation, service strategy, measurement

Introduction

Servitization is pursued by many manufacturers as a potential source of competitive advantage (Baines et al. 2017; Cusumano and Kahl 2015) and as a means to stabilize their revenue streams, to lock-in their customers, and to respond to economic downturns (Raddats and Easingwood 2010). Servitization studies have primarily focused on: i) the identification and classification of servitization strategies (Yang et al. 2018; Adrodegari et al. 2017; Raddats and Kowalkowski 2014); ii) the investigation of trajectories through which manufacturers become product-service providers, and inherent challenges (Jovanovic et al. 2016; Löfberg, Witell, and Gustafsson 2015); iii) the diffusion of servitization among manufacturers (Partanen et al. 2017; Baines and Shi 2015); iv) the impact of servitization on firms' organizational structures (Raddats and Burton 2011); v) and the financial performance of servitized firms (Benedettini et al. 2017; Rapaccini 2015). Relevant theoretical and empirical outcomes have been achieved, yet some challenges remain (Kowalkowski, Gebauer, and Oliva 2017). Servitization measurement is one of such challenges (Bigdeli et al. 2018; Baines and Shi 2015).

Particularly, the lack of agreed measures for firm-level servitization degree is a critical challenge for assessing and implementing servitization strategies (Partanen et al. 2017; Rapaccini and Visintin 2015). It is critical to practitioners because they need tools and measures for designing and assessing their service solutions (Adrodegari et al. 2017; Löfberg, Witell, and Gustafsson 2015; Rapaccini and Visintin 2015). Also, it is critical for scholars because it hinders comparison among findings, and impairs systematic investigation of the phenomenon (Bigdeli et al. 2018; Rabetino et al. 2018; Gebauer et al. 2012). In fact, while it could be useful to apply different measures for different purposes, the adoption of common measures when applications are essentially the same would enable progress. Yet, in examining empirical applications of servitization measurement, consistency is rarely observed. For example, in investigating the relationships between servitization degree and firm's performance, Crozet and Milet (2017) measure the firm-level degree of

servitization as the share of revenue from services, while Benedettini, Swink, and Neely (2017) assume it to be the number of service types. On the other hand, in studying the different service offerings of firms, Baines and Lightfoot (2013) measure the firm-level degree of servitization by means of the types of services provided, while Burton et al. (2017) measure it through the share of revenue from services.

The aim of this research is to contribute to servitization literature and practice by reviewing existing measures, by analysing the consistency of their use and, in collaboration with a panel of experts, by devising a framework for their classification and use. Hence, the research contributes to the "methodology", "practice", and "theory" of servitization.

The review contributes to the "methodology" because it devises a framework to measure consistently the firm-level servitization degree by distinguishing among different types of degrees and by developing appropriate measures for each type. The adoption of this framework will benefit the "practice" of servitization by resolving past inconsistencies in cross-case comparisons of its diffusion, performance, and impact (Bigdeli et al. 2018; Partanen et al. 2017; Ostrom et al. 2015), and by providing a guide to managers to assess servitization degree in their firms (Adrodegari et al. 2017; Rapaccini and Visintin 2015). Finally, the framework contributes to advance "theory" through the systematic classification of the various measures used to assess the servitization degree. Consistency in the application of agreed measures to individual phenomena is the foundational step towards knowledge accumulation in any discipline (Franco-Santos et al. 2007).

The next section of the paper describes the process of identifying relevant articles in the literature and of extracting measures from them. Subsequent sections provide the results of the analyses of the papers and the outcome of the servitization measurement framework devised after the discussion with the experts. The paper concludes with a discussion of the findings, their implications for scholars and practitioners, and the elaboration of an agenda for future research.

Research methodology

The research method consists of two phases carried on sequentially. The first phase consists of a systematic literature review of firm-level servitization measures aimed to achieve conceptual and practical understanding on the subject (Thomé, Scavarda, and Scavarda 2016). The second phase consists of a discussion with a panel of experts to design a framework for servitization measurement (Bigdeli et al. 2018).

Collection of articles

The first step in a systematic literature review is database selection. The most complete databases of scientific studies are Web of Science (WoS), Scopus (Guz and Rushchitsky 2009) and Google Scholar (Gehanno et al. 2013). None of these offer a single best solution (De Winter et al. 2014; Bakkalbasi et al. 2006; Burnham 2006), therefore the current review investigates all three at once (Gasparyan, Ayvazyan, and Kitas 2013; Bergman 2012). According to Thomé, Scavarda, and Scavarda (2016), the collection of the relevant papers is carried on in eight steps (see Appendix A for details), similarly to Baines et al. (2017) and Eloranta and Turunen (2015):

1. Scopus query;
2. WoS query;
3. Combination of step 1 and 2 results, eliminating duplicates;
4. Iterative analysis, for exclusion/inclusion of articles from step 3;
5. Google Scholar queries;
6. Inclusion of relevant results from step 4;
7. Inclusion of articles from authors' personal knowledge;
8. Inclusion of articles from forward and backward reference analysis.

Queries in steps 1, 2, and 5 combine the two concepts "measurement" and "servitization", and extend them with synonyms and overlapping terms (Brax and Visintin 2017). For "measurement", equivalent concepts have been derived from dictionaries and thesauruses, similarly to Brax and Visintin (2017) and Baines et al. (2009). For "servitization", related labels were

referenced from Brax and Visintin (2017), Lightfoot, Baines, and Smart (2013) and Baines et al. (2009).

The Scopus and WoS queries retrieved 265 and 143 articles respectively, from which 307 unique articles remained. Next, iterative content analysis was used to select the most relevant publications, thereby countering any subjectivity effect (Tranfield et al. 2003; Clarke and Oxman 2001). This process, widely used in servitization literature (Benedettini et al. 2017; Story et al. 2017; Eloranta and Turunen 2015), began from a preliminary selection of all articles including any measure of firm-level degree of servitization (e.g. number of services; number of service types; share of revenue from services), or any combination of measures (e.g. share of revenue from services and number of service types). Multi-step screening was then performed through discussion boards, with the aid of a data-extraction sheet (Cassell and Symon 2004), up to theoretical saturation (Tranfield et al. 2003; Bryman 2015), i.e. the match among all coders of exclusion and inclusion criteria for each article (permitting slight differences in the inclusion excerpt). This iterative process left 23 relevant papers. As in Baines et al. (2017), a series of Google Scholar queries were then used to complement these results (see Appendix B for the details), resulting in the addition of two more papers.

The full set of 25 papers has been complemented with three recent literature reviews on servitization, for purposes of forward and backward reference analysis (Baines et al. 2017; Kowalkowski et al. 2017; Valtakoski 2017). This process retrieved 14 more papers, thus bringing the final sample to 39 papers. The outcome of selection and extraction process produced an overall data-extraction sheet, seen here in excerpt (Table 1).

Table 1 – Excerpt of overall data-extraction sheet showing two “exclusions” and two “inclusions”

Article	**Excluded**
(Pascual et al. 2017)	Focused on PSS Design/Development
(Whittaker et al. 2017)	Focused on public sector policy problems
	Included

	Measure	Excerpt
(Crozet and Milet 2017)	Share of Revenue from Services	Figure 1 + "[t]o grasp the extent of servitization in French manufacturing, we focus instead on the service intensity, which is defined as the share of services of total production sales". The same measure is used at a disaggregated (firm) level.
(Burton et al. 2017)	Share of Revenue from Services	Table 1 + "[f]our case studies are undertaken in large UK-based manufacturers with services strategies differing with respect to the importance of services within their portfolios of offerings".

Experts' session

The second stage of the methodology was aimed at operationalizing the servitization measurement framework designed after the analysis of the retrieved material. To this purpose, three experts from three leading multinational companies have been involved in multiple interview sessions. The three companies have been chosen from different business sectors in order to be able to consider different servitization degrees and experiences and, therefore, avoid biases deriving from considering homogeneous servitization practices. In addition, the interviews have been performed in separate sessions to avoid interviewees' reciprocal biases and influence. Table 2 reports a summary of the companies surveyed along with their level of servitization, as quoted from the interviewees.

Table 2 – Experts panel

Company	Turnover (Worldwide)	Employees (Worldwide)	Role of the Interviewee	Interview(s) Length	Servitization Level
Leading manufacturer of electric and electronic devices	~33B€	~147k	"Advanced Processes and Technologies Manager"	2*1h	"We sell some product-service solution and we are quite good at it. Yet, we think that servitization as a business model will never reach more than 20% of our revenues."
Leading manufacturer of medical devices, pharmaceutical and consumer packaged goods	~67B€	~134k	"Global Make Value Stream Beauty and Liquids Platform Manager"	2*1h	"We are still studying the phenomenon. For our business, it is not easy to think of ways to deliver consumables as services. To embrace a servitization business model is our next big challenge."

Leading manufacturer of tyres	~29B€	~143k	"Business Planner & Program Manager"	1h	"We have done a lot of steps in our servitization transformation and we have a number of quite advanced solutions. We would like all our revenues to be from service fees. We want to do more, particularly by exploiting servitization in connection with industry 4.0."

From the quotes it emerges that servitization still represents a challenge for leading manufacturing companies (Löfberg, Witell, and Gustafsson 2015), not only for SMEs (Adrodegari and Saccani 2017). The managers' interviews show that servitization is regarded as a journey, whose difficulties depend on the organizational complexity of the services offered. Yet, as also shown by recent research (Yang et al. 2018; Gaiardelli, Martinez, and Cavalieri 2015; Peillon, Pellegrin, and Burlat 2015), the transformation is not a one-way journey. Indeed, analogously to multi-product lines, manufacturers are oriented toward a multi-service level, i.e. to the adoption of different servitization solutions in parallel.

Experts interviews revolved around three questions aimed to elicit a contribution to operationalize our measurement framework:

- Do you think our framework captures what you would expect as a manager from a servitization measurement?
- Would you discard/refine any of the selected measures?
- Would you restore any of the discarded measures?

Experts have been interviewed after a draft of the framework was completed. On the one hand, we as researchers performed most of the analytical work by thoroughly discussing each measure in relation with servitization literature. On the other hand, experts contributed in transposing an academic research to the needs of practitioners, without losing the theory behind it.

Such a sequence of steps aims to achieve the best trade-off between theoretical robustness, completeness, and usability of the proposed framework.

Results

Descriptive analysis

The descriptive analysis summarizes the articles' distribution over time, journals, and geographical areas (Thomé, Scavarda, and Scavarda 2016). Coherent with the evolution of servitization studies observed in other reviews (Baines et al. 2017), the majority of the articles date to less than ten years ago (only 16% prior to 2009). The journals with the highest number of papers are those dealing with service management in industry (Eloranta and Turunen 2015), specifically *Industrial Marketing Management* (5 articles), *Journal of Service Management* (4), *European Management Journal* (2), *International Journal of Operations & Production Management* (2), *International Journal of Production Economics* (2), *International Journal of Services, Technology and Management* (2), *Journal of Business and Industrial Marketing* (2), *Journal of Business-to-Business Marketing* (2), and *Journal of Marketing* (2). These journals represent, along with those for the management of operations (Bigdeli et al. 2018), the publication outlets for the research communities most involved in servitization studies (Baines et al. 2009).

The geographical distribution of the papers shows that servitization research continues to be concentrated in developed countries (Neely 2008). Indeed, 59% of the articles are from scholars based in four countries: UK, Sweden, Germany, and USA (out of a total of 18 countries). As suggested by Luoto, Brax, and Kohtamäki (2017), the lack of servitization research in developing countries represents an opportunity for scholars to examine how this business model unfolds in different environments (Szász and Demeter 2015).

The measures of firm-level servitization degree

This section names and describes all the measures of firm-level servitization degree as observed in the selected articles (Table 3). The purpose, common to analogous studies (Chatha et al. 2015), is to contribute in developing a more holistic understanding of the approaches to measure the firm-level degree of servitization.

Table 3 – Measures servitization degree observed in the literature

NAME OF MEASURE	DESCRIPTION
Number of Service Types	Degree of servitization is measured in terms of the number of service types offered (e.g. maintenance or consulting). This measure is vectorial because the different service types are not simply additive. For example, if a firm offers maintenance and repair services, and another offers maintenance and consulting services, the measurement of servitization is not the same, because the types of services are different.
Number of Services	Degree of servitization is measured in terms of the number of services offered, regardless of their types. The more services a company offers, the higher is the degree of servitization. However, in some cases the measure is applied only to a particularly type of service, e.g. the number of product-related services.
Share of Revenue from Services	Degree of servitization is measured in terms of the share of revenue from services.
Emphasis/Focus on a Number (Range) of Service Types	Degree of servitization is measured by asking managers to evaluate how strongly they emphasise or focus on a range of service types, usually on a Likert Scale. (e.g. "Evaluate on a 1-7 scale how strongly your company offers the following service types.").
Emphasis/Focus on a Number (Range) of Services	Degree of servitization is measured by asking managers to evaluate how strongly they emphasise or focus on a range of services, usually on a Likert Scale. (e.g. "Evaluate on a 1-7 scale how strongly your company offers the following services.").
Emphasis/Focus on Share of Revenue from Services	Degree of servitization is measured by asking managers to evaluate the significance of services in firm revenue, usually on a Likert Scale. (e.g. "Evaluate on a 1-7 Scale how strongly services impact on overall company revenues.").
Emphasis/Focus on Service Strategies	Degree of servitization is measured by asking managers to evaluate how strongly they pursue, or will pursue, the offering/development of additional services, usually on a Likert Scale. (e.g. "Evaluate on a 1-7 Scale how strongly you will pursue development of new service offerings in the near future.").
Number of Customers Serviced	Degree of servitization is calculated on the basis of the number of customers reached by the firm's services.
Product-Service (P-S) Continuum	Degree of servitization is measured by asking the manager to place their firm within an imagined continuum of firms, ranging from "purely product" to "purely service" providers.
Value Basis of Activity	Degree of servitization is evaluated on the basis of the nature of commercial exchange practiced by the firm: low if exchanges are transactional; high if exchanges are relational.
Primary Role of Assets	Degree of servitization is evaluated on the basis of the asset ownership model adopted by the firm: low if customers own their own assets; high if customers use the firm's assets.
Production Strategy	Degree of servitization is evaluated on the basis of the firm's production strategy: low if the firm focuses on mass production; high if it focuses on customization.
Services Reputation	The service reputation, usually measured as satisfaction, is used as a proxy of the degree of servitization.

Use of measures in different methods of servitization research

Servitization literature is dominated by two kinds of studies: those examining in-depth a limited number of firms and those analysing the phenomenon on a larger scale (Bigdeli et al. 2018). Both kinds of studies tend to be used to examine specific aspects of servitization (Sousa and da Silveira 2017). Accordingly, this section analyses the measures of firm-level servitization degree by classifying articles as "case studies" (based on in-depth analysis of a restricted number of firms) and "statistical analyses" (based on samples composed of a large number of firms). Table 4 reports the results of such classification. The details for each article are reported in Appendix C (see Appendix D for a reliability test).

Table 4 – Measures of the degree of servitization (methods)

RESEARCH METHOD	**MEASURE (% of studies adopting the measure)**
Case Study	• Number of Service Types (53%); • Share of Revenue from Services (20%). Others (less than 10% each): • P-S Continuum; • Number of Services AND Number of Service Types AND Number of Customers Serviced AND Emphasis/Focus on Service Strategies; • Number of Service Types AND Number of Services AND Share of Revenue from Services; • Value Basis of Activity AND Primary Role of Assets AND Number of Service Types AND Production Strategy;
Statistical Analysis	• Number of Service Types AND Number of Services (27%); • Share of Revenue from Services (18%). Others (less than 10% each): • Number of Service Types; • Number of Services; • Emphasis/Focus on Number of Service Types AND Emphasis/Focus on Number of Services; • Share of Revenue from Services AND Number of Services; • Number of Services AND Number of Customers Serviced AND Emphasis/Focus on Service Strategies; • Number of Service Types AND Number of Services AND Emphasis/Focus on Service Strategies; • Number of Service Types AND Number of Services AND Number of Customers Serviced AND Emphasis/Focus on Service Strategies; • Emphasis/Focus on Number of Service Types AND Emphasis/Focus on Number of Services AND Emphasis/Focus on Share of Revenue from Services; • Emphasis/Focus on Service Strategies AND Services Reputation

Measures in case studies tend to be quite consistent. The most frequently used measure is the "Number of Service Types" (53% of case studies), followed by the "Share of Revenue from Services", (20%). The remaining studies (27%) uses only four further measures. In addition, the majority of the studies (80%) investigate the degree of servitization using a single measure.

Research taking the statistical analysis approach tends to apply a similar selection of measures, again with notable emphasis on the "Share of Revenue from Services" and the "Number of Service Types", this latter in combination with the "Number of Services". Yet, the frequency distribution is flatter. In addition, differently from case studies, most of the statistical analyses (64%) apply more than one measure (multi-dimensional analysis). Finally, it is interesting to note that some studies in the "statistical analysis" category explicitly endeavour to find the most appropriate way to measure the degree of servitization (e.g. Homburg et al. 2002; Partanen et al. 2017). These studies consider the servitization phenomenon as multidimensional, yet they do not come to an agreement on which measures to adopt.

Purposes for using measures of firm-level servitization degree

According to Zhang and Banerji (2017), the purposes for which each measure is used can be divided into those concerned with servitization itself (e.g. evolution of services offered by single manufacturers; diffusion of servitization among manufacturers) and those concerned with its consequences and relations to other business aspects (e.g. organizational changes related to servitization strategies; relations between degree of servitization and firm performance; effects of servitization on customer relations). In investigating these purposes, researchers tend to use measures of servitization to "profile" the companies' service offering, or to relate the firm-level degree of servitization to other aspects. Hence, the following categories emerge:

- "Profiling" servitization: the measurement of servitization degree is employed to conceptualize different servitization levels (Raddats and Kowalkowski 2014), to investigate

the evolution of servitization over time (e.g. Jovanovic et al. 2016; Baines and Lightfoot 2013), to quantify its diffusion (Partanen et al. 2017), or to examine best practices and challenges associated with servitization development (Burton et al. 2017);

- "Relating" servitization: the measurement of servitization degree is employed to relate its degree to other company aspects, such as overall performance (Crozet and Milet 2017; Gebauer et al. 2005), organizational changes, and impact on customer relationships (Raddats and Burton 2011; Homburg et al. 2002).

Table 5 reports the frequency analyses of the measures grouped under these two categories. The results resemble that of the previous analysis (Table 4): both categories largely use the same measures, yet with different frequencies.

Table 5 – Measures of the degree of servitization (goals)

RESEARCH GOAL	SUB-GOALS	MEASURE (% of studies adopting the measure)
Profiling servitization	• Investigation of the servitization journey; • Classification of servitization business models; • Investigation of servitization best practice; • Investigation of servitization challenges; • Diffusion of servitization (intra and inter firm).	• Number of Service Types (53%); • Share of Revenue from Services (20%). Others (less than 10% each): • Emphasis/Focus ON (Number of Service Types AND Number of Services AND Share of Revenue from Services); • Number of Services; • P-S Continuum; • Value Basis of Activity AND Primary Role of Assets AND Number of Service Types AND Production strategy.
Relating servitization to other aspects	• Relationship between degree of servitization and company performance; • Relationship between servitization degree and organizational structure; • Relationship between servitization degree and customer relationships; • Relationship between servitization degree and product innovation; • Relationship between servitization degree and employment.	• Number of Service Types AND Number of Services (25%); • Share of Revenue from Services (17%); • Number of Service Types (13%). Others (less than 10% each) • Number of Services; • Emphasis/Focus on Number of Service Types AND Emphasis/Focus on Number of Services; • Number of Service Types AND Number of Services AND Number of Customers Serviced AND Emphasis/Focus on Service Strategies; • Emphasis/Focus ON Service Strategies AND Service Reputation; • Number of Service Types AND Number of Services AND Emphasis/Focus on Service

	Strategies; • Number of Service Types AND Number of Services AND Share of Revenue from Services; • Number of Services AND Number of Customers Serviced AND Emphasis/Focus on Service Strategies; • Number of Services AND Share of Revenue from Services.

In studies involving "profiling" goals, the "Number of Service Types" is the far more frequent measure. Differently, the class of articles involving "relating" goals is heterogeneous, with heterogeneity extending even to the different sub-goals. For example, there are eight studies investigating the correlation between degree of servitization and "service paradox" (Gebauer et al. 2005), i.e. the higher than average financial strain of firms undergoing a servitization journey: Crozet and Milet (2017); Visnjic et al. (2016); Benedettini et al. (2015); Kohtamäki et al. (2015); Kohtamäki et al. (2013); Suarez et al. (2013); Lay et al. (2010); Neely (2008). These eight studies employ four different individual or combined servitization measures: i) "Share of Revenue from Services"; ii) "Number of Services", "Number of Service Types", "Emphasis/Focus on Service Strategy"; iii) "Number of Service Types", "Number of Services"; iv) "Emphasis/Focus on Number of Service Types", "Emphasis/Focus on Number of Services". Comparison of results between these studies is clearly impaired by such inconsistency, confirming the need to establish guidelines for future research to be consistent (Bigdeli et al. 2018; Rabetino et al. 2018).

A guiding framework for measuring firm-level servitization degree

Based on the preceding analysis, three classes of firm-level measures of servitization degree can be identified: "objective", "contingent", and "subjective". The "objective"-"subjective" distinction for servitization measurement has already been observed by Bigdeli et al. (2018). Here, we propose a further refinement (i.e. the "contingent" class) to capture different facets of firm-level servitization degree. The measures collected through the literature review have been classified accordingly, and then discussed with three experts.

Objective measures

The measures included in this class are “Number of Service Types”, “Number of Services”, “Value Basis of Activity” and “Primary Role of Assets”, with the former two being much more used than the others. This class of measures are considered objective in that two firms having the same value in the measured dimension will have the same degree of servitization, independently of any contingent or subjective factor (e.g. assessment of managers). Measures in this class are suitable to capture the extensions of servitization, i.e. the “Degree of Servitization Extension”. Indeed, taking the “Number of Service Types” as an example, the observation of the same number of service types in two firms results in the same measure, independently of other factors that might influence service provision (e.g. management commitments to service strategies). Yet, as the “Number of Service Types” only captures the breadth of servitization, it is necessary to join it with the “Number of Services” to also capture the depth, i.e. to have a complete measure of servitization extension (Partanen et al. 2017).

A disadvantage of the “Number of Service Types” is that the definition of the types vary (Bigdeli et al. 2018; Rapaccini and Visintin 2015). For example, Benedettini, Swink, and Neely (2017) and Benedettini, Neely, and Swink (2015) use twelve service types; Mathieu (2001) contends that service types are two (“services supporting the product” and “services supporting the customer”); Yang et al. (2018) propose to refine Mathieu's (2001) classification by distinguishing “services supporting the customers” into “use-oriented services” (operational lease of an asset) and “result-oriented services” (operation of an asset on behalf of the customer); Baines and Lightfoot (2013) indicate three other types, i.e. base, intermediate, and advanced services. Literature is again inconsistent. Therefore, it is impossible to measure consistently the “Number of Service Types”.

To overcome these inconsistent definitions, we propose to use the NACE (the acronym stands for the translation from French of “European Classification of Economic Activities”) standard classification (European Commission 2008). NACE groups organizations according to their business activities. Statistics based on NACE are comparable at European level and, in

general, at world level in line with the United Nations' International Standard Industrial Classification (ISIC) (United Nations 2008). The NACE code has a hierarchical, four-level structure. The highest level categories are named "sections"; the first two digits of the code identify the "division", the third digit the "group", and the fourth digit the "class" (e.g. "Section C": Manufacturing; "Division *33*": Repair and installation of machinery and equipment; "Group 33.*1*": Repair of fabricated metal products, machinery and equipment; "Class 33.1*5*" Repair and maintenance of ships and boats). NACE classifies economic activities into 21 sections (a descriptive literal field usually not reported in the classification), 88 divisions (two-digit field), 272 groups (three-digit field), and 615 classes (four-digit field). This classification provides an exhaustive, comparable, and standardized representation of the observable universe of economic activities through mutually exclusive items (divisions, groups, and classes). Namely, there is a one-to-one correspondence between NACE codes and economic activities, and therefore service activities. Depending on the level of detail (two, three, or four digits) an economic activity can be as particular as "Repair and maintenance of ships and boats" or as general as "Repair and installation of machinery and equipment". Accordingly, NACE is suitable to classify, at any desired level of detail, the service offering of manufacturers. Its implementation will counter the arbitrariness in the choice of the archetypical service types and allow their identification in a standard way, making the measures "Number of Service Types" and "Number of Service" more reliable.

Contingent Measures

The measures included in this class are "Share of Revenue from Services" and "Number of Customers Serviced", the former being far more frequently used. In this class of measures, the observed value of servitization degree depends on contingent factors internal or external to the firm. The measurement of a company's servitization is specified as a numeric value, which depends on firm-specific abilities to leverage their service offering on markets. The measure therefore does not record the degree of servitization in terms of the extension of the services provided, rather it records

the degree of servitization in terms of the economic result generated by the services (in the "Share of Revenue from Services" case, the measure records the financial weight of servitization in the firm).

Accordingly, this class of measures is best used in evaluations and investigations where, rather than extensions, the weight and/or financial impact of servitization strategies is the focus. However, in the articles examined this is not always true. Indeed, the "Share of Revenue from Services" (the most frequent of the contingent measures) is also used as a measure of servitization "degree" in contexts similar to the previous ones, such as in the investigation of service strategies employed by manufacturers (Burton et al. 2017) or in the analysis of the diffusion of servitization among manufacturers (Davidsson et al. 2009). It is logically implicit that the share of revenues has advantages in informing on the weight of service strategies in firms balance sheets (as seen in Crozet and Milet 2017), i.e. on "service infusion" (Eloranta and Turunen, 2015), more than on servitization extension within organisations, better conveyed by objective measures. Therefore, the "Degree of Servitization Infusion" should be the focus of contingent measures, whereas the "Degree of Servitization Extension" should be the focus of objective measures.

Subjective measures

This class of measures includes "Emphasis/Focus on Number of Service Types", "Emphasis/Focus on Number of Services", "Emphasis/Focus on Share of Revenue from Services", "Emphasis/Focus on Service Strategies", "P-S Continuum", "Production Strategy", and "Services Reputation". All of the "Emphasis/Focus" measures are subjective because managers of two firms with identical services, under identical conditions, can place different emphasis on their firms' service provision, thus generating different measures of servitization degree. In fact, objective and contingent measures are grounded on numerical values not subject to any further "interpretation": the former are influenced only by the arbitrariness in the definition of service types, the latter are influenced only by contingent factors. Subjective measures are instead biased by managers'

perceptions. Two firms could conceivably be observed as having identical objective and contingent measures (e.g. “Number of Service Types” and “Share of Revenue from Services”), yet be different under any of these subjective measures, and thus have different values of servitization “degree”. Accordingly, subjective measures are suitable to investigate firms' present or intended strategic and cultural attitudes towards servitization (Kowalkowski, Gebauer, and Oliva 2017). However, the literature again fails to provide a clear rationale to distinguish subjective measures from others. For example, such measures are used without those of other classes in four of the articles examined (Partanen et al. 2017; Kohtamäki et al. 2015; Kohtamäki et al. 2013; Gebauer et al. 2011), and in combination with measures of other classes in another four cases (Kowalkowski et al. 2013; Lay et al. 2010; Antioco et al. 2008; Homburg et al. 2002). The information conveyed by subjective measures clearly has managerial connotations different from information on “extension” or “infusion”. Therefore, we propose this class of measures to be labelled “Degree of Servitization Orientation”. This class should measure the managerial commitment to the development of overall service strategies, or towards particular services, and should be used only when this specific information is sought.

The Servitization Measurement Framework

The classification and selection of the measures presented above as well as the three questions reported in the methodology section served as a basis for our interviews aimed at finalizing the design of the measurement framework. Overall, experts welcomed the idea of a framework to measure servitization in practice and thought it to be both appropriate and exhaustive to represent the various degrees as “objective”, “contingent”, and “subjective”.

With respect to our initial proposition of using either singularly or in combination the “Number of Service Types” and the “Number of Services”, an expert pointed out:

> “The ‘Number of Services’ is a too general, and rather uninformative, measure if one has to discern, even at an approximate level, how the service business of a manufacturer is developed. It would be much better to link it with the ‘Number of Service Types’.”

Hence, after a thorough discussion, the "Number of Services" has been replaced by the "Number of Services within each Type". For a standardized identification of the "Number of Service Types", we elaborated a synthesis of the NACE document containing all the divisions with service activities (44 out of 88 divisions), which we submitted to the three experts. We chose to use as a basis the 88 divisions, rather than the 272 groups or the 615 classes, because they represent a manageable number of categories. For each division, we went through its description and its sub-items (groups and classes) and worked out a table containing a description of the division and of the services included in it. In addition, we added suggestions distinguish among similar divisions. The engagement of the experts helped us operationalizing the NACE classification in a way suitable for applications. The final result is reported in Table E (Appendix E). It contains all the NACE divisions with service activities, hence it contains the existing service types that firms can offer, organized in mutually exclusive categories. Therefore, it can be used to detect the number of service types that a firm offers, out of all the existing types (the 44 rows in the table).

From the contingent measures, experts agreed on using "Share of Revenue from Services". Their feeling is that such measures represent a good trade-off between ease of usability and completeness in evaluating the presence of services in a manufacturing business.

Finally, on the subjective measures managers suggested the integration of our list with analogous measures. As reported by one manager:

> "The 'Emphasis/Focus on Service Strategy' is too generic: you could be extremely committed at a managerial level but observe the failure of your service strategy because you did not provide your employees with the right motivation. You ought to take into account employees too."

This remark is in line with a number of authors reporting on the threats posed on servitization success by employees' resistance (Löfberg, Witell, and Gustafsson 2015; Ulaga and Loveland 2013; Brax 2005). In the end, agreement has been reached on the decision of splitting the "Emphasis/Focus on Service Strategies" into three parts, to take into account respectively managers, front-end, and back-end employees. Table 6 summarizes the outcome of our revision and

discussion. It represents an operative version of our firm-level servitization measurement framework.

Table 6 – Framework for measurement of servitization degree at firm level

DIMENSION MEASURED	RESEARCH METHODS	RESEARCH GOALS	CLASS OF MEASURES	RECOMMENDED MEASURES
Servitization Extension	Case studies, statistical analysis.	Classification of servitization strategies; Servitization journey; Servitization performance; Servitization impact on organizational aspects.	Objective	Number of Service Types (see Table E to detect the service types), Number of Services within each Type.
Servitization Infusion	Statistical analysis.	Financial-economic weight of servitization.	Contingent	Share of Revenue from Services.
Servitization Orientation	Statistical analysis.	Servitization impact on customer relationships; Servitization future developments; Strategic importance of servitization.	Subjective	Emphasis/Focus on Service Strategies (Managers, Front-End Employees, Back-End Employees); Emphasis/Focus on Share of Revenue from Services.

As said, considering both the "selected" and "discarded" papers, it emerges that servitization can be detected and measured at four levels. One of these is the firm level, discussed in the current paper, which can further be split into firm-level measures of degree and performance (Bigdeli et al. 2018). The others are detection and measurement at the level of individual employees, which serve as the micro-foundations for diffusion of servitization within organizations (Lenka et al. 2017); at the product level (Baines and Lightfoot 2013), where indicators ranging from product ownership to product performance are used to assess the servitization degree of the product-service provided (e.g. fuel consumption monitored by the "MAN Fleet Management" solution); and at the regional level, where servitization diffusion and/or performance are investigated with reference to specific regions (Falk and Peng 2013). Table 7 integrates the firm-level framework (Table) with servitization measurement at other levels.

Table 7 – Framework for measurement of servitization at all levels

Individual level: this level has not been the object of systematic literature reviews.

Product level: this level has not been the object of systematic literature reviews.			
Firm level	*Sublevel*	*Dimension*	*Measures*
	Degree of servitization:	Extension	Number of Service Types AND Number of Services within each Type
		Infusion	Share of Revenue from Services
		Orientation	Emphasis/Focus on Service Strategies (Managers, Front-End Employees, Back-End Employees); Emphasis/Focus on Share of Revenue from Services.
	Performance servitization:	For a review identifying a set of measures see Bigdeli et al. (2018)	
Regional level: this level has not been the object of systematic literature reviews.			

Discussion and conclusion

In line with the increasing adoption of service strategies by manufacturers, servitization research has been constantly increasing over the last decade (Bigdeli et al. 2018; Kowalkowski, Gebauer, and Oliva 2017; Nemoto, Akasaka, and Shimomura 2015). Despite this, many questions still remain unanswered: whether the transformation is a linear or a parallel journey (Bigdeli et al. 2018; Yang et al. 2018; Peillon, Pellegrin, and Burlat 2015); why some firms abandon such a strategy (Kowalkowski et al. 2017; Valtakoski 2017); when and for whom servitization is profitable (Baines and Shi 2015); what are its risks (Benedettini, Swink, and Neely 2017; Benedettini, Neely, and Swink 2015); and whether the phenomenon should be confined to manufacturing firms (Baines et al. 2017). A common agreement on how to measure servitization is insufficient to answer all these questions, yet it is a necessary condition (Brax and Visintin 2017; Rapaccini and Visintin 2015). Despite that, the results of our review demonstrate that a wide range of alternatives are currently adopted and – most notably – identical questions are often investigated with different measures. This instability creates a significant problem in comparing results from different studies, therefore hindering the acquisition of knowledge (Baines and Shi 2015).

The causes of the above inconsistencies are substantially two. First, the concept of servitization degree is not established: it is unknown whether it should be referred to, for instance, by means of the share of revenue from services or the types of service offered. Second, even when the concept of degree is agreed upon (e.g. degree is measured by means of service offering), different ways exist to operationalize the measures. The numerous classifications that exist to measure the firms' service offering are representative of the latter (Benedettini, Swink, and Neely 2017; Rapaccini and Visintin 2015; Gaiardelli et al. 2014; Saccani, Visintin, and Rapaccini 2014; Ulaga and Reinartz 2011; Mathieu 2001 – to provide just but a few examples). Clearly, such heterogeneity makes it impossible to establish unambiguously what the service offering of a firm is, thus undermining the possibility to discuss different servitization outcomes.

The framework developed in this review (Table 6) is a conceptual and operative tool that solves both issues, and thus it fosters constructive accumulation of knowledge (Bigdeli et al. 2018; Rabetino et al. 2018). It resolves the first issue by defining three aspects of servitization degree and by proposing measures most suited to each aspect; whereas it resolves the second issue by creating a tool, based on the NACE classification, to identify unambiguously the service types offered by firms. Such a solution contributes to both research and practice of servitization.

Research contribution

The first contribution is the distinction between degree of servitization "extension", "infusion", and "orientation", measured respectively by objective, contingent, and subjective measures. Such a distinction, with the corresponding definitions, supports researchers in choosing the type of measure best suited to their investigations. Given the possibility of investigating these different levels and their combinations, it becomes ever more essential to establish clarity in defining the level of interest, the purpose of measurement, and the measures to be applied. Indeed, the distinction of the concepts would favour a more proficient investigation of the correlation between servitization extension and performance, i.e. the "service paradox" (Benedettini et al. 2017;

Baines and Shi 2015; Gebauer et al. 2005) and would pave the way for the investigation of the correlations between infusion, orientation, extension and performance.

The second contribution is represented by the particular shape of the framework. Indeed, for the degree of servitization "extension", this is the first time that a measure is designed based on an international standard. Our choice of using the NACE classification – and our operative synthesis in Appendix E – ensure that service types would be represented by means of mutually exclusive categories (the 44 divisions in Table E), which include all the service activities that firms can conceivably offer. This contribution counters, by means of a recognized standard, the somewhat subjective choices of the various researchers, and it makes the "Number of Service Types" objective. For the degree of servitization "infusion" and "orientation", the paper provides measures that are efficient (i.e. based on a low number of dimensions) and effective (i.e. highly specific to the aspect they measure); the paper also provides guidelines to apply them to specific research goals (see Table 6).

Finally, although the current review has focused on measuring firm-level servitization degree, the collected material (included and excluded articles) has allowed us to distinguish, at firm-level, measures addressing servitization degree and measures addressing servitization performance. This distinction endeavours the measurement of the value created from servitization (Guo et al. 2015; Grönroos and Helle 2010). Clearly the two are related, most notably in the evaluation of servitization economic benefits, yet it is important to keep the concepts separated. This distinction – along with the distinction among measures at individual, product, and regional level – is at the basis of our general servitization framework that conceptualizes servitization measurement beyond the firm-level degree (Table 7).

All these implications contribute to develop theory, lexicon, and tools for servitization measurement. The theory creates the premises to discuss the causes of successful and unsuccessful servitization experiences (Baines and Shi 2015); the lexicon support scholars in being consistent across their applications (Kowalkowski, Gebauer, and Oliva 2017; Partanen et al. 2017); and the

tool help carrying on the measurement in practice (Bigdeli et al. 2018; Rapaccini and Visintin 2015).

Managerial contribution

A number of case studies show that the managerial challenges to implement servitization strategies revolve around three interconnected goals: the effective design of a service offering, the leverage of that offering, and the acquisition of a service oriented attitude (Bigdeli et al. 2018; Adrodegari and Saccani 2017; Alghisi and Saccani 2015; Kreye, Roehrich, and Lewis 2015; Rapaccini and Visintin 2015). Our operational framework supports managers in facing these three challenges (Table 6).

The framework allows the measurement of the various aspects of servitization degree, i.e. the degree of extension, infusion, and orientation. Hence, it supports managers in the challenge of quantifying the phenomenon (Adrodegari and Saccani 2017; Rapaccini and Visintin 2015). To this purpose, Table E provides a tool to operationalize the measurement of the number of service types in an unambiguous and comparable manner according to international standards (Kreye, Roehrich, and Lewis 2015). Such a tool would be useful for internal and external assessment of a manufacturer's service extension (Nemoto, Akasaka, and Shimomura 2015). As for the service infusion and orientation dimensions, the framework clarifies concepts often misunderstood and provides managers with simple, effective measures to take both aspects into account.

Lastly, the framework connects the services offered (extension), the revenue generated (infusion), and the organizational alignment (orientation). The possibility to link these three aspects and to examine them separately and in parallel is considered fundamental to be successful in transforming a goods-dominated organization into a servitized one (Alghisi and Saccani 2015; Gaiardelli, Martinez, and Cavalieri 2015; Rapaccini and Visintin 2015). Indeed, explanations of successful or unsuccessful outcomes will be looked for by managers in the combined evaluation of how they design their service portfolio, how capable they are at generating revenues from that

portfolio, and how committed the organization is toward the business transformation (Löfberg, Witell, and Gustafsson 2015; Peillon, Pellegrin, and Burlat 2015; Rapaccini 2015).

Future research and limitations

Future research should investigate the degree of servitization from a more holistic perspective. Starting from the current study, which breaks down firm-level servitization degree into "extension" (measured by means of objective measures), "infusion" (measured by means of contingent measures), and "orientation" (measured by means of subjective measures), it would be possible to study a "complex" scale interrelating these parts. A research path in this direction is suggested by Composite Indicators (CIs) (Saltelli 2007), i.e. aggregations of ordinal or cardinal measures that summarize "complex and sometime elusive processes (e.g. sustainability, single market policy, etc.) into a single figure" (Saisana et al. 2005). In the social science, CIs have been used to quantify constructs that resist reduction to a single dimension (Bandura 2008). In the servitization field, the development of CIs could provide holistic indices of servitization degree accounting for its three aspects (extension, infusion, orientation). The further distinction between the four levels of servitization measurement (individual, product, firm, and regional level) opens a path for future studies to investigate each level and their interrelations.

Another contribution for future research is the development of a standard approach to detect the "Number of Service Types", which is observed as the most prominent measure of servitization degree. Such a standard would help profiling the strategies of manufacturers in a consistent manner, and facilitating comparison among future studies. Table 8 summarizes the research agenda.

Table 8 – Further developments in the measurement of servitization degree

Further Developments	
Degree of servitization	1. Adoption of appropriate measures of servitization degree in each circumstance, depending on the objective of the study. 2. Adoption of the standard service types in Table E to identify different servitization strategies.

	3. Holistic investigation of servitization degree (extension, infusion, orientation) by means of a composite measure.
Servitization measurement framework	1. Adoption of the measurement framework to frame future servitization studies.
	2. Empirical completion of the unexplored entries in the framework.

On the whole, this review reinforces the idea that servitization is best understood in multidimensional terms (Brax and Visintin 2017; Lee et al. 2016) and contributes to clarify concepts and purposes of "servitization measurement". The frameworks presented in Tables 6 and 7 resolve conceptual confusion in the application of the various measures and contribute to the investigation of some "paradigmatic" assumptions concerning servitization (Luoto et al. 2017).

Despite our efforts to be rigorous, this study has some limitations. The measures are not always explicit in the reviewed studies, and sometimes inference (validated through iterative content analysis) was necessary. In addition, by focusing on the measurement of the firm-level degree of servitization, the study does not consider measures which might come from dyadic or network interactions among firms and their business partners. Finally, despite our test with selected experts, multiple large-scale assessments are needed to confirm the applicability of the proposed framework.

References

Adrodegari, Federico, and Nicola Saccani. 2017. “Business Models for the Service Transformation of Industrial Firms.” *The Service Industries Journal* 37 (1): 57–83. https://doi.org/10.1080/02642069.2017.1289514.

Adrodegari, Federico, Nicola Saccani, Christian Kowalkowski, and Jyrki Vilo. 2017. “PSS Business Model Conceptualization and Application.” *Production Planning & Control* 28 (15): 1251–63. https://doi.org/10.1080/09537287.2017.1363924.

Ahamed, Zahir, Takehiro Inohara, and Akira Kamoshida. 2013. “The Servitization of Manufacturing: An Empirical Case Study of IBM Corporation.” *International Journal of Business Administration* 4 (2): 18–26. https://doi.org/10.5430/ijba.v4n2p18.

Alghisi, Andrea, and Nicola Saccani. 2015. “Internal and External Alignment in the Servitization Journey–overcoming the Challenges.” *Production Planning & Control* 26 (14–15): 1219–32. https://doi.org/10.1080/09537287.2015.1033496.

Antioco, Michael, Rudy K. Moenaert, Adam Lindgreen, and Martin G.M. Wetzels. 2008. “Organizational Antecedents to and Consequences of Service Business Orientations in Manufacturing Companies.” *Journal of the Academy of Marketing Science* 36 (3): 337–58. https://doi.org/10.1007/s11747-008-0085-1.

Baines, Tim, Ali Ziaee Bigdeli, Oscar F. Bustinza, Guang Shi, James S. Baldwin, and Keith Ridgway. 2017. “Servitization: Revisiting the State-of-the-Art and Research Priorities.” *International Journal of Operations & Production Management* 37 (2): 256–78. https://doi.org/10.1108/IJOPM-06-2015-0312.

Baines, Tim, Howard Lightfoot, Ornella Benedettini, and John M. Kay. 2009. “The Servitization of Manufacturing: A Review of Literature and Reflection on Future Challenges.” *Journal of Manufacturing Technology Management* 20 (5): 547–67. https://doi.org/10.1108/17410380910960984.

Baines, Tim, Howard Lightfoot, Ornella Benedettini, D. Whitney, and J.M. Kay. 2010. “The Adoption of Servitization Strategies by UK-Based Manufacturers.” *Journal of Engineering Manufacture* 224 (5): 815–29. https://doi.org/10.1243/09544054JEM1567.

Baines, Tim, and Howard W. Lightfoot. 2013. “Servitization of the Manufacturing Firm: Exploring the Operations Practices and Technologies That Deliver Advanced Services.” *International Journal of Operations & Production Management* 34 (1): 2–35. https://doi.org/10.1108/IJOPM-02-2012-0086.

Baines, Tim, and Victor Guang Shi. 2015. “A Delphi Study to Explore the Adoption of Servitization in UK Companies.” *Production Planning & Control* 26 (14–15): 1–17. https://doi.org/10.1080/09537287.2015.1033490.

Bakkalbasi, Nisa, Kathleen Bauer, Janis Glover, and Lei Wang. 2006. “Three Options for Citation Tracking: Google Scholar, Scopus and Web of Science.” *Biomedical Digital Libraries*. https://doi.org/10.1186/ 1742-5581-3-7.

Bandura, Romina. 2008. “A Survey of Composite Indices Measuring Country Performance: 2008 Update.” *Office of Development Studies, New York: United Nations Development Programme*, no. February: 1–95.

Benedettini, Ornella, Andy Neely, and Morgan Swink. 2015. “Why Do Servitized Firms Fail? A Risk-Based Explanation.” *International Journal of Operations & Production Management* 35 (6): 946–79. https://doi.org/10.1108/IJOPM-02-2014-0052.

Benedettini, Ornella, Morgan Swink, and Andy Neely. 2017. “Examining the Influence of Service Additions on Manufacturing Firms’ Bankruptcy Likelihood.” *Industrial Marketing Management* 60 (January 2017): 112–25. https://doi.org/10.1016/j.indmarman.2016.04.011.

Bergman, Elaine M. Lasda. 2012. “Finding Citations to Social Work Literature: The Relative Benefits of Using Web of Science, Scopus, or Google Scholar.” *Journal of Academic Librarianship* 38 (6): 370–79. https://doi.org/10.1016/j.acalib.2012.08.002.

Bigdeli, Ali Z., Tim Baines, Andreas Schroeder, Steve Brown, Eleanor Musson, Victor Guang Shi, and Armando Calabrese. 2018. “Measuring Servitization Progress and Outcome: The Case of ‘Advanced Services.’” *Production Planning & Control* 29 (4): 315–32. https://doi.org/10.1080/09537287.2018.1429029.

Brax, Saara. 2005. “A Manufacturer Becoming Service Provider–challenges and a Paradox.” *Managing Service Quality: An International Journal* 15 (2): 142–55. https://doi.org/10.1108/09604520510585334.

Brax, Saara A., and Filippo Visintin. 2017. “Meta-Model of Servitization: The Integrative Profiling Approach.” *Industrial Marketing Management* 60 (January 2017): 17–32. https://doi.org/10.1016/j.indmarman.2016.04.014.

Bryman, Alan. 2015. *Social Research Methods*. Oxford university press.

Burnham, Judy F. 2006. “Scopus Database: A Review.” *Biomedical Digital Libraries*. https://doi.org/10.1186/1742-5581-3-1.

Burton, Jamie, Vicky M. Story, Chris Raddats, and Judy Zolkiewski. 2017. “Overcoming the Challenges That Hinder New Service Development by Manufacturers with Diverse Services Strategies.” *International Journal of Production Economics* 192 (October 2017): 29–39. https://doi.org/10.1016/j.ijpe.2017.01.013.

Cassell, Catherine E., and Gillian E. Symon. 2004. *Essential Guide to Qualitative Methods in Organizational Research*. Sage.

Chakkol, Mehmet, Mark Johnson, Jawwad Raja, and Anna Raffoni. 2014. “From Goods to Solutions: How Does the Content of an Offering Affect Network Configuration?” *International Journal of Physical Distribution & Logistics Management* 44 (1–2): 132–54. https://doi.org/10.1108/IJPDLM-03-2013-0064.

Chatha, K.A., I. Butt, and Adeel Tariq. 2015. “Research Methodologies and Publication Trends in Manufacturing Strategy: A Content Analysis Based Literature Review.” *International Journal of Operations & Production Management* 35 (4): 487–546. https://doi.org/10.1108/IJOPM-07-2012-0285.

Clarke, Mike, and Andy Oxman. 2001. *Cochrane Reviewers’ Handbook*. Oxford: The Cochrane Library.

Crozet, Matthieu, and Emmanuel Milet. 2017. “Should Everybody Be in Services? The Effect of Servitization on Manufacturing Firm Performance.” *Journal of Economics & Management Strategy* 26 (4): 820–41. https://doi.org/10.1111/jems.12211.

Cusumano, Michael A., and Steven J. Kahl. 2015. “Services, Industry Evolution, and the Competitive Strategies of Product Firms.” *Strategic Management Journal* 36 (4): 559–75. https://doi.org/10.1002/smj.2235.

Dachs, Bernhard, Sabine Biege, Martin Borowiecki, Gunter Lay, Angela Jäger, and Doris Schartinger. 2014. “Servitisation of European Manufacturing: Evidence from a Large Scale Database.” *The Service Industries Journal* 34 (1): 5–23. https://doi.org/10.1080/02642069.2013.776543.

Davidsson, Nina, Bo Edvardsson, and Anders Gustafsson. 2009. “Degree of Service-Orientation in the Pulp and Paper Industry.” *International Journal of Services Technology and Management* 11 (1): 24–41. https://doi.org/10.1504/IJSTM.2009.02238.

Eggert, Andreas, Jens Hogreve, Wolfgang Ulaga, and Eva Muenkhoff. 2011. “Industrial Services, Product Innovations, and Firm Profitability: A Multiple-Group Latent Growth Curve Analysis.” *Industrial Marketing Management* 40 (5): 661–70.

https://doi.org/10.1016/j.indmarman.2011.05.007.

———. 2014. “Revenue and Profit Implications of Industrial Service Strategies.” *Journal of Service Research* 17 (1): 23–39. https://doi.org/10.1177/1094670513485823.

Eloranta, Ville, and Taija Turunen. 2015. “Seeking Competitive Advantage with Service Infusion: A Systematic Literature Review.” *Journal of Service Management* 26 (3): 394–425. https://doi.org/10.1108/JOSM-12-2013-0359.

European Commission. 2008. “Statistical Classifcation of Economic Activites in the European Community (NACE Rev.2).” Luxembourg.

Falk, Martin, and Fei Peng. 2013. “The Increasing Service Intensity of European Manufacturing.” *The Service Industries Journal* 33 (November 2013): 1686–1706. https://doi.org/10.1080/02642069.2011.639872.

Fang, Eric, Robert W. Palmatier, and Jan-Benedict E.M. Steenkamp. 2008. “Effect of Service Transition Strategies on Firm Value.” *Journal of Marketing* 72 (5): 1–14. https://doi.org/10.1509/jmkg.72.5.1.

Gaiardelli, Paolo, Veronica Martinez, and Sergio Cavalieri. 2015. “The Strategic Transition to Services: A Dominant Logic Perspective and Its Implications for Operations.” *Production Planning & Control* 26 (14–15): 1165–70. https://doi.org/10.1080/09537287.2015.1033498.

Gaiardelli, Paolo, Barbara Resta, Veronica Martinez, and Roberto Pinto. 2014. “A Classification Model for Product-Service Offerings.” *Journal of Cleaner Production* 66 (March 2014): 507–19. https://doi.org/10.1016/j.jclepro.2013.11.032.

Gasparyan, Armen Yuri, Lilit Ayvazyan, and George D. Kitas. 2013. “Multidisciplinary Bibliographic Databases.” *Journal of Korean Medical Science* 28 (9): 1270–75. https://doi.org/10.3346/jkms.2013.28.9.1270.

Gebauer, Heiko, Elgar Fleisch, and Thomas Friedli. 2005. “Overcoming the Service Paradox in Manufacturing Companies.” *European Management Journal* 23 (1): 14–26. https://doi.org/10.1016/j.emj.2004.12.006.

Gebauer, Heiko, Anders Gustafsson, and Lars Witell. 2011. “Competitive Advantage through Service Differentiation by Manufacturing Companies.” *Journal of Business Research* 64 (12): 1270–80. https://doi.org/10.1016/j.jbusres.2011.01.015.

Gebauer, Heiko, Guang-Jie Ren, Aku Valtakoski, and Javier Reynoso. 2012. “Service-driven Manufacturing: Provision, Evolution and Financial Impact of Services in Industrial Firms.”

Journal of Service Management 23 (1): 120–36. https://doi.org/10.1108/09564231211209005.

Gehanno, Jean-François, Laetitia Rollin, and Stefan Darmoni. 2013. "Is the Coverage of Google Scholar Enough to Be Used Alone for Systematic Reviews." *BMC Medical Informatics and Decision Making*. https://doi.org/10.1186/1472-6947-13-7.

Grönroos, Christian, and Pekka Helle. 2010. "Adopting a Service Logic in Manufacturing: Conceptual Foundation and Metrics for Mutual Value Creation." *Journal of Service Management* 21 (5): 564–90. https://doi.org/10.1108/09564231011079057.

Guo, Aifang, Yuke Li, Ze Zuo, and Guangpu Chen. 2015. "Influence of Organizational Elements on Manufacturing Firms' Service-Enhancement: An Empirical Study Based on Chinese ICT Industry." *Technology in Society* 43 (November 2015): 183–90. https://doi.org/10.1016/j.techsoc.2015.07.003.

Guz, Alexander N., and Jeremiah Rushchitsky. 2009. "Scopus: A System for the Evaluation of Scientific Journals." *International Applied Mechanics* 45 (4): 351–62. https://doi.org/10.1007/s10778-009-0189-4.

Ha, Seung Yin, Gun Hee Lee, and Bum Seok Kim. 2016. "Strategies For Manufacturing Servitization Of Korean SMEs: By Using Data Envelopment Analysis." *Journal of Applied Business Research* 32 (2): 635–46. https://doi.org/10.19030/jabr.v32i2.9600.

Homburg, Christian, Wayne D. Hoyer, and Martin Fassnacht. 2002. "Service Orientation of a Retailer's Business Strategy: Dimensions, Antecedents, and Performance Outcomes." *Journal of Marketing* 66 (4): 86–101. https://doi.org/10.1509/jmkg.66.4.86.18511.

https://siccode.com/en/pages/what-is-a-nace-code

Jovanovic, Marin, Mats Engwall, and Anna Jerbrant. 2016. "Matching Service Offerings and Product Operations: A Key to Servitization Success: Existing Conditions, Such as Product Characteristics or Market Attributes, May Determine the Success of a Move toward Servitization." *Research-Technology Management* 59 (3): 29–36. https://doi.org/10.1080/08956308.2016.1161403.

Kassarjian, Harold H. 1977. "Content Analysis in Consumer Research." *Journal of Consumer Research* 4 (1): 8–18. https://doi.org/10.1086/208674.

Kindström, Daniel, Christian Kowalkowski, and Thomas Brashear Alejandro. 2015. "Adding Services to Product-Based Portfolios: An Exploration of the Implications for the Sales Function." *Journal of Service Management* 26 (3): 372–93. https://doi.org/10.1108/JOSM-02-

2014-0042.

Kohtamäki, Marko, Henri Hakala, Jukka Partanen, Vinit Parida, and Joakim Wincent. 2015. “The Performance Impact of Industrial Services and Service Orientation on Manufacturing Companies.” *Journal of Service Theory and Practice* 25 (4): 463–85. https://doi.org/10.1108/JSTP-12-2013-0288.

Kohtamäki, Marko, Jukka Partanen, Vinit Parida, and Joakim Wincent. 2013. “Non-Linear Relationship between Industrial Service Offering and Sales Growth: The Moderating Role of Network Capabilities.” *Industrial Marketing Management* 42 (8): 1374–85. https://doi.org/10.1016/j.indmarman.2013.07.018.

Kowalkowski, Christian, Per-Olof Brehmer, and Daniel Kindstrom. 2009. “Managing Industrial Service Offerings: Requirements on Content and Processes.” *International Journal of Services Technology and Management* 11 (1): 42–63. https://doi.org/10.1504/IJSTM.2009.022381.

Kowalkowski, Christian, Heiko Gebauer, Bart Kamp, and Glenn Parry. 2017. “Servitization and Deservitization: Overview, Concepts, and Definitions.” *Industrial Marketing Management* 60 (January 2017): 4–10. https://doi.org/10.1016/j.indmarman.2016.12.007.

Kowalkowski, Christian, Heiko Gebauer, and Rogerio Oliva. 2017. “Service Growth in Product Firms: Past, Present, and Future.” *Industrial Marketing Management* 60 (January 2017): 82–88. https://doi.org/10.1016/j.indmarman.2016.10.015.

Kowalkowski, Christian, Daniel Kindström, and Heiko Gebauer. 2013. “ICT as a Catalyst for Service Business Orientation.” *Journal of Business & Industrial Marketing* 28 (6): 506–13. https://doi.org/10.1108/JBIM-04-2013-0096.

Kreye, Melanie E., Jens K. Roehrich, and Michael A. Lewis. 2015. “Servitising Manufacturers: The Impact of Service Complexity and Contractual and Relational Capabilities.” *Production Planning & Control* 26 (14–15): 1233–46. https://doi.org/10.1080/09537287.2015.1033489.

Lay, Gunter, Giacomo Copani, Angela Jäger, and Sabine Biege. 2010. “The Relevance of Service in European Manufacturing Industries.” *Journal of Service Management* 21 (5): 715–26. https://doi.org/10.1108/09564231011092908.

Lee, Sunghee, Yoo Shijin, and Kim Daeki. 2016. “When Is Servitization a Profitable Competitive Strategy?” *International Journal of Production Economics* 173 (March 2016): 43–53. https://doi.org/10.1016/j.ijpe.2015.12.003.

Lenka, Sambit, Vinit Parida, David Rönnberg Sjödin, and Joakim Wincent. 2017. “Exploring the

Microfoundations of Servitization: How Individual Actions Overcome Organizational Resistance." *Journal of Business Research* 88 (July 2018): 328–36. https://doi.org/10.1016/j.jbusres.2017.11.021.

Lightfoot, Howard, Tim Baines, and Palie Smart. 2013. "The Servitization of Manufacturing: A Systematic Literature Review of Interdependent Trends." *International Journal of Operations & Production Management* 33 (11–12): 1408–34. https://doi.org/10.1108/IJOPM-07-2010-0196.

Löfberg, Nina, Lars Witell, and Anders Gustafsson. 2015. "Service Manoeuvres to Overcome Challenges of Servitisation in a Value Network." *Production Planning & Control* 26 (14–15): 1188–97. https://doi.org/10.1080/09537287.2015.1033491.

Luoto, Seppo, Saara A. Brax, and Marko Kohtamäki. 2017. "Critical Meta-Analysis of Servitization Research: Constructing a Model-Narrative to Reveal Paradigmatic Assumptions." *Industrial Marketing Management* 60 (January 2017): 89–100. https://doi.org/10.1016/j.indmarman.2016.04.008.

Martinez, Veronica, Marko Bastl, Jennifer Kingston, and Stephen Evans. 2010. "Challenges in Transforming Manufacturing Organisations into Product-Service Providers." *Journal of Manufacturing Technology Management* 21 (4): 449–69. https://doi.org/10.1108/17410381011046571.

Mathieu, Valérie. 2001. "Service Strategies within the Manufacturing Sector: Benefits, Costs and Partnership." *International Journal of Service Industry Management* 12 (5): 451–75. https://doi.org/10.1108/EUM0000000006093.

Matthyssens, Paul, and Koen Vandenbempt. 2010. "Service Addition as Business Market Strategy: Identification of Transition Trajectories." *Journal of Service Management* 21 (5): 693–714. https://doi.org/10.1108/09564231011079101.

Neely, Andy. 2008. "Exploring the Financial Consequences of the Servitization of Manufacturing." *Operations Management Research* 1 (2): 103–18. https://doi.org/10.1007/s12063-009-0015-5.

Nemoto, Yutaro, Fumiya Akasaka, and Yoshiki Shimomura. 2015. "A Framework for Managing and Utilizing Product–service System Design Knowledge." *Production Planning & Control* 26 (14–15): 1278–89. https://doi.org/10.1080/09537287.2015.1033493.

Oliva, Rogelio, Heiko Gebauer, and Jeremy M. Brann. 2012. "Separate or Integrate? Assessing the Impact of Separation between Product and Service Business on Service Performance in Product Manufacturing Firms." *Journal of Business-to-Business Marketing* 19 (4): 309–34.

https://doi.org/10.1080/1051712X.2012.647797.

Oliva, Rogelio, and Robert Kallenberg. 2003. “Managing the Transition from Products to Services.” *International Journal of Service Industry Management* 14 (2): 160–72. https://doi.org/10.1108/09564230310474138.

Ostrom, Amy L., A. Parasuraman, D.E. Bowen, L. Patricio, C.A. Voss, and K. Lemon. 2015. “Service Research Priorities in a Rapidly Changing Context.” *Journal of Service Research* 18 (2): 127–59. https://doi.org/10.1177/1094670515576315.

Partanen, Jukka, Marko Kohtamäki, Vinit Parida, and Joakim Wincent. 2017. “Developing and Validating a Multi-Dimensional Scale for Operationalizing Industrial Service Offering.” *Journal of Business & Industrial Marketing* 32 (2): 295–309. https://doi.org/10.1108/JBIM-08-2016-0178.

Pascual, Rodrigo, Matias Siña, Gabriel Santelices, and Milton Román. 2017. “Optimal Channel Coordination in Use-Based Product-Service System Contracts.” *International Journal of Production Research* 55 (23): 1–11. https://doi.org/10.1080/00207543.2017.1332793.

Peillon, Sophie, Claude Pellegrin, and Patrick Burlat. 2015. “Exploring the Servitization Path: A Conceptual Framework and a Case Study from the Capital Goods Industry.” *Production Planning & Control* 26 (14–15): 1264–77. https://doi.org/10.1080/09537287.2015.1033492.

Rabetino, Rodrigo, Willem Harmsen, Marko Kohtamäki, and Jukka Sihvonen. 2018. “Structuring Servitization-Related Research.” *International Journal of Operations & Production Management* 38 (2): 350–71. https://doi.org/10.1108/IJOPM-03-2017-0175.

Rabetino, Rodrigo, Marko Kohtamäki, Heini Lehtonen, and Hanna Kostama. 2015. “Developing the Concept of Life-Cycle Service Offering.” *Industrial Marketing Management* 49 (August 2015): 53–66. https://doi.org/10.1016/j.indmarman.2015.05.033.

Raddats, Chris, and Jamie Burton. 2011. “Strategy and Structure Configurations for Services within Product-Centric Businesses.” *Journal of Service Management* 22 (4): 522–39. https://doi.org/10.1108/09564231111155105.

Raddats, Chris, and Chris Easingwood. 2010. “Services Growth Options for B2B Product-Centric Businesses.” *Industrial Marketing Management* 39 (8): 1334–45. https://doi.org/10.1016/j.indmarman.2010.03.002.

Raddats, Chris, and Christian Kowalkowski. 2014. “A Reconceptualization of Manufacturers’ Service Strategies.” *Journal of Business-to-Business Marketing* 21 (1): 19–34.

https://doi.org/10.1080/1051712X.2013.857500.

Rapaccini, Mario. 2015. “Pricing Strategies of Service Offerings in Manufacturing Companies: A Literature Review and Empirical Investigation.” *Production Planning & Control* 26 (14–15): 1247–63. https://doi.org/10.1080/09537287.2015.1033495.

Rapaccini, Mario, and Filippo Visintin. 2015. “Devising Hybrid Solutions: An Exploratory Framework.” *Production Planning & Control* 26 (8): 654–72. https://doi.org/10.1080/09537287.2014.961106.

Saccani, Nicola, Filipppo Visintin, and Mario Rapaccini. 2014. “Investigating the Linkages between Service Types and Supplier Relationships in Servitized Environments.” *International Journal of Production Economics* 149 (March 2014): 226–38. https://doi.org/10.1016/j.ijpe.2013.10.001.

Saisana, Michaela, Andrea Saltelli, and Stefano Tarantola. 2005. “Uncertainty and Sensitivity Analysis Techniques as Tools for the Quality Assessment of Composite Indicators.” *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 168 (2): 307–23. https://doi.org/10.1111/j.1467-985X.2005.00350.x.

Saltelli, Andrea. 2007. “Composite Indicators between Analysis and Advocacy.” *Social Indicators Research* 81 (1): 65–77. https://doi.org/10.1007/s11205-006-0024-9.

Sousa, Rui, and Giovani J.C. da Silveira. 2017. “Capability Antecedents and Performance Outcomes of Servitization: Differences between Basic and Advanced Services.” *International Journal of Operations & Production Management* 37 (4): 444–67. https://doi.org/10.1108/IJOPM-11-2015-0696.

Story, Vicky M., Chris Raddats, Jamie Burton, Judy Zolkiewski, and Tim Baines. 2017. “Capabilities for Advanced Services: A Multi-Actor Perspective.” *Industrial Marketing Management* 60 (January 2017): 54–68. https://doi.org/10.1016/j.indmarman.2016.04.015.

Suarez, Fernando, Michael A. Cusumano, and Steven J. Kahl. 2013. “Services and the Business Models of Product Firms: An Empirical Analysis of the Software Industry.” *Management Science* 59 (2): 420–35. https://doi.org/10.1287/mnsc.1120.1634.

Szász, Levente, and Krisztina Demeter. 2015. “Business Models along Supply Chain Position and Servitisation: An Empirical Investigation of European Manufacturers.” *Acta Oeconomica* 65 (3): 367–91. https://doi.org/10.1556/032.65.2015.3.2.

Thomé, Antônio Márcio Tavares, Luiz Felipe Scavarda, and Annibal José Scavarda. 2016.

"Conducting Systematic Literature Review in Operations Management." *Production Planning & Control* 27 (5): 408–20. https://doi.org/10.1080/09537287.2015.1129464.

Tranfield, David, David Denyer, and Palminder Smart. 2003. "Towards a Methodology for Developing Evidence-informed Management Knowledge by Means of Systematic Review." *British Journal of Management* 14 (3): 207–22. https://doi.org/10.1111/1467-8551.00375.

Ulaga, Wolfgang, and James M. Loveland. 2013. "Transitioning from Product to Service-Led Growth in Manufacturing Firms: Emergent Challenges in Selecting and Managing the Industrial Sales Force." *Industrial Marketing Management* 43 (1): 113–25. https://doi.org/10.1016/j.indmarman.2013.08.006.

Ulaga, Wolfgang, and Werner J. Reinartz. 2011. "Hybrid Offerings: How Manufacturing Firms Combine Goods and Services Successfully." *Journal of Marketing* 75 (6): 5–23. https://doi.org/10.1509/jm.09.0395.

United Nations. 2008. "International Standard Industrial Classifcation of All Economic Activities (Rev. 4)." New York.

Valtakoski, Aku. 2017. "Explaining Servitization Failure and Deservitization: A Knowledge-Based Perspective." *Industrial Marketing Management* 60 (January 2017): 138–50. https://doi.org/10.1016/j.indmarman.2016.04.009.

Vandermerwe, Sandra, and Juan Rada. 1988. "Servitization of Business: Adding Value by Adding Services." *European Management Journal* 6 (4): 314–24. https://doi.org/10.1016/0263-2373(88)90033-3.

Visnjic, Ivanka, Frank Wiengarten, and Andy Neely. 2016. "Only the Brave: Product Innovation, Service Business Model Innovation, and Their Impact on Performance." *Journal of Product Innovation Management* 33 (1): 36–52. https://doi.org/10.1111/jpim.12254.

Whittaker, Gerald, Rolf Färe, Shawna Grosskopf, Bradley Barnhart, Moriah Bostian, George Mueller-Warrant, and Stephen Griffith. 2017. "Spatial Targeting of Agri-Environmental Policy Using Bilevel Evolutionary Optimization." *Omega* 66 (January 2017): 15–27. https://doi.org/10.1016/j.omega.2016.01.007.

Winter, Joost C. F. De, Amir A. Zadpoor, and Dimitra Dodou. 2014. "The Expansion of Google Scholar versus Web of Science: A Longitudinal Study." *Scientometrics* 98 (2): 1547–65. https://doi.org/10.1007/s11192-013-1089-2.

Yang, Miying, Palie Smart, Mukesh Kumar, Mark Jolly, and Steve Evans. 2018. "Product-Service

Systems Business Models for Circular Supply Chains." *Production Planning & Control* 29 (6): 498–508. https://doi.org/10.1080/09537287.2018.1449247.

Zhang, Wanrong, and Sujit Banerji. 2017. "Challenges of Servitization: A Systematic Literature Review." *Industrial Marketing Management* 65 (August 2017): 217–27. https://doi.org/10.1016/j.indmarman.2017.06.003.

Appendix A

The table below reports the details of the article collection and selection process.

Table A – Article collection and selection process

Query Scopus (265 articles):	TITLE-ABS-KEY((“measur*” OR “apprais*” OR “estimat*” OR “degree” OR “calc*”) AND (“serviti?a?ion” OR “performance-based contracting” OR “product-service systems” OR “service-infusion” OR “service-transition” OR “integrated-solutions” OR “industrial-services” OR “advanced-services” OR “service-dominant logic” OR “s-d logic” OR “service-dominant orientation” OR “s-d orientation” OR “service-intensity” OR “service-orientation”)) AND PUBYEAR > 1987 AND (LIMIT-TO (DOCTYPE, “ar”) OR LIMIT-TO (DOCTYPE, “re”) OR LIMIT-TO (DOCTYPE, “ip”)) AND (LIMIT-TO (SUBJAREA, “BUSI”)).
Query WoS (143 articles):	TOPIC: ((“measur*” OR “apprais*” OR “estimat*” OR “degree” OR “calc*”) AND (“servitization” OR “servitization” OR “performance-based contracting” OR “product-service systems” OR “service-infusion” OR “service transition” OR “integrated-solutions” OR “advanced-services” OR “service-dominant logic” OR “s-d logic” OR “service-dominant orientation” OR “s-d orientation” OR “service-intensity” OR “service-orientation”)) Refined by: DOCUMENT TYPES: (ARTICLE) AND WEB OF SCIENCE CATEGORIES: (MANAGEMENT OR BUSINESS OR ENGINEERING INDUSTRIAL).
Articles merged:	307
Articles included:	23
Articles excluded:	284

Exclusion Criteria (n. articles):

Customer-only focus (21)	Innovation (3)	Literature review (6)
Management, leadership & entrepreneurship (11)	Marketing (26)	Not in English (9)
Performance/regional/risk (45)	PSS design/development (3)	Public sector (21)
Service sector (89)	Supply chain (8)	Sustainability (19)
Technology (3)	Business networks (6)	Other (e.g. cloud manufacturing, optimisation, business and psychology) (20)

Articles from Google Scholar:	2
Articles from forward and backward analysis:	14
Final sample:	39

Appendix B

This appendix reports the queries performed in Google Scholar.

Table B – Google Scholar Queries

Query Scholar: exact phrase (string1 AND string2 ANYWHERE in the article) AND PUBYEAR > 1987					
string1 / **string2**	measure (measurement) [measuring]	appraise (appraisement) [appraising]	estimate (estimation) [estimating]	degree	calculate (calculation) [calculating]
servitization	3(0)[1]	1(0)[0]	0(0)[0]	4	0(0)[0]
performance-based contracting	1(2)[0]	0(0)[0]	0(0)[0]	1	0(0)[0]
product-service systems	0(0)[0]	0(0)[0]	0(0)[0]	1	0(1)[0]
service-infusion	2(0)[0]	0(0)[0]	0(0)[0]	0	0(0)[0]
service-transition	0(2)[0]	0(0)[0]	0(0)[0]	0	0(0)[0]
advanced-services	0(0)[1]	0(0)[0]	0(0)[0]	0	0(0)[0]
industrial-services	0(0)[1]	0(0)[0]	0(1)[0]	0	0(1)[1]
service-dominant logic	0(4)[0]	0(0)[0]	0(0)[0]	0	0(0)[0]
s-d logic	1(3)[0]	0(0)[0]	0(0)[0]	1	0(0)[0]
service-dominant orientation	1(0)[0]	0(0)[0]	0(0)[0]	0	0(0)[0]
s-d orientation	2(0)[0]	0(0)[0]	0(0)[0]	0	0(0)[0]
service-intensity	12(0)[5]	0(0)[0]	1(0)[1]	0	2(0)[0]
integrated-solutions	0(0)[1]	0(0)[0]	0(0)[0]	0	0(0)[1]
Total = 60					

Appendix C

This appendix reports the classification of each article. CS stands for "case study", SA for Statistical Analysis, P for "Profiling", and R for "Relating".

Table C – Results from article extraction and classification

Article	Method	Goal	Measure
(Ahamed, Inohara, and Kamoshida 2013)	CS	P	Share of Revenue from Services
(Antioco et al. 2008)	SA	R	Number of Service Types AND Number of Services AND Number of Customers Serviced AND Emphasis/Focus ON (Service Strategies)
(Baines and Lightfoot 2013)	CS	P	Number of Service Types
(Baines et al. 2010)	SA	P	Number of Services
(Benedettini, Neely, and Swink 2015)	SA	R	Number of Service Types AND Number of Services
(Benedettini, Swink, and Neely 2017)	SA	R	Number of Service Types AND Number of Services
(S. A. Brax and Visintin 2017)	NA*	P	Number of Service Types
(Burton et al. 2017)	CS	P	Share of Revenue from Services
(Chakkol et al. 2014)	CS	P	Number of Service Types
(Crozet and Milet 2017)	SA	R	Share of Revenue from Services
(Dachs et al. 2014)	SA	R	Share of Revenue from Services AND Number of Services
(Davidsson, Edvardsson, and Gustafsson 2009)	SA	P	Share of Revenue from Services
(Eggert et al. 2011)	SA	R	Number of Service Types AND Number of Services
(Eggert et al. 2014)	SA	R	Number of Service Types AND Number of Services
(Fang, Palmatier, and Steenkamp 2008)	SA	R	Share of Revenue from Services
(Gebauer, Fleisch, and Friedli 2005)	CS	R	Share of Revenue from Services
(Gebauer, Gustafsson, and Witell 2011)	SA	R	Emphasis/Focus ON (Service Strategies) AND Services Reputation (Customer Side)
(Lay et al. 2010)	SA	R	Number of Service Types AND Number of Services AND Emphasis/Focus ON (Service Strategies)
(Ha, Lee, and Kim 2016)	SA	R	Number of Service Types
(Homburg, Hoyer, and Fassnacht 2002)	SA	R	Number of Services AND Number of Customers Serviced AND Emphasis/Focus ON (Service Strategies)
(Jovanovic, Engwall, and Jerbrant 2016)	CS	P	Number of Service Types
(Kindström, Kowalkowski, and Alejandro 2015)	CS	R	Number of Service Types
(Kohtamäki et al. 2015)	SA	R	Emphasis/Focus ON (Number of Service Types AND Number of Services)
(Kohtamäki et al. 2013)	SA	R	Emphasis/Focus ON (Number of Service Types AND Number of Services)
(Kowalkowski, Brehmer, and Kindstrom 2009)	CS	P	Number of Service Types
(Kowalkowski, Kindström, and Gebauer 2013)	CS	R	Number of Service Types AND Number of Services AND Number of Customers Serviced AND Emphasis/Focus ON (Service Strategies)
(Lee, Shijin, and Daeki 2016)	NA**	R	Number of Services

(Martinez et al. 2010)	CS	P	Value Basis of Activity AND Primary Role of Assets AND Number of Service Types AND Production strategy
(Matthyssens and Vandenbempt 2010)	CS	P	Number of Service Types
(Neely 2008)	SA	R	Number of Service Types AND Number of Services
(Oliva, Gebauer, and Brann 2012)	SA	R	Number of Services
(Oliva and Kallenberg 2003)	CS	P	P-S Continuum
(Partanen et al. 2017)	SA	P	Emphasis/Focus ON (Number of Service Types AND Number of Services AND Share of Revenue from Services)
(Rabetino et al. 2015)	CS	R	Number of Service Types AND Number of Services AND Share of Revenue from Services
(Raddats and Kowalkowski 2014)	SA	P	Number of Service Types
(Raddats and Burton 2011)	CS	R	Number of Service Types
(Suarez, Cusumano, and Kahl 2013)	SA	R	Share of Revenue from Services
(Vandermerwe and Rada 1988)	CS	P	Number of Service Types
(Visnjic, Wiengarten, and Neely 2016)	SA	R	Number of Service Types AND Number of Services

* Theoretical Paper
** Simulation-based Paper

Appendix D

The classifications in thematic analysis have been validated with a reliability test. The test involved two coders who have been instructed on the topic and familiarized with the definition of measures and objectives of each classification. The coders were provided with a version of the codebook used in articles selection indicating the measures in each article and the strings to identify them. The coders assigned a 1 to each element of the classification if they judged that it had been dealt with in the article, 0 otherwise. Reliability of classification has been assessed by means of "percentage agreement" (Kassarjian 1977), i.e. a measure of the total number of pairwise agreements between the authors and each coder. The outcome of the test, reported in Table D, exceeds Kassarjian (1977)'s recommended standard (85%).

Table D – Reliability of the Classifications

	Method	***Goal***	***Overall***
Author – Coder1	85%	91%	92%
Author – Coder2	95%	88%	94%
Overall	90%	89%	93%

Appendix E

Table E – Service Activities (NACE rev. 2 synthesis)

Division	Description (I) and disambiguation (E)
01 Crop and animal production, hunting and related service activities	**I**: service activities like support for crop and animal production. Includes provision of agricultural machinery with operators and crew. **E**: landscape architecture (71) and gardening (81), activities of agronomists (74), renting of equipment without operator (77), organization of agricultural shows and fairs (82).
02 Forestry and logging	**I**: support service to forestry like forestry inventory, forest management and consulting, timber evaluation. Includes transport of logs within forests and provision of machinery with operators. **E**: draining of forestry land and cleaning of building sites (43), renting of equipment without operator (77).
09 Mining support service activities	**I**: specialised support services for petroleum and natural gas extraction or for other mining and quarrying such as draining, pumping, and test drilling services. **E**: specialized repair of equipment (33) and geophysical surveying (71).
18 Printing and reproduction of recorded media	**I**: support activities such as bookbinding, phototypesetting, preparation of data files, and reproduction from master copies. **E**: publishing (58), production of video tapes (59), and photocopying (82).
33 Repair and installation of machinery and equipment	**I**: Installation, routine and preventive maintenance, and specialised repair of goods produced. Includes installation, on-site assembling, and specialised repair and maintenance of products like metal tanks, nuclear reactors, shopping carts, photocopy machines, pumps, gearings, sensors, monitoring instruments, and other industrial equipment. **E**: repair of elevators, heating systems, and other construction equipment (43), repair of motor vehicles and trucks (45), cleaning of industrial machines (81), repairing of computer, communication and other household goods (95).
38 Waste collection, treatment and disposal activities; materials recovery	**I**: collection, treatment, and disposal of non-hazardous and hazardous waste, as well as recovery of sorted materials. **E**: dismantling of automobiles, ships, computers, televisions and other equipment to obtain re-sellable usable parts (46).
39 Remediation activities and other waste management services	**I**: decontamination of soils, groundwater (not for supply purposes), industrial plants and sites. **E**: treatment of waste (38).
43 Specialised construction activities	**I**: construction of parts of buildings and civil engineering works like site preparation, clearing of building sites, plumbing, heat and air conditioning installation and repair, alarm systems without monitoring, painting and glazing. Includes renting of building equipment (e.g. cranes) with operator. **E**: decontamination of soil (39) and oil and gas field exploration, geophysical, geological and seismic surveying (71), renting of equipment without operator (77), installation of alarm systems with later monitoring (80).
45 Wholesale and retail trade and repair of motor vehicles and motorcycles	**I**: repair (mechanical, electrical, windows, bodywork apart from tyres) and maintenance (also washing, polishing, spraying, painting) of vehicles and sale of parts and accessories for motor vehicles and motorcycles. **E**: rent with (49) or without (77) driver.
49 Land transport and transport via pipelines	**I**: freight transport via road and rail including removal/relocation services to businesses and households by road transport as well as freight transport via pipelines. Includes the provision of transportation services with a driver (on cars, coaches, trucks, etc.). **E**: warehousing, packaging activities for transport, and freight terminal activities (52), parcel activities (53), waste transport as integrated part of its disposal (38), renting of equipment (like trucks) without operator (77), ambulance transport by any mean (86).
50 Water transport	**I**: freight over water. Includes operation of ferries, and renting of vessels with crew for sea and coastal freight water transport. **E**: storage of freight (52), renting of commercial ships without crew (77).
51 Air transport	**I**: freight by air or via space. Includes renting of equipment with operator for freight purposes. **E**: NA.
52 Warehousing and support activities for transportation	**I**: warehousing, operating of transport infrastructure (e.g. airports, harbours, tunnels, bridges, etc.), activities of transport agencies, operations of cargo handling and terminal facilities, arranging of transport (by air, sea, road, and rail) operations, issue of transport documentation, sampling and protecting goods, packaging activities incidental to transport. **E**: courier activities (53), activities of travel agencies and tour operators (79).
53 Postal and courier activities	**I**: postal and courier activities such as pickup, transport and delivery of letters and parcels. **E**: freight transport (49, 50, 51).
56 Food and beverage service activities	**I**: food and beverage serving activities providing complete meals or drinks fit for immediate consumption. **E**: NA.
58 Publishing activities	**I**: publishing of books, brochures, leaflets, encyclopaedias, maps, newspapers, journals, and periodicals (including publications in electronic forms); directory and mailing list and other publishing, software publishing (computer games and ready-made, non-customised software like operating systems). **E**: publishing of music, motion pictures, video tapes and movies on DVD or similar media (59), application hosting (63).

60 Programming and broadcasting activities	**I**: activities of media content creation or distribution via different technologies (radio, TV, internet) such as data programs of entertainment, news, talk, and the like. **E**: NA.
62 Computer programming, consultancy and related activities	**I**: writing system software, applications, and databases; planning and designing computer systems that integrate computer hardware, software and communication technologies; users training; on-site management and operation of clients' computer systems and/or data processing facilities (including design of computer software for accounting systems); and other professional and technical computer-related activities (setting up of personal computers, software installation services, disaster recovery services, etc.). **E**: installation of mainframe and similar computer (33), publishing of packaged software (58), and data processing and hosting (63).
63 Information service activities	**I**: provision of web search portals, data processing (e.g. complete processing of data supplied by clients, generation of specialised reports from data supplied by clients) and hosting activities. **E**: call centres and the like (82), activities of libraries and archives (91).
64 Financial service activities, except insurance and pension funding	**I**: activities of obtaining and redistributing funds and financial leasing. The key element of financial leasing is the fact that the lessee acquires all the benefits and risks associated with ownership, which may or may not eventually be transferred. In addition, the lease period is expected to cover the whole life of the asset and the contract does not cover maintenance or repair. **E**: operational leasing (77).
65 Insurance, reinsurance and pension funding, except compulsory social security	**I**: underwriting of policies like accident and fire insurance, transport insurance, pecuniary loss and liability insurance, property insurance, and insurance over an insurance. **E**: NA.
66 Activities auxiliary to financial services and insurance activities	**I**: services related to financial service activities, but not themselves providing financial services. For instance risk and damage evaluation, risk assessing, and fund management. **E**: NA.
69 Legal and accounting activities	**I**: legal assistance and accounting services such as auditing, preparation of financial statements, and bookkeeping. **E**: data-processing and tabulation activities (63), management consultancy on accounting systems, budgetary control procedures (70), bill auditing and freight rate information (74), bill collection (82).
70 Activities of head offices, management consultancy activities	**I**: advice and assistance to businesses and other organisations on management issues, such as strategic and organisational planning; financial planning and budgeting (e.g. design of accounting methods or procedures, cost accounting programmes); human resource policies, practices, and planning; production scheduling; control planning; and marketing objectives and policies (included advice, guidance and operational assistance on public relations and communication. **E**: design of computer software for accounting systems (62), activities of computer consultants (62), architectural and engineering advisory activities (71), advertising and market research (73), environmental, agronomy, security and similar consulting activities, bill auditing and freight rate information (74), educational consulting activities (85).
71 Architectural and engineering activities; technical testing and analysis	**I**: architectural services, engineering consulting and services (e.g. machinery and industrial plant, civil, mining, chemical, mechanical, industrial and systems, and safety engineering), drafting services, building inspection services, surveying and mapping services. Performance testing of materials, machines, and chemicals is also included. **E**: development (62) and publishing (58) of associated software, and research activities in engineering and technology (72), freight rate information (74).
72 Scientific research and development	**I**: activities of basic research (acquisition of new knowledge without particular application or use in view), applied research (acquisition of new knowledge directed towards a specific practical aim), and experimental development (systematic work, based on existing knowledge, directed to producing, installing, or improving new materials, products, systems, and services). **E**: NA.
73 Advertising and market research	**I**: creation of advertising campaigns and tools; placement of advertising material on any media; market research and opinion polling. **E**: publishing of advertisement material (58) and organization of trade shows (82).
74 Other professional, scientific and technical activities	**I**: professional scientific and technical services not included in previous categories (for example agronomy, environmental, security consulting, weather forecast, videotaping, translations, graphic designers, interior decorators, bill auditing, and freight rate information). **E**: NA.
75 Veterinary activities	**I**: provision of animal health care and control activities. **E**: NA.
77 Rental and leasing activities	**I**: renting and leasing of tangible and non-financial intangible assets, including motor vehicles, recreational and sport equipment, household and consumer goods, machinery and equipment for office, business, or industrial operations, intellectual property and similar products (e.g. brand name and franchise agreements). Ownership is not transferred and therefore the risks and rewards of ownership are shared between the parties. Services like vehicle maintenance are included. **E**: renting of equipment with operator (e.g. 01, 02, 43, 49, 50).
78 Employment activities	**I**: placing applicants for employment, supplying workers to clients' businesses for limited periods of time to supplement its working force, and providing other human resources with various functions, but not responsible for direction and supervision of employees. **E**: NA.
79 Travel agency, tour operator and other reservation service and related activities	**I**: arranging, assembling, and selling of travels and tours, including incidental services (transportation, accommodation, tourist guides). **E**: NA.
80 Security and investigation activities	**I**: security-related services such as investigation and detective services, guard and patrol services, picking up and delivering money, receipts, or other valuable items with personnel and equipment

	to protect such properties while in transit, and operation of electronic security alarm systems. Includes sale, installation and repair services. **E**: NA.
81 Services to buildings and landscape activities	**I**: provision of a number of general support services such as interior and exterior cleaning of buildings of all types, cleaning of industrial machinery, cleaning of vehicles and tankers, disinfecting activities for buildings, ships, trains, etc., bottle cleaning, street sweeping, snow and ice removal, planting and caring of parks, gardens, and greenery for buildings, building of plants for protection against noise, wind, erosion, visibility and dazzling. Includes cleaning of buses, planes, etc. **E**: cleaning of cars (45).
82 Office administrative, office support and other business support activities	**I**: Provision of a range of day-to-day office administrative services such as receptionist, record keeping, billing, document preparation and editing, photocopying, call centres, packaging and labelling, parcel packing, bottling of liquids. **E**: NA.
85 Education	**I**: education at any level or training for any profession like cosmetology and barber schools, computer repair training, driving schools for occupational drivers e.g. of trucks, buses, coaches, schools for professional pilots. Training for hobby or self-development purposes and education consulting activities are also included. Instructions may come by any mean (oral or written, by radio, television, or Internet). **E**: job training as social work (88).
86 Human health activities	**I**: activities of short- or long-term hospitals, rehabilitation centres, and other human health institutions which have accommodation facilities. It also includes medical consultation and treatment in the field of general and specialised medicine by general practitioners, medical specialists, surgeons, and paramedical staff. Includes ambulance transport of patients by any mode of transport. **E**: NA.
88 Social work activities without accommodation	**I**: provision of a variety of social assistance services directly to clients, like child day-care and job training as social work. **E**: NA.
90 Creative, arts and entertainment activities	**I**: production and promotion of, and participation in, live performances, events or exhibits intended for public viewing aimed to meet cultural and entertainment interests of customers; provision of artistic, creative or technical skills for the production of artistic products and live performances. **E**: operations of museums of any kind (91) and sports and amusement and recreation activities (93).
91 Libraries, archives, museums and other cultural activities	**I**: activities of libraries and archives, operation of museums of all kinds, operation of historical sites and nature reserves activities (included botanical and zoological gardens). **E**: activities related to artistic creation (90).
93 Sports activities and amusement and recreation activities	**I**: provision of recreational, amusement and sports activities. Operations of facilities for indoor and outdoor sport, fitness and body-building clubs and facilities. **E**: renting of sport equipment (77), sports instruction by individual teachers and trainers (85), amusement activities in 91.
94 Activities of membership organisations	**I**: activities of organisations representing interests of special groups or promoting ideas to the general public (employers, self-employed individuals and the scientific community, interests of employees, or promotion of religious, political, cultural, educational or recreational ideas and activities), usually with a constituency of members. **E**: education (85) and health activities (86) provided by such organizations.
95 Repair of computers and personal and household goods	**I**: repair and maintenance of computers, storage devices, printers, fax machines, radios, phones, TVs, garden equipment, blowers, footwear and leather goods, furniture and home furnishings, clothing and clothing accessories, sporting goods, musical instruments, hobby articles and other personal and household goods. **E**: repair of conditioning systems (43).
96 Other personal service activities	**I**: all service activities not mentioned elsewhere such as washing and (dry-)cleaning of textiles and fur products, hairdressing and other beauty treatment, physical well-being activities (e.g. steam baths), dating services. **E**: NA.