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The impact of servitization on firm performance: A meta-analysis

Abstract:

Purpose – Servitization has been recognized as an effective means for manufacturers to achieve superior performance. However, the servitization-performance relationship is controversial since prior empirical studies have provided inconsistent and even contradictory results. Hence, this paper aims to provide a quantitative review on the servitization-performance relationship based on research findings reported in the extant literature.

Design/methodology/approach – Studies from 41 peer-reviewed journal articles were sampled and analyzed. A meta-analytic approach was adopted to conduct a quantitative review on the relationship between servitization and firm performance.

Findings – The results confirm a positive servitization-performance relationship. In addition, the results reveal that the observed servitization-performance relationship is influenced by the operationalization of constructs (servitization and performance) and control variables (industry and region).

Originality/value - As the first meta-analysis on the servitization-performance relationship, this study contributes to the servitization literature and provides future research directions.

Keywords: servitization; firm performance; meta-analysis; operationalization; contextual factor

1. Introduction

Over the recent decades, servitization has received increasing attention from both practitioners and scholars, and evolved from a niche topic into a broad cross-disciplinary research area (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Baines et al., 2011). Since the term 'servitization' was first coined by Vandermerwe and Rada (1988) to delineate the process of creating value by adding services to products, there have been growing studies in this field. Many manufacturing enterprises regard servitization as an important route to acquire growth, profitability, and economic stability (Spohrer and Maglio, 2008; Bandinelli and Gamberi, 2011). Neely (2008) reports that globally over a third of manufacturing firms have servitized. Increasingly, firms recognize and utilize servitization as a viable means of creating value and making profits. For example, the core business of IBM has gradually shifted to provide solutions for customers and Rolls-Royce's annual report in 2015 revealed that more than half of its total revenues was generated from maintenance on its engine products.

Considering the expected benefits of servitization, many scholars have explored the impact of servitization on firm performance but provided inconsistent results (Oliva and Kallenberg, 2003; Neu and Brown, 2005; Gebauer and Fleisch, 2007; Fang et al., 2008; Neely, 2008; Lapré, 2011; Suarez et al., 2013). Some studies confirm the positive effect of servitization on firm performance. For example, Homburg et al. (2002; 2003) find positive effects of retailers' service orientation on customer relationship quality, service profitability and overall company profitability. Skaggs and Droege (2004) argue that manufacturing firms with service infusion achieved higher financial performance than pure manufacturers. Antioco et al. (2008) highlight the positive impact of service orientation on relative product sales. Chen and Tsou (2012)

suggest that firms can create superior performance gains through customer service in the IT industry. In contrast, there are also studies showing a negative association between servitization and firm performance. For example, Neely (2008) evidences the negative effect of servitization on financial performance based on data from manufacturing firms in 25 countries, and Visnjic et al. (2012) argue that the increasing service breadth erodes firms' profit. Sousa and Silveira (2017) contend that advanced services positively affect firms' sales and profitability while basic services negatively affect firms' profitability. Furthermore, researchers have found nonlinear effects of servitization on firm performance. The findings by Fang et al. (2008) and Kohtamäki et al. (2013b) reveal a U-shaped relationship between servitization and firm performance whereas Visnjic and van Looy (2013) find a positive S-shaped association between the scale of service activities and profit margin. So far, the extant literature shows mixed findings on the performance effect of servitization, which implies the need for further investigation of the servitization-performance relationship.

Besides, due to the mixed findings on the performance effect of servitization, researchers speculate that there might be contingency factors affecting the servitization-performance relationship. Some studies have examined the moderating role of firm-related characteristics such as slack resource, service relatedness, networking capabilities, and product innovation (e.g. Fang et al., 2008; Eggert et al., 2011; Kohtamäki et al., 2013b). However, except that Fang et al. (2008) identify industry growth and industry turbulence as positive moderators of the servitization-performance relationship, and Szász et al. (2017) confirm that service paradox occurs more frequently in less-developed economic contexts, few studies have explored the moderating effect of external environmental factors (e.g. industry and region) on the servitization-performance relationship. Nevertheless, there are empirical studies conducted in

different industries or regions, so it provides an opportunity to narrow this gap by synthesizing the reported results to examine the moderating role of industry and region.

Overall, the inconsistent and even contradictory research findings in the extant literature suggest an ambiguous servitization-performance relationship and few studies have explored the moderating effects of external environmental factors, which implies a great need to gain further insights into the relationship and motivates our study. We also conjecture that the mixed findings might be caused by the different operationalization of constructs used in empirical studies. Hence, we employ a meta-analysis approach (Hunter and Schmidt, 2004) to investigate the servitization-performance relationship by statistically analyzing the quantitative results reported in the literature. We expect that our study sheds light to the servitization research and provides future research directions.

2. Literature review and research framework

Prior literature reviews have summarized many characteristics, drivers, factors and future research directions of servitization based on narrative methods (Baines et al., 2009a; Lightfoot et al., 2013; Luoto et al., 2017). Specifically, Baines et al. (2009a) provide a clinical review of servitization literature, which consists of definition, origin, features and drivers of servitization, while Lightfoot et al. (2013) perform a systematic review of the literature associated with the servitization of manufacturing firms and develop a descriptive and thematic awareness of servitization theory. In addition, Luoto et al. (2017) conduct a systematic analysis of the paradigmatic assumptions of servitization research and propose alternative directions for servitization research to challenge these paradigmatic dominances. In the extant literature,

servitization is recognized as a multidimensional construct and has been defined from different perspectives (summarized in Table 1).

[Insert Table 1 here]

As shown in Table 1, some scholars emphasize the combination of services and products when defining servitization (Vandermerwe and Rada, 1988; Tellus Institute, 1999; Desmet et al., 2003), while some regard servitization as a business model or strategy (Lewis et al., 2004; Ren and Gregory, 2007; Baines et al., 2009a; Visnjic et al., 2012). Although scholars define servitization from various perspectives, most scholars agree that the essence of servitization involves the process of firms' transformation. Specifically, the research defining servitization as the combination of services and products describes the shift from offering products to product service systems while the studies regarding servitization as a business model or strategy concentrate on the change of firms' strategic focus (from product-oriented strategy to service-oriented strategy). The former type of definition emphasizes the servitization result as adding more services to existing products while the latter highlights the shift of strategic focus. Both definitions reflect a firm's transformation from goods-dominant logic to service-dominant logic. Briefly, goods-dominant logic emphasizes value-in-exchange and views services as a special type of goods while service-dominant logic denotes a new perspective of value creation focusing on value-in-use in customer's own context (Vargo and Lusch, 2008; Gebauer et al., 2010). In this study, we define servitization as a transformational process of adding services to products with a strategic transition from goods-dominant logic to service-dominant logic. Accordingly, servitization involves a redefinition of the firm's mission, a redeployment and reconfiguration of

organizational resources, capabilities and structures, and a renewal of organizational routines, shared norms and values (Kindström and Kowalkowski, 2014; Kowalkowski et al., 2017).

2.1 Sampling

In this study, we attempt to conduct a meta-analysis to explore the impact of servitization on firm performance. Meta-analysis refers to a set of procedures for analyzing coefficients reported by prior published research and is the quantitative synthesis of research findings across a number of studies (Damanpour, 1991; Geyskens et al., 2009). This technique is a rigorous approach with external validation and allows researchers to cumulate findings from multiple studies to draw comprehensive and valid conclusions. Hence, it offers firm support for the proposed models and further explains the variance in previous empirical findings. Our meta-analysis primarily focuses on empirical studies in which independent variables are indicators of servitization and dependent variables are closely associated with firm performance. We followed the instructions and procedures proposed by Hunter and Schmidt (2004) to calculate corrected correlations among the constructs.

In order to obtain the studies on the servitization-firm performance relationship, we searched for peer-reviewed journal articles in English language with combinations of search terms related to servitization and firm performance. Since 'servitization' was first proposed in 1988 (Vandermerwe, 1988), we searched for all relevant articles published from January 1988 to December 2017 in major databases including Web of Science, Scopus, Emerald, ABI/INFORM Complete (ProQuest), Business Source Complete (EBSCO) and Google Scholar.

The search terms for servitization and firm performance were adopted from prior literature. Specifically, the search terms for servitization were derived from literature reviews offering the

definitions of servitization and covering popular terminologies (Baines et al., 2009a, 2009b; Gebauer et al., 2012; Lightfoot et al., 2013; Brax and Visintin, 2017; Luoto et al., 2017; Rabetino et al., 2018). The following keywords were adopted as search terms for servitization: "servitization", "servitisation", "servicizing", "servicising", "tertiarization", "service strategy", "service-oriented strategy", "industrial service", "service offering", "service provision", "service orientation", "service innovation", "service transition", "service integration", "service expansion", "service addition", "service infusion", "service differentiation", "service diversification", "service competition", "customer service", "customer support service", "service business", "service-dominant logic", "product service system", "integrated solution", "hybrid offering", "service-based manufacturing", "service-driven manufacturing", "service-oriented manufacturing" and "service-oriented transformation". The search terms for firm performance were also adopted from the literature (Homburg et al., 2002; Kastalli et al., 2013; Kamboj and Rahman, 2015; Rasool and Shah, 2015). The keywords for firm performance include "performance", "benefit", "outcome", "consequence", "effect", "return", "firm value", "competitive advantage", "profit", "profitability", "turnover", "sales", "growth", "revenue", "market share", "quality", "relationship", "customer satisfaction" and "customer loyalty".

We combined the above-mentioned terms for servitization and firm performance to search in titles, keywords, abstracts and subjects of articles in the databases. After excluding duplicates and screening for relevance by reviewing the abstracts, an initial sample of 396 journal articles was obtained. Then we used three selection criteria to identify the valid articles for inclusion in our analyses from the initial sample. First, the article must be empirical or field studies on the performance effects of servitization, which provides valid quantitative data for follow-up analysis. Second, the article reports the correlation between the independent variable

(servitization) and the dependent variable (firm performance). This study used Pearson product-moment correlations to represent the relationship between servitization and firm performance (Hunter and Schmidt, 2004). If the correlation is not reported directly, other statistics such as Student's t, F-ratios, Chi-square value, Cohen's d or beta coefficient are converted to the corresponding correlation using the formulae in Appendix 1 (Peterson and Brown, 2005; Geng et al., 2017). Third, the study must be based on a unique data set. If there are multiple studies using the same data set, we only include one study into our sample. By manually excluding invalid articles which did not meet these criteria, a final sample of 41 valid journal articles was obtained, which exceeds the minimum sample size of 30 (Hedges and Olkin, 2014). The identified 41 empirical articles are summarized in Table 2.

[Insert Table 2 here]

Various theoretical lenses were used by the sampled studies, as summarized in Table 3. A large portion of articles did not specify a theoretical lens (43.9%). Resource-based view (19.5%) was the most widely-used theory in the sample. Other articles adopt a wide range of theoretic lenses such as contingency theory, resource-advantage theory, economies of scale, and attention-based view.

[Insert Table 3 here]

Table 4 summarizes the analysis methods used in the articles. The majority of articles adopted regression analysis to perform data analysis (48.8%), which covers several methods with different model estimate methods such as logistic regression analysis, seemingly unrelated

regression, generalized method of moments, etc. Structural equation modelling (SEM) is also popular, including covariance-based structural equation modelling (CB-SEM) (36.6%) and partial least squares structural equation modelling (PLS-SEM) (7.3%).

[Insert Table 4 here]

2.2 Coding

Table 2 provides a summary of the sampled studies. To ensure the commensurability and heterogeneity of the sampled studies in the meta-analysis, there exists an additional unique challenge when coding data for variables with multiple dimensions (Geng et al., 2017). That is, researchers have difficulty in distinguishing the different measures of the same theoretical constructs but need to ensure their consistency among primary studies. When there exist issues regarding construct boundaries, researchers who engage in data coding need to resolve these disagreements through discussion (Hunter and Schmidt, 2004). The coding was conducted by two researchers who had knowledge in servitization research and meta-analysis. The two researchers worked independently in the first step and then compared their coding results with each other. As suggested by Bullock and Svyantek (1985), inconsistencies in the coding results could be resolved by discussing and re-examining the debatable studies until reaching complete agreement. Besides, if the coding is still inconsistent, the coding persons may ask for the participation of a third expert.

The coding results consist of the sample's primary information and effect size which often refers to the correlation coefficients among variables. The primary information includes authors, publication year, journal, sample size, region, industry, servitization measurement or its related dimensions, performance measurement or its related indicators, research model, etc. For each

study in the sample, the coding information of effect size consists of correlation coefficients between independent and dependent variables, and other statistics such as Student's t, F-ratios, Chi-square value, Cohen's d or beta coefficient which could be transformed to corresponding correlations (Peterson and Brown, 2005; Geng et al., 2017). The coding results of the sample are presented in Table 2. The publication year of the sampled articles ranges from 2002 to 2017 and the total number of observations is 60,618. The specific coding process and results of independent variables, dependent variables, and moderating variables are described as follows.

2.2.1 Independent variable

Servitization is the independent variable of this meta-analysis, which is a multidimensional construct and involves different service types. Considering the heterogeneity of servitization, it is necessary to distinguish service types when investigating the performance effects of servitization. Researchers have identified different service types, as summarized in Table 5 (Kohtamäki et al., 2013b; Saccani et al., 2014). These service types range from basic and elementary services (which are more product-related) to intricate and professional services (which are more customer-related). Mathieu (2001) proposes a generic classification scheme with two service types, namely services supporting the product (SSPs) and services supporting the clients' actions (SSCs). His classification scheme is in line with our definition of servitization as a transformational process from goods-dominant logic to service-dominant logic. Table 5 summarizes that most service types in the extant literature can be mapped to either SSP or SSC, which are detailed as follow.

(1) SSP supports the installation and use of the supplier's core products and ensures their proper functioning (Mathieu, 2001). SSP is characterized with low customization, low complexity, and high purchasing frequency (Eggert et al., 2011; Saccani et al., 2014).

(2) SSC is comprised of services that support the client's actions in relation to the supplier's product (Mathieu, 2001). SSC is characterized with high customization and high complexity (Eggert et al., 2011; Saccani et al., 2014).

[Insert Table 5 here]

Moreover, some studies on the servitization-performance relationship have explored the differential effects of SSP and SSC on firm performance. For example, Antioco et al. (2008) find that SSC helps promote relative product sales while SSP generates higher service volume. Eggert et al. (2011; 2014a)'s findings indicate that SSC mediates the impact of SSP on the firm's revenue and profit trajectories. These studies suggest that SSP and SSC significantly differ in the use of critical resources and capabilities, thus the distinction between SSP and SSC not only is grounded in managerial practice but also helps explain differences in antecedents and outcomes of servitization (Eggert et al., 2011). In the sample, there are 13 articles which have examined the effects of SSP and SSC on firm performance.

2.2.2 Dependent variable

Firm performance is considered as a multidimensional construct in the literature. After reviewing the sampled studies, two types of firm performance are identified: financial and non-financial performance. To be more specific, 35 (out of 41) articles explore the impact of servitization on financial performance while two papers report only the non-financial performance. Besides, three articles report both financial and non-financial performance. Therefore, 38 articles report financial performance and five articles report non-financial performance. We coded the firm

performance as financial performance and non-financial performance, which are detailed as follows:

(1) Financial performance is often measured by the indexes in the financial statements or accounting reports such as sales growth, profit margin, return on asset, and return on investment (Fang et al., 2008; Neely, 2008; Kohtamäki et al., 2013a).

(2) Non-financial performance mainly refers to customer satisfaction, customer value performance, strategic performance, and innovation performance (Gebauer and Putz, 2007; Oliva et al., 2012).

2.2.3 Moderators

Apart from the independent and dependent variables, moderating variables which may influence the primary relationship should be explored in meta-analysis. The potential moderating variables in meta-analysis tend to be operationalizations of constructs and control variables in empirical studies (Delbufalo, 2012; Golicic and Smith, 2013).

The operationalization of constructs is recognized as the most common moderating variable in meta-analysis since the difference in operationalizations may affect the direction and/or magnitude of the relationship between independent and dependent variables (Delbufalo, 2012; Golicic and Smith, 2013). In this study, we employ the operationalizations of servitization and firm performance as measurement moderators. That is, we explore the effect of different measurements of servitization and firm performance on the primary servitization-performance relationship.

The construct ‘servitization’ has been used broadly with a variety of measurements (Homburg et al., 2002; Neely, 2008; Fang et al., 2008). Based on the sampled studies, four

measurements for servitization (i.e. service orientation, service offering, service breadth and service revenue) were identified:

(1) Service orientation refers to an organizational preference for service excellence (Lytle and Timmerman, 2006). It is a measurement from the perspective of firm strategy. Therefore, we coded studies that measured service orientation using firms' motivation or preference towards services, employees' behaviour or customers' desire to services, firms' emphasis and efforts in services, etc. (Homburg et al., 2003; Grawe et al., 2009).

(2) Service offering is closely related with the extent of service provisions from manufacturing firms, which implies the efforts in service business made by manufacturing firms (Kohtamäki et al., 2013b; Sousa and Silveira, 2017). Moreover, the service list is also an important component of service offering measurement. When measured with service offering, the respondent should first select the used services in a series of service list and accordingly assess the extent of the selected services offered by firms to customers (Kohtamäki et al., 2015; Szász et al., 2017).

(3) Service breadth refers to the number of services provided by manufacturing firms (Neely, 2008; Benedettini et al., 2017). Both service offering and service breadth are measures based on the characteristics or attributes of servitization.

(4) Service revenue is closely associated with firms' sales from service business. Many studies have used the percentage of service-based turnover in total sales to measure service revenue (Suarez et al., 2013; Szász et al., 2017). Hence, service revenue is a measurement based on the output of servitization.

Moreover, prior literature has suggested that industry and region are important control variables, which may influence the implementation of servitization and hence firm performance

(Fang et al., 2008; Oliva et al., 2012; Suarez et al., 2013). Specifically, manufacturing firms in different industries or regions may perform differently when implementing servitization (Fang et al., 2008; Szász et al., 2017). Based on the sampled articles, two industry types were coded, namely the traditional manufacturing industry and the other industries. The traditional manufacturing industry mainly includes the industrial sectors with International Standard Industrial Classification (ISIC) codes ranging from 20 to 39. In addition, we coded three regions: developing, developed, and global. There is only one developing region (China) in the sample. The developed regions consist of countries from Europe, North America, and two Asian regions (South Korea and Taiwan). Besides, the global region refers to a wide range of regions where manufacturing firms' information was collected. For example, Visnjic et al. (2016) collect data from the Osiris database, which contains firms' information from over 150 countries. Szász et al. (2017) and Souza et al. (2017) obtain information based on the International Manufacturing Strategy Survey (IMSS), which covers more than 20 countries throughout the world.

2.3 Research framework and hypotheses development

In this section we propose the hypotheses on the servitization-performance relationship and the differential effects of service types. Following the meta-analysis approach, we also propose hypotheses on the moderating effects of operationalization of constructs and control variables.

2.3.1 The servitization-performance relationship

We adopt the resource-advantage theory (RAT) as the theoretical lens to hypothesize the performance effect of servitization and the performance outcomes of different service types (Hunt and Morgan, 1996; Chen et al., 2009; Eggert et al., 2015). RAT extends the resource-

based view (RBV) which considers firms as the combination of tangible and intangible resources the organization owns, controls or to which it has access (Hunt and Davis, 2008). RBV suggests that resource endowments explain performance differences whereas RAT accounts for the acquisition of the market position of a firm by means of comparative advantage in resources (Hunt and Morgan, 1997). Specifically, RAT posits that when firms have a comparative advantage in resources, they will occupy market positions of competitive advantage in some market segments and then their market positions of competitive advantage will result in superior firm performance (Hunt and Morgan, 1996; Hunt and Davis, 2008).

Since services are characterized as intangible, highly customized, and hard to imitate and substitute, the resources and capabilities required for the deployment of servitization are strongly tacit and socially complex. Hence, if servitizing firms have comparative advantage in resources and capabilities, they may be able to differentiate from their competitors in the product market. According to RAT, the comparative advantage in resources or capabilities could help acquire the market positions of competitive advantage, which will then produce superior performance. Besides, when a firm acquires comparative advantage in resources and capabilities via servitization, it is also more difficult for its competitors to neutralize or leapfrog this comparative advantage because services are hard to imitate and substitute. Therefore, firms adopting servitization could gain comparative advantages in resources that accordingly yield market positions of competitive advantage, and thereby superior performance. Therefore, we hypothesize that:

Hypothesis 1: Manufacturing firms' servitization is positively associated with firm performance.

In this study, servitization is categorized into two types, namely SSP and SSC. SSP is accompanied with standardization, low complexity and low relation-based cooperation while SSC is accompanied with customization, high complexity and high relation-based cooperation (Eggert et al., 2011; Bastl et al., 2012). Hence, SSC directly affects firm performance whereas SSP has only indirect effects on firm performance mediated through SSC (Eggert et al., 2014a). On one hand, the provisions of SSC could create value independently from manufacturing firms' products while the sales of SSP must be based on products selling. On the other hand, the high uniqueness of SSC could effectively reduce the likelihood of imitation thus to create higher customer value while SSP is easy to follow by competitors (Mathieu, 2001).

Due to the significant differences between SSP and SSC, their performance outcomes may also vary (Eggert et al., 2011). From the perspective of RAT, once a servitizing firm achieves superior performance through the competitive advantage of its market position, its competitors may attempt to neutralize or offset its advantage by means of acquisition, imitation, substitution, or major innovation (Hunt and Davis, 2008). Specifically, SSP is easier to follow by competitors whereas the high uniqueness of SSC could effectively reduce the likelihood of imitation (Mathieu, 2001). In other words, the comparative advantages in resources resulting from the provisions of SSP and SSC are different. When firms acquire the comparative advantages in resources in the provisions of SSP, competitors have the possibility to neutralize or leapfrog this advantaged firm through imitation or substitution. In contrast, it is more difficult for competitors to catch up with the advantaged firms through imitation or substitution when firms gain the comparative advantages in resources in the provisions of SSC (Eggert et al., 2011). Hence, SSC has greater potential to generate comparative advantage and yield superior performance than SSP. The hypothesis is proposed as follows:

Hypothesis 2: The performance effect of SSC is stronger than that of SSP.

2.3.2 Moderating effects

Prior studies suggest that the servitization-performance relationship is far from being simple (Fang et al., 2008; Eggert et al., 2011; Kohtamäki et al., 2013b; Eggert et al., 2014a). The limited empirical studies provide mixed evidence with regard to the firms' servitization-performance relationship and pinpoint the difficulties and challenges in implementing servitization in a manufacturing context (Neu and Brown, 2005; Jacob and Ulaga, 2008; Gebauer et al., 2012; Visnjic and Van Looy, 2013). Hence, it is highly desirable to further explore the factors affecting the observed servitization-performance relationship. The potential moderating variables in meta-analysis tend to be operationalization of constructs and control variables in empirical studies (Delbufalo, 2012; Golicic and Smith, 2013).

(1) Operationalization of constructs

Since both servitization and performance are multidimensional constructs, the operationalization of each construct may act as an influencing factor in a specific study. Servitization has been measured in terms of different perspectives. Specifically, service orientation reflects manufacturing firms' change towards service business at the strategic level (Homburg et al., 2002, 2003; Antioco et al., 2008). Service offering and service breadth are measured by focusing on the attributes of service itself, including the extent and number of services offered (Neely, 2008; Kohtamäki et al., 2013b; Benedettini et al., 2017; Sousa and Silveira, 2017). Service revenue is a measurement in terms of servitization outcome since the revenue from service business represents the output of servitization implementation in manufacturing firms' revenue (Skaggs and Droege, 2004; Fang et al., 2008; Suarez et al., 2013). Prior studies with different servitization measurements have demonstrated different servitization-

performance relationship outcomes (Homburg et al., 2003; Kohtamäki et al., 2013b; Neely, 2008; Suarez et al., 2013). Besides, previous research in the literature has challenged the validity of single-item measurements (Churchill, 1979) since such measurements may result in significant bias. Hence, we infer that the adoption of different servitization operationalizations may influence the observed primary relationship. Accordingly, we hypothesize that:

Hypothesis 3: The observed servitization-performance relationship varies with servitization measurements.

Firm performance is also recognized as a multidimensional construct and has multiple operationalizations in the extant literature. In this study, firm performance is categorized as financial and non-financial. Most studies in the sample focus on the effect of servitization on manufacturing firms' financial performance (e.g. Fang et al., 2008; Neely, 2008; Kohtamäki et al., 2013a). There are also studies exploring the impact of servitization on non-financial performance (e.g. Gebauer and Putz, 2007; Oliva et al., 2012; Wang, 2014). Overall, servitization of manufacturing firms may greatly affect both firms' financial and non-financial performance. However, due to the enormous investment in support of service business operations, servitization may generate high non-financial performance (such as product brand image, increased customer satisfaction and loyalty) and thus achieve high total sales but may not obtain the expected high profits (Neely, 2008). Consequently, we propose the following hypothesis.

Hypothesis 4: The observed servitization-performance relationship varies with performance measurements.

(2) Control variables

It is noticed that most studies exploring the servitization-performance relationship collect their data from different industries and regions. Industry and region are important control

variables affecting the implementation of servitization (Fang et al., 2008; Oliva et al., 2012; Suarez et al., 2013). Hence, the two control variables may act as contextual moderators influencing the relationship between servitization and performance.

Most extant studies on servitization focus on traditional manufacturing industries (Antioco et al., 2008; Gebauer, 2009; Oliva et al., 2012) while only a few studies concentrate on other industries such information technology (Ceci and Prencipe, 2008; Suarez et al., 2013). There are significant differences between industries, including industrial structure, products offered, required resources and capabilities, customer demand, and competitive environment. Therefore, firms in different industries may obtain differential performance by the same extent of servitization. Consequently, given the significant differences of industry characteristics, we propose the following hypothesis.

Hypothesis 5: The servitization-performance relationship varies with industries.

As for economic region, the role of economic context in the servitization-performance relationship has been explored in the literature but has not reached an agreement among researchers (Szász et al., 2017). Local economic circumstances affect the servitization of manufacturing firms (Neely, 2008) and more manufacturing firms are reported to servitize in highly developed regions than in developing regions (Lay et al., 2010). Gebauer et al. (2012) state that the majority of extant literature has concentrated on services in manufacturing firms of developed countries while only a limited number of studies focus on the servitization in developing economies such as China (Gebauer et al., 2007). These statements suggest that in different economic regions, firms with the same extent of servitization may achieve different performance. Specifically, in different countries or economic regions, they differ in many aspects, including the abundance and structure of resources, the stability of economic environment, the

soundness of social institutions, and the completeness of physical and regulatory infrastructure. Thus, we conjecture that firms in different economic regions may benefit from servitization differently and propose the following hypothesis.

Hypothesis 6: The servitization-performance relationship varies with economic regions.

3. Research method

3.1 Meta-analytic procedures

As proposed by Hunter and Schmidt (2004), meta-analysis is a statistical aggregation method for cumulating effect sizes with the aim to estimate the population effect size among variables. The population effect size indicates the extent that the independent variable affects the dependent variable, which is estimated from correlations reported in prior studies and may differ from individual effect size in the original sampled studies (Damanpour, 1991). The sample collection process and specific coding process of this study have been elaborated in Section 2 and the coding results are presented in Table 2.

As shown in Table 2, the effect sizes are correlation coefficients between independent and dependent variables in these studies. In case some studies did not provide the correlation coefficients directly, their effect sizes were estimated based on other data such as t-values and f-values (Hunter and Schmidt, 2004).

In this study, we used Comprehensive Meta-analysis (CMA) version 3.0 to transform the effect sizes and calculate the pooled mean effect sizes (Geng et al., 2017). Next, we conducted some critical tests by using CMA based on the inputs of effect sizes, including the tests of heterogeneity and publication bias, and then tested the stated hypotheses.

3.2 Publication bias

Given that publication bias may cause a threat to validity (Rothstein et al., 2005), it is necessary to test whether there is a risk of publication bias concerning the effect sizes in sampled studies before further testing our hypotheses. Publication bias is termed as what occurs whenever the research appearing in the published literature is systematically unrepresentative of the population studies (Rothstein et al., 2005).

In this study, we tested the potential publication bias in our sample by adopting two common approaches, namely funnel plot and fail-safe N (Rothstein et al., 2005). As shown in Figure 1, the funnel plot of the sample is nearly symmetrical, qualitatively indicating there is no serious publication bias.

[Insert Figure 1 here]

In addition, the fail-safe N was employed to quantitatively confirm the non-existence of publication bias in our sample (Rothstein et al., 2005). The fail-safe N represents the number of studies with insignificant correlations that would have to be added into the sample to reverse the significant relationship. As suggested by Rosenthal (1991), the significant threshold of fail-safe N at the 95% confidential level is $N_{fs} > 5\times$sample size+10, where N_{fs} is the fail-safe N. The fail-safe N of this study is 5996 (p=0.000, α=0.05), which significantly exceeds the critical value (5×41+10=215) and suggests no significant publication bias.

3.3 Heterogeneity

In order to ascertain whether there is significant difference among the sampled studies, we need to determine the heterogeneity of the sample. Q value and I-squared value are often applied to

judge the heterogeneity of the sample (Higgins et al., 2003). Specifically, the significance of Q value represents systematic difference in the sample. If Q is significant, then the systematic differences may affect the results. Moreover, the I-squared value reflects the proportion of total variation across sampled studies caused by heterogeneity. The higher I-squared value represents larger heterogeneity. The amount of heterogeneity as 25%, 50%, and 75% respectively corresponds to three different extent of heterogeneity, namely low, moderate, and high (Higgins et al., 2003). Hence, based on the Q value and I-squared value, we can determine the heterogeneity of the sample; and if there exists high heterogeneity, we should employ the random-effects model instead of the fixed-effect model (Borenstein et al., 2010).

The heterogeneity testing results are described in Table 6 and Table 7. For example, for the test of the overall servitization-performance relationship, the Q value of 1079.673 is significant at the level of 0.01, indicating the systematic difference among the 41 sampled studies that may significantly affect meta-analysis results (Hunter and Schmidt, 2004). In addition, an I-squared value of 96.3% also confirms high heterogeneity in our sample (Higgins et al., 2003). Therefore, we applied the random-effects model.

[Insert Table 6 here]

[Insert Table 7 here]

4. Results

4.1 The performance effect of servitization

The meta-analytic results on the correlations between servitization and firm performance are shown in Table 6. The overall servitization-performance relationship is significant and positive

(*Z*=6.690, *p*=0.000). In addition, the effect size is 0.179 and the 95% confidence interval of (0.127, 0.230) excludes 0, which support the overall positive effect of servitization on firm performance (Hypothesis 1).

The effects of both SSP and SSC on performance are significant (Z=3.463, *p*=0.001; Z=4.710, *p*=0.000). Moreover, the effect sizes for SSP and SSC are 0.141 and 0.185, and the 95% confidence intervals are (0.062, 0.219) and (0.109, 0.259), respectively. It is observed that SSC has a greater effect size than SSP. The differences between the effect size, confidence interval, and statistical significance related to the two servitization types provide evidence for Hypothesis 2 that the performance effect of SSC is stronger than that of SSP.

4.2 Moderating effects

In order to analyze the moderating effects of measurement and contextual factors, we split the whole sample to test the differences between subsamples. The results are shown in Table 7. We performed subgroup analysis in CMA instead of meta-analytic regression analysis (MARA) since we did not have enough sampled studies covering all variables. For example, performance is measured in terms of “financial performance” and “non-financial performance”. However, some studies combine these two performance measurements and hence cannot be assigned a binary value but can be grouped into two subsamples. If we exclude these studies, we will get a final sample covering all variables with a small sample size (less than 30), which does not meet the criteria of MARA. Therefore, it is appropriate to use the subgroup analysis.

4.2.1 Operationalization

In Table 7, the effect sizes of the four servitization measurements (i.e. service orientation, service offering, service breadth, and service revenue) are 0.305, 0.179, 0.125 and 0.087, respectively. In addition, the 95% confidence intervals for these four servitization measurements are (0.153, 0.443), (0.114, 0.243), (0.009, 0.238) and (-0.032, 0.203), respectively. It means that the observed servitization-performance relationship is significant with three measurements: service orientation (Z=3.833, p=0.000), service offering (Z=5.343, p=0.000), and service breadth (Z=2.118, p=0.034), among which the performance effect is strongest when servitization is measured by service offering (r=0.305). However, the observed servitization-performance relationship is not significant with the service revenue measurement (Z=1.434, p=0.151). Overall, Hypothesis 3 is supported.

Similarly, the results of subsamples with two performance measurements (i.e. financial and non-financial) support Hypothesis 4. Servitization has a significant and positive influence on financial performance (Z=6.695, p=0.000) with an effect size of 0.156 and a confidence interval of (0.111, 0.201). The effect of servitization on non-financial performance is also significant and positive (Z=3.563, p=0.000) with an effect size of 0.481 and a confidence interval of (0.081, 0.767). It is noticed that the effect on non-financial performance is much stronger. In other words, the observed servitization-performance relationship is markedly different with performance measurements.

4.2.2 Control variables

The comparison between two industrial subsamples provides support for Hypothesis 5. For studies in traditional manufacturing sectors, the effect size is 0.170 and the 95% confidence

interval is (0.127, 0.212), which implies that servitization significantly affects firm performance (Z=7.661, *p*=0.000). However, there is no significant servitization-performance relationship in other industries (Z=1.267, *p*=0.205). Thus, it is confirmed that the performance effect of servitization varies across industries.

Additionally, the statistical results of three regional subsamples support Hypothesis 6. In two subsamples (developing and developed), servitization has significant effects on firm performance (Z=5.121, *p*=0.000; Z=7.078, *p*=0.000). Particularly, the effect sizes are 0.305 with a 95% confidence interval (0.192, 0.410) for the developing region and 0.258 with a 95% confidence interval (0.189, 0.325) for the developed regions. However, in the global subsample, servitization has no significant effect on firm performance (Z=0.184, *p*=0.854). Therefore, these results partially support Hypothesis 6 that the performance effect of servitization varies across regions.

5. Discussion

5.1 Theoretical contributions

The extant literature has yielded inconsistent and even conflicting results on the performance effect of servitization. This study advanced this research stream by synthesizing the findings on the servitization-performance relationship reported in previous studies and further examining the impact of operationalization and contextual variables on this relationship.

First, the meta-analytic results provide a conclusive support that the performance effect of servitization is significant and positive. Although there are negative or ambiguous relationships reported in the extant literature, the detailed analyses of this study suggest that the inconsistency of research findings may arise from operationalization and contextual moderators.

Second, our research reveals the significant impact of operationalization of constructs on the observed servitization-performance relationship. This study has identified four servitization measurements: service orientation, service offering, service breadth, and service revenue. The meta-analytic results show that there is significant servitization-performance relationship in three subsamples except the subsample in which servitization is measured by service revenue. The former two measurements of servitization (service orientation and service offering) are based on survey data using multiple-item scales (Homburg et al., 2002; Gebauer, 2007; Kohtamäki et al., 2013b) while the latter two (service breadth and service revenue) adopt archival data with single item. These results are in line with Churchill (1979)'s argument that construct measurement with multiple items has greater validity than single-item measurement. However, the survey data often have a certain degree of subjectivity. In short, it calls for careful design of servitization measurement in future empirical studies.

Another noticeable finding is that service revenue shows no significant impact on firm performance. This result may be atttibuted to measurement errors. Service revenue, as a proxy of servitization, may have some drawbacks. For example, many manufacturing firms may not distinguish the revenues from service and product business, and a high percentage of total revenue from services may not represent a high level of servitization but result from unsuccessful product business (Raddats et al., 2015). Therefore, this measurement might introduce measurement errors and fail to reveal the real relationship between constructs. Hence, it is highly desirable to conduct further research on the proper use of service revenue as a proxy of servitization.

In addition, the impact of performance operationalization on the observed servitization-performance relationship is also confirmed. More precisely, servitization has a stronger positive

effect on firms' non-financial performance than financial performance. This is attraibutable to the nature of servitization. From the perspective of RAT, servitization is an effective means for manufacturing enterprises to acquire competitive edge and generate many invisible benefits such as increased customer loyalty and stronger buyer-seller relationships (Fang et al., 2008; Baines et al., 2009b). However, the formulation and implementation of servitization requires a great deal of resources and investment, and may not have corresponding returns in a short term. This finding helps to explain the "service paradox" phenomenon and corroborates the complicated association between servitization and financial performance. Hence, we speculate that there are contingency factors affecting manufacturers' servitization and financial performance, which needs further examination.

Some contextual variables are also found capable of explaining the difference in servitization-performance relationship reported in the extant literature. In previous studies, these contextual variables, particularly industry and region, were frequently regarded as control variables (Kwak and Kim, 2016; Visnjic et al., 2016). In terms of industry, the results demonstrate that servitization in non-manufacturing industries has no significant impact on performance whereas servitization in traditional manufacturing sectors, such as equipment and machinery, positively and significantly affects firm performance. This finding can be explained by the difference of product and service positions in various industries (Suarez et al., 2013). The meta-analytic results of this study call for more rigorous research on the impact of these industrial factors on servitization.

The meta-analytic results confirm that the performance effect of servitization varies across economic regions. To be more specific, the performance effects in both developed and developing regions are significant whereas the effect in the global region is insignificant. This

finding is not fully in line with previous studies. For example, Hong et al. (2014) suggest that customer service has significant effect on performance outcomes in developed countries but not in developing countries. It is noticed that the developing region in this sample contains only China, which is a special case of developing countries since China provides a vast demand for service business of product firms (Gebauer and Fischer, 2009). If more studies in other developing regions are reported, a more robust meta-analysis can be conducted to examine the performance effects of servitization in developing and developed regions. The limited number of studies in developing regions may be due to the fact that only peer-reviewed journal articles published in English language have been included in our sample. In short, the performance effect of servitization in different economic regions needs further investigation.

5.2 Managerial implications

The empirical findings of this study lead to practical implications for managers. First, the performance effect of different types of services varies. Although both SSP and SSC have significant influence on firm performance, SSC has greater effect on performance than SSP. This conclusion is consistent with prior studies (He and Lai, 2012; Visnjic et al., 2016). Therefore, manufacturing firms should gradually perform the transition from the provisions of product-related services towards customer-related services if they expect to maintain the competitive edge. Overall, SSC has great value at the strategic level. However, managers are suggested to notice the huge challenges and risks accompanied with the provisions of SSC. Firms need more resources to support the operations of SSC; otherwise, they may not be able to compete with third-party service providers. Therefore, although SSC has the potential to create more benefits than SSP, not all firms are guaranteed to achieve superior performance by offering SSC. If firms

do not have enough resources and capabilities to positively respond to intensive competition and challenges, they may be trapped in "service paradox" when offering SSC.

Second, the meta-analytic results suggest that firms in traditional manufacturing industries could generate improved performance by means of servitization but firms in other industries may not create significant benefits by servitization. This is possible due to the industry characteristics such as industry clockspeed and competition intensity. In short, servitization could be an effective means to achieve competitive advantage for firms in traditional manufacturing industries but may not be an effective strategy for firms in other industries. In this case, it may be advisable for firms in non-traditional manufacturing industries to concentrate on product and process innovation, which could help them more effectively realize differentiation and create competitive edge. Overall, manufacturers should seriously consider their industry and product characteristics, and balance the investments between products and services when formulating and implementing servitization.

6. Conclusion

A meta-analytic approach is adopted to examine the empirical studies reported in 41 peer-reviewed journal articles. We tested the servitization-performance relationship and the impact of operationalization of constructs (servitization and performance) and control variables (industry and economic region) on the relationship. The results support our hypotheses.

This research has several limitations. First, meta-analysis has some inherent limitations. Specifically, the data in different sampled studies were collected from different sources and at different time, which may lead to biased observations. Up to the present, the number of empirical studies on servitization is still limited. To our best knowledge, we have covered all valid studies

in the extant literature. With more empirical studies in the future, it is possible to enlarge the sample size and retest the hypotheses for robustness. In addition, this study analyzes only a few contextual factors. Factors such as product characteristics are recommended for inclusion in future studies. Moreover, the meta-analysis can only examine the linear relationship between servitization and firm performance but cannot explore the non-linear effect of servitization on firm performance, which needs further investigation.

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Appendix 1. Formulae for transformation to correlation

Statistics to be transformed	Formula to calculate correlation	Note
Student's t	$r = \sqrt{\frac{t^2}{t^2 + df}}$	Can be used for either paired or unpaired *t* test
F-ratios	$r = \sqrt{\frac{F}{F + df(error)}}$	Can only be used for one way ANOVA
χ^2	$r = \sqrt{\frac{\chi^2}{n}}$	χ^2 is the Chi-square value and *n*=sample size. Can be used when df=1
d	$r = \frac{d}{\sqrt{d^2 + 4}}$	*d* = Cohen's d
β	$r = 0.98 \times \beta + 0.05, \text{if } \beta \geq 0;$ $r = 0.98 \times \beta, \text{if } \beta < 0.$	β is the beta coefficient of the regression results, $\beta \in (-0.5, 0.5)$

Sources: Adapted from Peterson and Brown (2005) and Geng et al. (2017)

Note: *r* denotes the correlation between an independent variable and a dependent one.

Table 1. Definitions of servitization

Authors	Definition
Vandermerwe and Rada (1988)	"The increased offering of fuller market packages or bundles of customer focussed combinations of goods, services, support, self-service and knowledge in order to add value to core product offerings"
Tellus Institute (1999)	"The emergence of product-based services which blur the distinction between manufacturing and traditional service activities"
Desmet et al. (2003)	"A trend in which manufacturing firms adopt more and more service components in their offerings"
Lewis et al. (2004)	"Any strategy that seeks to change the way in which a product functionality is delivered to its markets"
Ward and Graves (2005)	"Increasing the range of services offered by a manufacturer"
Ren and Gregory (2007)	"A change process wherein manufacturing companies embrace service orientation and/or develop more and better services, with the aim to satisfy customer's needs, achieve competitive advantages and enhance firm performance"
Baines et al. (2009a)	"The innovation of an organization's capabilities and processes to better create mutual value through a shift from selling product to selling product service system"
Martinez et al. (2010)	"The journey or transformation process whereby an organization enables its product-service offerings"
Visnjic et al. (2012)	"A business model innovation whereby existing product offerings are extended through related services"

Sources: Adapted from Baines et al. (2009a)

Table 2. Coding results of the sample

No.	Study	Data	Analysis method	Theoretical lens	Region	Industry	Servitization measurement	Performance measurement	Sample size	Effect Size
1	Homburg et al. (2002)	Survey	Regression analysis	Contingency theory	USA and Germany	Other	Service orientation	Non-financial	411	0.750
2	Homburg et al. (2003)	Survey	CB-SEM	Not specified	Germany	Traditional manufacturing	Service orientation	Financial	271	0.308
3	Vickery et al. (2003)	Survey	CB-SEM	Value chain	North America	Traditional manufacturing	Service offering	Financial	57	0.377
4	Skaggs and Droege (2004)	Archival data	Regression analysis	Resource-based view and industrial organization economic model	USA	Traditional manufacturing	Service revenue	Financial	447	0.277
5	Gebauer (2007)	Survey	CB-SEM	Contingency theory and attention-based view	Germany and Swiss	Traditional manufacturing	Service orientation	Financial	212	0.145
6	Gebauer and Fleisch (2007)	Survey	Regression analysis	Not specified	Germany and Switzerland	Traditional manufacturing	Service revenue	Financial	187	0.533
7	Gebauer and Putz (2007)	Survey	Regression analysis	Not specified	Switzerland and Germany	Traditional manufacturing	Service breadth.	Financial and non-financial performance	198	0.381
8	Fang et al. (2008)	Archival data	Regression analysis	Resource-based view	USA	Traditional manufacturing	Service revenue	Financial	477	0.130
9	Neely (2008)	Archival data	Regression analysis	Competitive strategy	Global	Traditional manufacturing	Service breadth	Financial	7800	-0.027
10	Antioco et al. (2008)	Survey	PLS-SEM	Contingency theory	Netherlands, Belgium, and Denmark	Traditional manufacturing	Service orientation	Financial	137	0.219
11	Gebauer (2009)	Survey	CB-SEM	Attention-based view	Germany, Switzerland, and Australia	Traditional manufacturing	Service orientation	Financial	302	0.217
12	Grawe et al. (2009)	Survey	CB-SEM	Resource-based view	China	Traditional manufacturing	Service orientation	Financial	304	0.408
13	Gebauer et al. (2011)	Survey	CB-SEM	Not specified	Europe	Traditional manufacturing	Other	Financial	332	-0.023
14	Eggert et al. (2011)	Survey	Latent growth curve modeling	Resource-based view	Germany	Traditional manufacturing	Service orientation	Financial	414	-0.015
15	Aas and Pedersen	Survey	Non-parametric Mann-Whitney-	Not specified	Norway	Traditional manufacturing	Other	Financial	3575	0.288

	(2011)		Wilcoxon test							
16	Oliva et al. (2012)	Survey	CB-SEM	Not specified	Australia, Germany and Switzerland	Traditional manufacturing	Service breadth	Financial and non-financial performance	216	0.308
17	He and Lai (2012)	Survey	CB-SEM	Not specified	China	Traditional manufacturing	Service offering	Financial	229	0.314
18	Tian et al. (2012)	Survey	Hierarchical regression analysis	Not specified	Global	Traditional manufacturing	Service offering	Financial	719	0.239
19	Chen and Tsou (2012)	Survey	PLS-SEM	Resource-based view	Taiwan	Other	Service orientation	Financial and non-financial performance	174	0.575
20	Visnjic and Van Looy (2013)	Archival data	Regression analysis with GMM	Economies of scale	Global	Traditional manufacturing	Service revenue	Financial	308	-0.220
21	Kohtamäki et al. (2013a)	Survey and archival data	Ordinary least squares regression	Not specified	Finland	Traditional manufacturing	Service offering	Financial	91	0.350
22	Han et al. (2013)	Archival data	Ordinary least squares regression	Synergy theory	Global	Other	Service revenue	Financial	152	-0.445
23	Suarez et al. (2013)	Archival data	Regression analysis with GMM with system GMM	Economies of scale	North America	Other	Service revenue	Financial	3273	-0.060
24	Lin and Wu (2013)	Survey	CB-SEM	Service-dominant logic, resource-based view and service marketing theory	China	Traditional manufacturing	Service orientation	Financial	202	0.360
25	Eggert et al. (2014a)	Survey	Latent growth curve modeling	Resource-based view	Germany	Traditional manufacturing	Service orientation	Financial	513	0.156
26	Eggert et al. (2014b)	Survey	Seemingly unrelated regression	Resource advantage theory	Germany	Traditional manufacturing	Other	Financial	558	0.065
27	Wang (2014)	Survey	CB-SEM	Not specified	Taiwan	Traditional manufacturing	Service orientation	Non-financial	235	0.336
28	Hong et al. (2014)	Survey	CB-SEM	Socio-technical system theory	Global	Traditional manufacturing	Service orientation	Financial	571	0.045
29	Li et al. (2015)	Archival data	Regression analysis	Not specified	China	Traditional manufacturing	Service breadth	Financial	134	0.132
30	Hong et al. (2015)	Survey	CB-SEM	Not specified	Korea	Other	Other	Financial and non-financial performance*	221	0.500

31	Kohtamäki et al. (2015)	Survey	CB-SEM	Not specified	Finland	Traditional manufacturing	Service offering	Financial	115	0.150
32	Eggert et al. (2015)	Survey and archival data	Ordinary least squares regression	Resource advantage theory	Germany	Traditional manufacturing	Other	Financial	348	-0.030
33	He et al. (2015)	Survey	CB-SEM	Not specified	Global	Traditional manufacturing	Service offering	Financial	365	0.110
34	Kwak and Kim (2016)	Archival data	Regression analysis	Not specified	Korea	Traditional manufacturing	Service revenue and service breadth	Financial	202	0.209
35	Visnjic et al. (2016)	Archival data	Regression analysis	Demand-based view on value creation and complementarity theory	Global	Traditional manufacturing	Service breadth	Financial	522	-0.018
36	Chen et al. (2016)	Survey	Zero-inflated Poisson regression	Resource-based view and market orientation perspective	Taiwan	Traditional manufacturing	Service orientation	Financial	170	0.200
37	Jia et al. (2016)	Survey	Hierarchical regression analysis	Strategic fit	Global	Traditional manufacturing	Other	Financial	343	0.091
38	Benedettini et al. (2017)	Archival data	Logistic regression analysis	Portfolio theory	Global	Traditional manufacturing	Service breadth	Financial	273	0.028
39	Crozet and Milet (2017)	Archival data	Regression analysis	Not specified	French	Traditional manufacturing	Service revenue	Financial	34243	0.118
40	Szász et al. (2017)	Survey	CB-SEM	Not specified	Global	Traditional manufacturing	Service offering	Financial	554	0.220
41	Sousa and Silveira (2017)	Survey	PLS-SEM	Not specified	Global	Traditional manufacturing	Service offering	Financial	763	0.116

Note: *This measurement of performance includes financial and non-financial dimensions but the two dimensions cannot be distinguished.

Table 3. Theoretical lens in sampled studies

Theory	Numbers	Percentage (%)
Resource-based view	8	19.5
Contingency theory	3	7.3
Attention-based view	2	4.9
Economies of scale	2	4.9
Resource-advantage theory	2	4.9
Competitive strategy	1	2.4
Complementarity theory	1	2.4
Demand-based view on value creation	1	2.4
Portfolio theory	1	2.4
Synergy theory	1	2.4
Industrial organization economic model	1	2.4
Market orientation perspective	1	2.4
Service-dominant logic	1	2.4
Service marketing theory	1	2.4
Socio-technical system theory	1	2.4
Strategic fit	1	2.4
Value chain	1	2.4
Not specified	18	43.9

Note: Some articles adopt more than one theories, hence the total percentage is larger than 1.

Table 4. Analysis methods in sampled studies

Analysis method	Numbers	Percentage (%)
Regression analysis	20	48.8
CB-SEM	15	36.6
PLS-SEM	3	7.3
Latent growth curve modeling	2	4.9
Non-parametric Mann-Whitney-Wilcoxon test	1	2.4

Table 5. Service types in prior studies

	Types of services	SSP	SSC
Boyt and Harvey (1997)	Elementary services	*	
	Intermediate services		
	Intricate services		*
Frambach et al. (1997)	Pre-sale product services	*	
	Sale product services	*	
	Post-sale product services	*	
Oliva and Kallenberg (2003)	Basic services	*	
	Maintenance services	*	
	Professional services		*
	Operational services		*
Gebauer (2008)	After-sales services	*	
	Process-oriented services		*
	R&D services		*
	Operational services	*	
Gebauer et al. (2008)	Customer services		*
	Product-related services	*	
	Customer support		*
Gebauer et al. (2010)	Customer service		*
	Basic service for the installed base	*	
	Maintenance service	*	
	R&D-oriented service		*
	Operational service	*	
Kohtamäki et al. (2013b)	Maintenance services	*	
	R&D services		*
	Customer services		*

Sources: Adapted from Kohtamäki et al. (2013b) and Saccani et al. (2014)
Note: * denotes that the corresponding service is regarded as an SSP or SSC.

Table 6. Meta-analytic results of the main effect

Random-effects model		N	K	r	95%CI		Z	P	Q	I^2	SE
					Lower limit	Upper limit					
Overall effect	Servitization	60618	41	0.179	0.127	0.230	6.690	0.000	1079.673***	96.3 %	0.018
Differential effect	SSP	4922	13	0.141	0.062	0.219	3.463	0.001	90.930***	86.8%	0.009
	SSC	4827	13	0.185	0.109	0.259	4.710	0.000	84.286***	85.8%	0.009

Note: N is the total sample size, K is the number of sampled studies, r is the effect size (namely correlation coefficient), 95%CI is the confidence interval at the 5% significance level, Z and P are values to judge the significance, Q and I^2 are values related to Chi-square for determining the heterogeneity, *** indicates significance at the level of 0.01, and SE is the sampling standard error.

Table 7. Meta-analytic results of the moderating effects

Random-effects model	Factors	Subsamples	N	K	r	95%CI		Z	P	Q	I^2	SE
						Lower limit	Upper limit					
Operationalization	Servitization	Service orientation	3916	13	0.305	0.153	0.443	3.833	0.000	306.973***	96.1%	0.038
		Service offering	2893	8	0.179	0.114	0.243	5.343	0.000	18.596**	62.4%	0.005
		Service breadth	9345	7	0.125	0.009	0.238	2.118	0.034	63.607***	90.6%	0.019
		Service revenue	39289	8	0.087	-0.032	0.203	1.434	0.151	246.968***	97.2%	0.028
	Performance	Financial performance	59751	38	0.156	0.111	0.201	6.695	0.000	706.345***	94.8%	0.012
		Non-financial performance	1234	5	0.481	0.232	0.671	3.563	0.000	102.161***	96.1%	0.079
Control	Industry	Traditional manufacturing	56387	36	0.170	0.127	0.212	7.661	0.000	525.551***	93.3%	0.010
		Other	4231	5	0.317	-0.178	0.684	1.267	0.205	540.362***	99.3%	0.304
	Region	Developing	869	4	0.305	0.192	0.410	5.121	0.000	9.370**	68.0%	0.012
		Developed	47379	26	0.258	0.189	0.325	7.078	0.000	727.482***	96.6%	0.024
		Global	12370	11	0.007	-0.067	0.081	0.184	0.854	843.592***	90.6%	0.010

Note: N is the total sample size, K is the number of sampled studies, r is the effect size (namely correlation coefficient), 95%CI is the confidence interval at the 5% significance level, Z and P are values to judge the significance, Q and I^2 are values related to Chi-square for determining the heterogeneity, *** indicates significance at the level of 0.01, ** indicates significance at the level of 0.05, and SE is the sampling standard error.

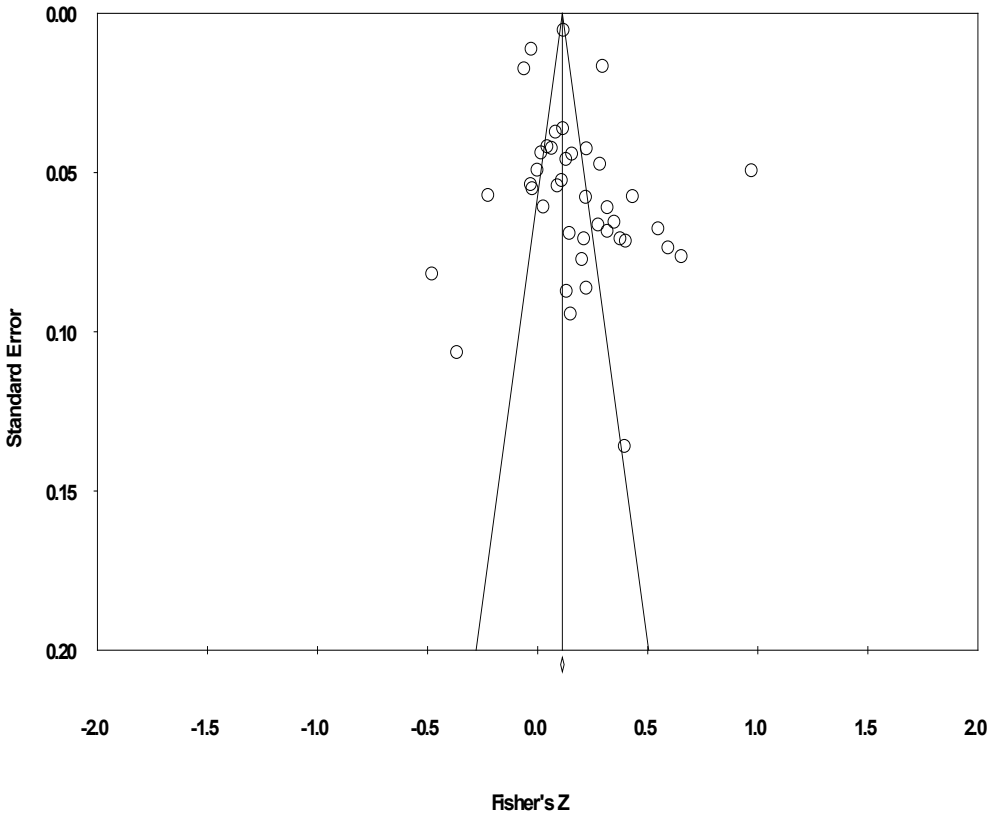

Figure 1. Funnel plot of the sample