UNIVERSIDADE FEDERAL DO RIO DE JANEIRO

RENATA DE CASTRO MORENO

THE RELATIONSHIP BETWEEN SERVITIZATION AND FIRM PERFORMANCE:

a multi-country study

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Master's dissertation presented to the Instituto Coppead de Administração, Universidade Federal do Rio de Janeiro, as part of the mandatory requirements in order to obtain the degree of Master in Business Administration (M.Sc.).

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ABSTRACT

MORENO, Renata de Castro. **The relationship between servitization and firm performance:** a multi-country study. Rio de Janeiro, 2018. Graduation Thesis (Master in Administration) – Instituto COPPEAD de Administração, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2018.

The concept of *servitization* was first defined by the authors Vandermerwe and Rada in 1988 to represent the movement of manufacturing firms to integrate services into their value proposition, traditionally limited to goods. Different authors have advocated that the transition from pure goods to a hybrid solution can bring a positive effect on firm performance, but existing empirical studies are still limited and offer mixed results, hence confirming the narrow understanding of the topic (GEBAUER et al., 2012; KASTALLI; VAN LOOY, 2013). The main objective of this study is to investigate the relationship between investments in servitization, servitization level and firm performance, as well as to test the influence of firm characteristics on this relationship. This study is based on the sixth edition of the International Manufacturing Strategy Survey (IMSS), carried out in 2013-2014 with firms of the metal-mechanic industry. Altogether 22 countries have taken part in this edition of the survey, collecting data from 931 manufacturing plants. After data cleaning, a sample of 539 plants was considered for this research. Regression techniques were adopted to test the relationships, as well as moderating and antecedent effects. When adopting the intensity of services offered as a metric for servitization level, it presented a significant relationship, at a 5% significance level, with all firm performance variables – sales increase in last three years, return on sales (ROS), and ROS increase in the last three years. Differently, the other metric used for servitization level – service ratio – is not significantly correlated to any of them. Therefore, aligned with Crozet and Milet (2015) and unlike other previous studies, we concluded that the increase in service offerings generate higher margins even when representing a small proportion of the total sales revenue (service ratio). The level of country development is the only moderator whose influence in the relationship between servitization and firm performance is significant. Interestingly and counter intuitively, our analysis indicated that the lower the level of country development, the stronger is the relationship between servitization and firm performance. Different analysis were conducted to confirm this finding and some hypothesis were raised to justify it. The empirical focus of this study, conducted with a global and generalizable sample, contributes for filling gaps in the extant literature about servitization and guides managerial team in expanding the service business.

Key words: Servitization, manufacturing firms, business performance, moderating effects, International Manufacturing Strategy Survey (IMSS)

FIGURES

TABLES

LIST OF ABBREVIATIONS

B2B – Business-to-Business

B2C – Business-to-Consumer

GNP – Gross National Product

HDI – Human Development Index

IMSS – International Manufacturing Strategy Survey

ISIC – International Standard Industrial Classification

PSS – Product-Service Systems

ROS – Return on Sales

SEM – Structural Equation Modeling

SMEs – Small and Medium Enterprises

UNDP – United Nations Development Programme

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1 INTRODUCTION

1.1 RELEVANCE

> Together, with globalization and sustainability, service-driven manufacturing will continue to be among the most significant developments in modern industrial business management. While the idea has been around for quite a long time, our understanding of the phenomenon is still relatively limited. (GEBAUER et al., 2012, p. 131)

Different authors agree that there are unanswered questions regarding the impact of service-driven strategies on firm performance (EGGERT et al., 2011; KASTALLI; VAN LOOY, 2013) and call for more investigation about this relationship (BENEDETTINI; NEELY; SWINK, 2015; GEBAUER et al., 2012; KOHTAMÄKI et al., 2013; KOWALKOWSKI; GEBAUER; OLIVA, 2016; ULAGA; REINARTZ, 2011). They recognize that research about services in manufacturing firms have been conducted since 1960s, but those have been mainly descriptive, focused on exploring the differences between product and service. In later decades, researchers have concentrated their efforts on the challenges related to the transition to service businesses and more recently on the impact on performance, but still few studies have focused on firm performance as a result of service provision (GEBAUER et al., 2012).

One of the main concerns is ensuring that the service business strategy is accurately beneficial for manufacturing firms in the long term (SUAREZ; CUSUMANO; KAHL, 2013). Theretofore, different authors have theoretically concluded that the transition brings a positive effect on firm performance, but recent empirical studies, although still limited in number, have provided mixed results, which confirms the narrow understanding about the topic (GEBAUER et al., 2012; KASTALLI; VAN LOOY, 2013).

Due to the mixed results in the extant literature, more empirical studies are required to understand the relationship between servitization and firm performance, as well as in what conditions this relationship is more significant (BENEDETTINI; SWINK; NEELY, 2013; FANG; PALMATIER; STEENKAMP, 2008; GEBAUER et al., 2012; KOWALKOWSKI; GEBAUER; OLIVA, 2016; TIAN et al., 2012). Eggert et al. (2011, p. 663) explain that "empirical research on industrial services is still in its infancy and can be divided into two groups focusing on (1) the effect of industrial services on firm performance and (2) the variables that moderate the effect of industrial services on firm performance". Regarding the moderating

effects, Benedettini, Swink and Neely (2013) highlight that the influence of the characteristics of servitized firms on this relationship is somewhat neglected.

The servitization literature draws largely on studies that are qualitative, firm-level or limited to a sample of firms, which are informative, but do not offer a large scale analysis of servitization effects on firm performance (CROZET; MILET, 2015; GEBAUER et al., 2012; JACOB; ULAGA, 2008; KOWALKOWSKI; GEBAUER; OLIVA, 2016; NEELY; BENEDETTINI; VISNJIC, 2011). There is also a shortage of studies in newly industrializing and developing economies such as Brazil, China, India, Mexico and Russia, which could diversify and validate the results encountered in developed environments (GEBAUER et al., 2007, 2012; KOWALKOWSKI; GEBAUER; OLIVA, 2016; LUOTO; BRAX; KOHTAMÄKI, 2017). Besides, Amaral et al. (2017) explain that developing economies share some characteristics, such as market size, proximity with customers and lack of control over product development, that configure them as favorable markets for service innovation, what should be more explored.

The remainder of this section includes the research objectives and an explanation about the international database adopted for testing the hypotheses.

1.2 OBJECTIVE

This study asks to questions regarding servitization: (1) *whether* and (2) *in what conditions* servitization impacts firm performance. The main objective of this study is to investigate the relationship between servitization and firm performance, as well as testing the influence of firm characteristics and antecedents on this relationship. Therefore, three main research questions were defined:

- Research Question 1: Is the servitization level associated to better firm performance?
- Research Question 2: Do firm characteristics exhibit significant moderating effects on the relationship between servitization and firm performance?
- Research Question 3: Does the effort put on developing the service business have an antecedent effect on the servitization level?

The servitization concept, motivators, challenges and previous studies regarding the relationship with firm performance will be explored in the literature review.

1.3 SURVEY

This study is based on the sixth edition of the International Manufacturing Strategy Survey (IMSS), carried out in 2013-2014 and covering 22 countries, represented by 931 manufacturing plants. The IMSS objective is to study manufacturing and supply chain practices and strategies within the metal-mechanic industry based on a comprehensive questionnaire. Companies that participate in the study can have access to the survey reports and benefit from the IMSS network. The survey was launched in 1990 and the numbers of countries and companies that have participated in all the editions of the survey are summarized in the

Table *1* below (MANUFACTURING STRATEGY, 2017).

Table 1 - IMSS Participants

Edition	Year	Number of Countries	Number of Companies
I	1992-1994	20	600
II	1996-1998	23	703
III	2000-2002	17	585
IV	2005	23	711
V	2009-2010	20	719
VI	2013-2014	22	931

The survey is currently coordinated by Politecnico di Milano and University of Bergamo, and carried together with a worldwide network of universities that act as local research groups. Nowadays, the IMSS network is formed by 26 partner institutions in 22 countries. Since the first edition, Instituto COPPEAD de Administração is responsible for administering the survey in Brazil (MANUFACTURING STRATEGY, 2017).

In Chapter 2, extant literature about servitization is explored, covering the concept, motivators, challenges and previous studies regarding the relationship between servitization and firm performance. Then in Chapter 3, the research design is presented, including the research hypotheses, sample, study variables and data analysis methodology. In Chapter 4, we present the research findings, which are discussed and compared with existing literature in Chapter 5. Finally, the study conclusions, limitations and suggestions for future studies are demonstrated in the last chapter.

2 LITERATURE REVIEW

This chapter presents a literature review about servitization of manufacturing firms, motivators, challenges and impact on firm performance. The chapter also explores the main characteristics of servitized firms and their relationship with performance.

2.1 SERVITIZATION

2.1.1 Concept

The concept of *servitization* was first defined by the authors Vandermerwe and Rada in 1988 to represent the movement of manufacturing firms in offering market packages or bundles, which combine goods, services, support, self-service and knowledge (VANDERMERWE; RADA, 1988). The definition proposed by Bustinza et al. (2015, p. 53) draws attention to the importance of developing new organizational capabilities to support the inclusion of service offerings: “Servitization represents a business-model change and organizational transformation from selling goods to selling an integrated combination of goods and services”. Baines et al. (2009b) explain that there are many other definitions of servitization in the extant literature, but the majority of them draw from the definition by Vandermerwe and Rada in 1988. Therefore, Baines et al. (2017) conclude and summarize that servitization is related to the process of manufacturers building service revenue streams.

There are different research communities within the servitization literature, showing that although principles are similar, they have different motivations and geographical origins. One of the most cited concepts is the Scandinavian definition of Product-Service Systems (PSS), which is closely related to servitization, but focuses on sustainability issues. Besides, it is visible that Bustinza et al. (2015) explore the concept of servitization as an innovative process, focused on accessing resources and building the internal capabilities to support this transition, while Vandermerwe and Rada (1988) are more focused on the operation of increasing the service offerings, what can be more related to the concept of PSS. Other research communities include services marketing, service operations and services science (BAINES et al., 2009a).

The objective of servitization is creating a hybrid solution, combining goods and services, which brings more customer benefits than if the offerings were provided separately (ULAGA; REINARTZ, 2011). Besides the benefits for the customer, this trend is also advantageous for the supplier, who see this as a way to increase their sales (NEELY, 2008),

achieve higher margins and escape the "product commoditization trap" (KOWALKOWSKI; GEBAUER; OLIVA, 2016). Ye, Priem and Alshwer (2012) and Visnjic, Wiengarten and Neely (2014) state that, in learning from customers with the service provision, firms can also create value by saving time, effort, and/or investments, which can be defined as *economies of scope*.

Baines et al. (2009b) explain that there is limited literature covering the evolution of servitization, but claim that its origin dates back to the 1960s. Furthermore, it is a common belief that "Everybody is in service" (LEVITT, 1972, p. 42), meaning that manufacturing firms have always provided services, such as maintenance and delivery (BAINES et al., 2009b; GEBAUER et al., 2012; REINARTZ; ULAGA, 2008; SCHMENNER, 2009). However, the main argument for servitization is that service represents a larger component of the offering (VANDERMERWE; RADA, 1988) and that including service in the value proposition is a strategic movement (BENEDETTINI; NEELY; SWINK, 2015; OLIVA; KALLENBERG, 2003). While the service offering used to be considered a "necessary evil" to support the product sale (BAINES et al., 2009b; GEBAUER; FRIEDLI, 2005; TIAN et al., 2012; WISE; BAUMGARTNER, 1999), the current trend is to define servitization as offering hybrid solutions that may eventually lead to the prevalence of services accompanied by some goods (BRAX, 2005). Besides, there is a change from *for free* to *for fee* in which services are usually provided and charged independently from the firm's goods price table (NEU; BROWN, 2008).

The extant literature offers some examples of prominent companies that have made a successful shift towards servitization. The Rolls-Royce Aerospace case is one of the most cited examples, as the firm shifted from selling the aircraft engine to offering hours of flying capability (BAINES et al., 2009a, 2009b; BUSTINZA et al., 2015; KASTALLI; VAN LOOY, 2013; NEELY, 2008; SLACK, 2005). Other outstanding examples where more than 50% of total sales result from services, include IBM, Xerox and General Electric (BAINES et al., 2009a, 2009b, GEBAUER et al., 2010, 2012; GEBAUER; BRAVO-SANCHEZ; FLEISCH, 2008; KASTALLI; VAN LOOY, 2013; MARTINEZ et al., 2010; NEELY, 2008; OLIVA; GEBAUER; BRANN, 2012; SUAREZ; CUSUMANO; KAHL, 2013; WISE; BAUMGARTNER, 1999).

Baines et al. (2009b) argue that most leading servitized firms are large multinationals offering services to support their high-value capital equipment. However, servitization is happening in a global scale and in different industries, mainly forced by deregulation, technology, globalization and competitive pressure (VANDERMERWE; RADA, 1988). Neely (2009) found in his empirical study with 25 countries that about one third of manufacturing firms have servitized, and Fang, Palmatier and Steenkamp (2008) found an

average service ratio (which accounts for the participation of service revenues in total sales) of 42.2% in traded U.S. manufacturing firms in 2005. Put together, these findings confirm that the growing trend of servitization strategies in manufacturing firms expands across countries and industry sectors.

Manufacturing firms that start to provide services are in a better competitive position than pure-service companies, due to their cumulative experience with the product and the market (FANG; PALMATIER; STEENKAMP, 2008; KASTALLI; VAN LOOY, 2013; MATHIEU, 2001a; OLIVA; KALLENBERG, 2003; ULAGA; REINARTZ, 2011; WISE; BAUMGARTNER, 1999). Among the critical resources leveraged by manufacturing firms, Ulaga and Reinartz (2011) emphasize product data, assets, sales force and distribution experience, and field service organization. However, the authors state that it is not enough to have these resources, it is necessary to transform them into capabilities to succeed in the service business. “Resources are productive assets the firm owns; capabilities are what the firm can do.” (ULAGA; REINARTZ, 2011, p. 6) Moreover, depending on the hybrid offering, the resources and capabilities may vary (ULAGA; REINARTZ, 2011). Besides the advantage of cumulative experience with the product/market and resources leverage, manufacturing firms also benefit from reciprocal spillovers between products and services, with a complementarity of product and product-related service sales (KASTALLI; VAN LOOY, 2013).

Different authors suggest that there is a product-service continuum process, in which manufacturers move across stages shifting from pure manufacturers to service providers. In other words, from having services as *add-ons* in one extreme to having tangible goods as *add-ons* at the other (BAINES et al., 2009b; GEBAUER; BRAVO-SANCHEZ; FLEISCH, 2008; GEBAUER; FLEISCH; FRIEDLI, 2005; GEBAUER; FRIEDLI, 2005; MARTINEZ et al., 2010; NEU; BROWN, 2005; OLIVA; KALLENBERG, 2003). The literature suggests that firms should start offering product-related services, such as repair, maintenance, and monitoring, which can help building knowledge and encourage organizational learning, before including customer-related services (EGGERT et al., 2011; VISNJIC; WIENGARTEN; NEELY, 2014).

Manufacturing firms facing this move are tempted to believe that a strategy of organic growth, adding services to the original offering one by one, is paramount to reduce risks. However, Brax (2005) argues that this *evolutionary* transformation can be more hazardous than the *revolutionary* approach. The argument is that manufacturers cannot only add services on top of previous product offerings. Instead, a more radical approach to change the transaction-

oriented business philosophy and structure is vital (BRAX, 2005). The motivators and challenges involved in making this shift are covered in the next sections.

2.1.2 Motivators

The motivations for servitization by manufacturers are becoming increasingly more documented (BAINES et al., 2017). Different authors emphasize that successful firms would be those that can blend service to their offering (NEELY, 2008; WISE; BAUMGARTNER, 1999), highlighting various motivators for that. The primary reason is sustaining a competitive advantage, as servitization may create barriers to competitors, create customer dependency, differentiate the offering, diffuse innovations and bring a better understanding of the market (BUSTINZA et al., 2015; GEBAUER et al., 2012; VANDERMERWE; RADA, 1988). Servitization is also pushed by more well-informed and demanding customers, who call for service offerings, and more convenient and customized solutions (OLIVA; KALLENBERG, 2003; VANDERMERWE; RADA, 1988).

Besides the competitive argument and customer pressure, other authors explore economic reasons. They suggest that services represent another source of revenues, have higher margins and are more stable to economic cycles (BAINES et al., 2009b; EGGERT et al., 2011; GEBAUER; FLEISCH, 2007; GEBAUER; FRIEDLI, 2005; OLIVA; KALLENBERG, 2003; REINARTZ; ULAGA, 2008; SLACK, 2005; WISE; BAUMGARTNER, 1999). A survey conducted by the German Association of Equipment and Machine Manufacturing Companies found that the average product margin was just 1% compared to 10% offered by services like repair, maintenance, contracts and assembly (VDMA, 2004 apud GEBAUER; FLEISCH, 2007).

Therefore, the literature summarizes the motivators to servitize in three main groups: (1) strategic motivators (sustainable competitive advantage); (2) marketing motivators (more appealing offerings to demanding customers); and (3) financial motivators (higher and more stable revenues and profits) (BAINES et al., 2009b; BRAX, 2005; GEBAUER; FLEISCH, 2007; GEBAUER; FLEISCH; FRIEDLI, 2005; GEBAUER; FRIEDLI; FLEISCH, 2006; GEBAUER; GUSTAFSSON; WITELL, 2011; MATHIEU, 2001a; OLIVA; KALLENBERG, 2003). The majority of these arguments derive from embedded service characteristics, such as intangibility and difficulty to standardize, making the total offerings more unique and hard to replicate by competitors (BAINES et al., 2009b; FANG; PALMATIER; STEENKAMP, 2008; GEBAUER; FRIEDLI, 2005; MARTINEZ et al., 2010; OLIVA; KALLENBERG, 2003).

Another motivator that has been increasingly cited relates to environmental reasons. The main rational is that adding services such as maintenance, upgrading, and remanufacturing extends the life of an existing product, what reduces product turnover and consequently diminishes the environmental impact (GEBAUER et al., 2012; KASTALLI; VAN LOOY, 2013; MONT; PLEPYS, 2003; NEELY, 2008).

2.1.3 Challenges

Despite the various reasons to servitize, manufacturing firms still struggle to shift toward servitization (BAINES et al., 2009a; BUSTINZA et al., 2015; CROZET; MILET, 2015; FANG; PALMATIER; STEENKAMP, 2008; GEBAUER et al., 2012; NEELY, 2008; SUAREZ; CUSUMANO; KAHL, 2013; VANDERMERWE; RADA, 1988; WISE; BAUMGARTNER, 1999). This transition depends on adjustments in company structure, culture, and competences, but the majority of the manufacturers are unware of the steps for this reconfiguration process (ADRODEGARI; PASHOU; SACCANI, 2017).

Analyzing 477 manufacturing firms from 1990 to 2005, Fang, Palmatier and Steenkamp (2008) verified that the average service ratio (participation of service sales on total sales) increased from 8.9% in 1990 to 42.2% in 2005. However, when Neely, Benedettini and Visnjic (2011) compared studies between 2007 and 2011, they verified that the percentage of servitized firms barely changed during this period (29.52% in 2007 vs 30.10% in 2011). Besides, the proportion of revenues generated through services have remained relatively stable or even declined, as in the case of Rolls-Royce (NEELY; BENEDETTINI; VISNJIC, 2011). Investigating 119 Swiss and German machinery and equipment manufacturing firms, Gebauer, Friedli and Fleisch (2006) found out that only 11.1% of manufacturing firms where generating more than 40% of their revenue through services, and more than 35% of the firms accumulate only 10% of revenues through services.

Low levels of servitization may be due to three main factors. First, it is questionable how far manufacturing firms can servitize, mainly for those firms in which the sale of services is dependent on a previous product sale (NEELY; BENEDETTINI; VISNJIC, 2011). Second, there is limited managerial motivation to servitize due to an overemphasis on tangible characteristics (preferring to focus the investments on product features), failure to recognize the potential of service offerings and risk aversion of managers in manufacturing firms (GEBAUER; FLEISCH; FRIEDLI, 2005). Gebauer and Fleisch (2007) affirm that managers have to overcome these behavioral factors in order to increase investments in service, so that

the participation of service in total revenue can increase. Third, there is a belief that providing services is easier and cheaper than goods production (VANDERMERWE; RADA, 1988), so managers often underestimate the challenges and investments involved in the transition (GEBAUER; FLEISCH, 2007). Neely (2009) found in his study with 10,028 firms incorporated in 25 different countries in 2007 that 53.3% of the firms that had declared bankruptcy, had also shifted toward servitization, hence indicating that this move might be problematic. Another indication of the challenges of such transition is proposed by Benedettini, Neely and Swink (2015) in their study with 129 bankrupt manufacturing firms, where the authors show that firms with a service orientation face a higher level of bankruptcy risk.

The study by Martinez et al. (2010) on the challenges faced by firms that are moving toward a product-service orientation offers the following list: (1) embedded product-service culture; (2) delivery of integrated offering; (3) internal process and capabilities; (4) strategic alignment; (5) supplier relationships. Vandermerwe and Rada (1988) believe that the main challenge for servitization is the strategic alignment (i.e. combining service offers into the overall manufacturing strategy); hence, it is paramount to reeducate internal teams and customers. Focusing on the product part of the offering may be an undesirable inclination, mainly due to employees' previous expertise or expectations of higher revenue (MARTINEZ et al., 2010). Different authors reinforce the need of a deliberate development process that includes (a) building new skills and capabilities, (b) formulating new metrics and incentives, (c) devising the right culture, and (d) defining new structures and processes in order to succeed in a servitization strategy (FANG; PALMATIER; STEENKAMP, 2008; GEBAUER; FLEISCH; FRIEDLI, 2005; MARTINEZ et al., 2010; NEELY; BENEDETTINI; VISNJIC, 2011; OLIVA; KALLENBERG, 2003; WISE; BAUMGARTNER, 1999). One point that deserves attention within process requirements is the development of information management and processing capabilities in order to deal with the complex nature of the service market (BAINES et al., 2009a; BRAX, 2005; NEU; BROWN, 2005, 2008). Hence, Brax (2005) concludes that becoming a service provider is not just a matter of expanding the offering, but also restructuring the firm' strategy and structure.

Brax (2005) and Bowen and Ford (2002) clarify that these structural adjustments are necessary because of service characteristics, which are new to the manufacturing firms, among them the inseparability between production and consumption, the operations exposure to customers and co-production, a higher focus on the process instead of the output, and the intangibility of the service provision. Hybrid offerings are also usually longer and more complex, depend on customer participation, frequently involve multiple actors, the decision

maker is typically higher in hierarchy, and the sales arguments are specific to each customer (BAINES et al., 2009a; ULAGA; REINARTZ, 2011). For these reasons, the authors argue that the capabilities for selling goods are different from selling hybrid offerings, depending on skilled workers with good communication and customer interface abilities, and highlight the importance of focusing on training the sales force.

These additional requirements and the opposing cultural characteristics of manufacturing and service firms are likely to generate organizational conflicts (BAINES et al., 2009b; EGGERT et al., 2011; FANG; PALMATIER; STEENKAMP, 2008; MATHIEU, 2001a, 2001b; SLACK, 2005). However, it is important to point out that different authors do not propose a substitution from one culture to another; they support the idea of a *symbiotic relationship*, combining the manufacturing values of efficiency with the service-oriented values of flexibility (BOWEN; SIEHL; SCHNEIDER, 1989; GEBAUER; FLEISCH; FRIEDLI, 2005). Likewise, Slack (2005) suggests that servitized manufacturing firms should pursue twin objectives: improving services through quality, variety and responsiveness, and reducing costs.

Another important point of concern and discussion is the deviation of resources from manufacturing core activities in order to develop the new service capabilities (FANG; PALMATIER; STEENKAMP, 2008; GEBAUER; GUSTAFSSON; WITELL, 2011; OLIVA; GEBAUER; BRANN, 2012; OLIVA; KALLENBERG, 2003; SLACK, 2005). In this case, a vicious cycle is created, since it may affect the motivation of manufacturing managers to continue the investments in building the service business, and consequently builds a barrier for the expansion of the service offerings. Therefore, Gebauer, Fleisch and Friedli (2005) alert managers for the necessity of anticipating the capacity expansion with the purpose of avoiding this resource bottleneck.

Despite all these challenges and new requirements to implement a service strategy, some authors suggest there is still little research offering guidance on how to conduct this transition process from a *product-centered* to a *servitized* organization (ADRODEGARI; PASHOU; SACCANI, 2017; BAINES et al., 2009b; MARTINEZ et al., 2010). Slack (2005) does not consider servitization as another management fad and believes it represents the future of manufacturing firms. The impact of this shift on firm performance is explored in the next section.

2.2 SERVITIZATION AND FIRM PERFORMANCE

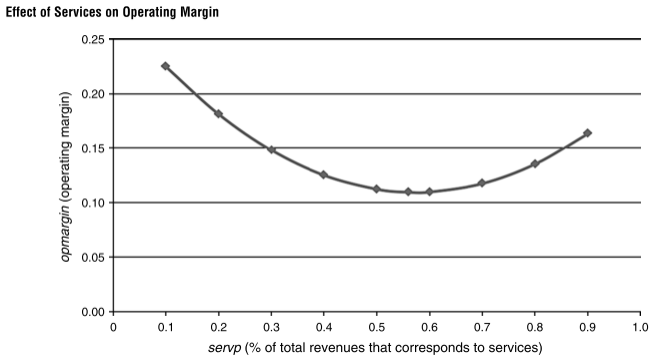
As previously presented in the motivators for servitization, one of the main reasons for the manufacturing firms to include services in their offerings is the expected financial returns, due to more stable and higher revenues and margins with service provision. Despite the fact that servitization can be seen as a strategic alternative that renders superior performance, there are few empirical studies focused on validating this relationship, and the results are mixed (BRAX, 2005; FANG; PALMATIER; STEENKAMP, 2008; GEBAUER et al., 2012; GEBAUER; FLEISCH; FRIEDLI, 2005; NEELY, 2008; NEU; BROWN, 2005; OLIVA; KALLENBERG, 2003).

Some researchers state that the returns are positive. Gebauer, Fleisch and Friedli (2005) cite a study that proved that services generate higher potential margins than other strategic pathways, such as improving product quality. Crozet and Milet (2015), analyzing data from French manufacturing firms between 1997 and 2007, also found that servitized firms are more profitable and that selling services increase profitability (from 3.7% to 5.3%, in the firms analyzed in their study), employment, total sales and sales of goods.

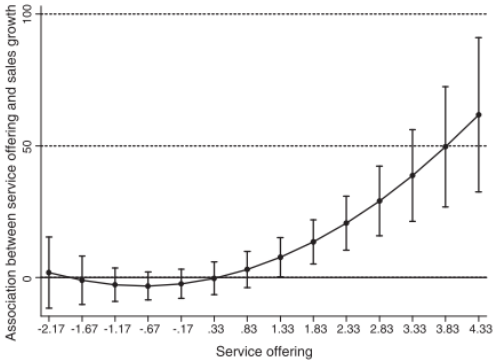
In contrast, a study from Bain & Co found that only 21% of firms succeed with their service strategies; manufacturing firms that servitize usually do not outperform their pure manufacturing counterparts in metrics related to revenue growth, stock performance, margins, and returns on equity (BAVEJA; GILBERT; LEDINGHAM, 2004). Likewise, a study from McKinsey with 200 executives at Fortune 1000 companies found that about 50% of companies that engage in bundled offerings realize only minor benefits and one quarter actually lose money (HANCOCK; JOHN; WOJCIK, 2005). In addition, in a analyses conducted with electronic and other electrical equipment and components' companies, Neely, Benedettini and Visnjic (2011) have not found statistical significance in the relationship between servitized firms and current profitability or current enterprise value. Comparing with pure product companies counterparts, Neely (2009) found that, at an aggregate level, servitized firms achieve lower profits and are more likely to declare bankruptcy; the explanation suggested by the author is that servitized firms usually have higher average labor costs, working capital and net assets. There are also some practical examples of firms that were unsuccessful in their service strategies, such as Intel's move to Web-based services and Boeing's proposal of financial services (FANG; PALMATIER; STEENKAMP, 2008; SAWHNEY; BALASUBRAMANIAN; KRISHNAN, 2004). The extant literature talks about a *service paradox*, when the servitization investments fail to generate the expected returns (GEBAUER; FLEISCH; FRIEDLI, 2005).

Besides knowing *whether* servitization and performance are related to each other, it is still not clear *how* they are correlated (BENEDETTINI; SWINK; NEELY, 2013). There are

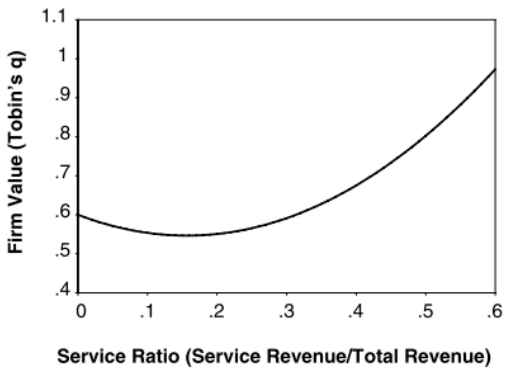
some recent studies analyzing this correlation and the results show a complex relationship. Different authors propose a U-shaped relationship between service sales and firm performance. Fang, Palmatier and Steenkamp (2008) found that only when the level of service sales achieve a critical mass (about 20-30% of total sales) the relationship with firm value becomes pronounced. Suarez, Cusumano and Kahl (2013) found a same non-linear relationship when analyzing 464 US software firms from 1990 to 2006; however, the authors argue that the additional services have a positive effect on profit margins when services achieve about 56% of total sales. Kohtamäki et al. (2013), analyzing the relationship between industrial service offerings and sales growth, found a similar U-shaped curve, with an inflection point around 33-83% of service offering levels. Kastalli and Van Looy (2013) suggest a cubic relationship between service sales scale and profitability, with two inflection points (instead of a quadratic/U-shaped curve): there is a sharp increase in profitability at low levels of service provision, followed by a period of stability and then profitability re-emerges. Similar to the previous studies, the authors recognize the initial gain, but suggest that servitization strategies are feasible only when economies of scale are reached, compensating the investments in service capability. The Figure 1 below is a good representation of these non-linear relationships between service provision and firm performance/value found by different authors.



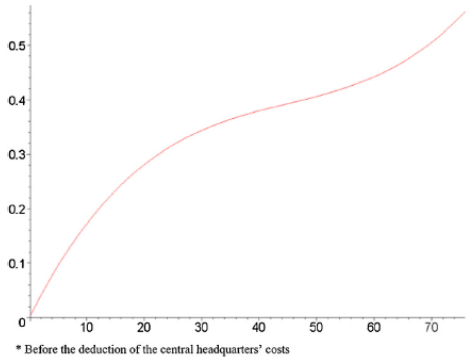
Suarez, Cusumano, & Kahl (2013)



Kohtamäki et al. (2013)



Fang, Palmatier, & Steenkamp (2008)



Kastalli & Van Looy (2013)

Figure 1 - Relationship between servitization and firm performance/value

For both curvilinear behaviors (quadratic and cubic), a possible explanation is that at the beginning, despite the low scale, there are some proactive customers *ready to pay* for the new service offerings, what brings positive returns (KASTALLI; VAN LOOY, 2013). At a second moment, when investments are combined with a low scale of services, the margins are expected to decrease (VISNJIC; WIENGARTEN; NEELY, 2014). Finally, as the investments are internalized and a higher scale is achieved, positive margins are visible again (FANG; PALMATIER; STEENKAMP, 2008; KASTALLI; VAN LOOY, 2013; SUAREZ; CUSUMANO; KAHL, 2013). Furthermore, some authors emphasize the positive learning effects resulted from accumulating levels of service over time, which may contribute to improve returns (KASTALLI; VAN LOOY, 2013; VISNJIC; WIENGARTEN; NEELY, 2014). Martinez et al. (2010) also suggest that it may be only in the long run that the servitization strategy will bring the expected returns, so it takes time for service strategies to bring firm profitability up.

Based on this effect, there is a risk of manufacturing managers to discard service activities precipitately when they face the reduction on profit margins after a promising beginning (GEBAUER; FLEISCH, 2007; KASTALLI; VAN LOOY, 2013). Therefore, Kastalli and Van Looy (2013) highlight the importance of estimating the potential of service business in advance, making sure that it will be possible to overcome the investment hurdles. After all, services investments are a prerequisite for growth when firms start to expand their service offerings, being necessary to invest, for example, in information systems, sales force and service structures (VISNJIC; NEELY; WIENGARTEN, 2012). Besides, Suarez, Cusumano and Kahl (2013) suggest that product firms should continue to offer services, even when worsening the overall profit margin, because service offerings can reduce customer reluctance to buy and use the company products, as well as help managers to learn more about customer needs. Alternatives proposed by Fang, Palmatier and Steenkamp (2008) to overcome this hurdle more quickly are: accelerating the growth of service levels via aggressive service prices or acquisition of ongoing service businesses; hiring experienced managers to coordinate the process; and, separating product and service teams or defining incentives that boost cooperation in order to reduce organizational conflict.

Crozet and Milet (2015) have achieved different results from previous authors, suggesting that servitization is related to better performance, even when the service ratio is low,

and that this correlation does not increase with higher shares of services. Actually, the authors found that for service levels below 30%, the premia is higher than for high levels, with servitized firms generating almost 20% more revenue than non-servitized ones. Therefore, the authors propose that the decision to start selling services is more important than the level of services provided.

Besides analyzing the relationship between service ratio/service scale and firm results, other authors have considered different independent variables, among them: size of the service portfolio and effort in developing the service business. Neely (2009) found that the size of the service portfolio, measured by the number of services offered, has a negative impact on firm performance. Visnjic, Neely and Wiengarten (2012), referring to the number of services offered as *service breadth*, have also identified a negative effect of increasing it, and recommend firms to stay focused on a selected portfolio. Likewise, in a study with 46 servitized firms that declared bankruptcy and 146 matched survivors, Benedettini, Swink and Neely (2013) found that successful firms appear to offer a smaller number of service types than unsuccessful ones. However, the authors bring attention to the fact that a broader service portfolio may be a symptom of troubled firms trying to increase revenue opportunities, instead of a cause of failure.

In contrast, Oliva, Gebauer and Brann (2012) found that a higher number of services allows for the development of deeper customer relationships, what consequently increases the service business profitability. However, this broader range of services does not affect the service non-financial performance. The authors suggest different explanations for this finding, among them: customers may only require specific services, not experiencing the whole portfolio; offering a wide range of services does not guarantee that the service is being provided with quality; and, a high variety may cause confusion to the customer.

In a more comprehensive analysis, Tian et al. (2012) found that the impact of the number of services on firm performance depends on the level of service capability. The authors verified that, when provided with better capabilities, firms improve performance by extending their service offerings. In contrast, without the necessary capabilities, the inclusion of more service offerings erodes the firm performance.

Regarding the relationship between effort in developing the service business and firm results, Gebauer and Fleisch (2007) have found a positive correlation, suggesting that service revenue and overall profitability are enhanced when investments are done in service business. To do so, managers must overcome some typical behaviors of manufacturing firms in order to be motivated to invest in the new business.

These diverting findings for the relationship between servitization level (measured by service ratio, number of services provided or effort in developing the service business) and firm performance confirm the limited understanding of the topic by researchers and practitioners.

2.3 THE MODERATING EFFECT OF FIRM CHARACTERISTICS

Besides the relevance of understanding *whether* and *how* servitization affects firm performance and/or value, it is important to identify *in what conditions* this relationship is more significant. The impact of servitization on performance/firm value seems to be highly influenced by internal factors.

In this study, the moderating effects of the following firm characteristics were tested: (a) firm size (based on number of employees and sales revenue), (b) firm age, and (c) level of country development. The main findings of previous studies that analyzed the impact of these factors on the relationship between servitization and firm performance are described in the following paragraphs.

2.3.1 Firm size

In a study covering 25 countries, Neely (2009) identified a tendency of larger firms to servitize more than smaller firms; this relationship was confirmed both in terms of number of employees and sales revenues. When comparing manufacturing firms that have servitized with pure manufacturing firms, the author identified that just in the top decile (in terms of sales revenues), the number of servitized firms surpass the number of traditional ones; in the other deciles, about one third of firms have servitized. This analysis is presented in the Figure 2 below, developed by the author. Crozet and Milet (2015) also identified that the servitized firms are larger (in terms of total production and employment).

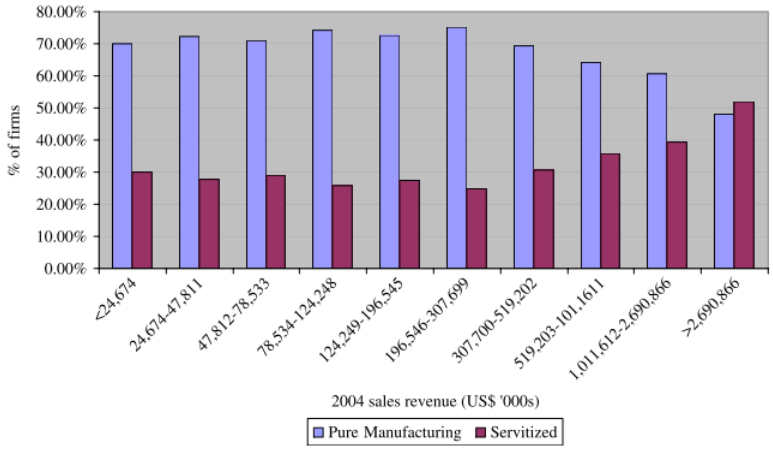


Figure 2 - Relationship between firm size (in sales revenue) and servitization

In order to identify the moderating effect of firm size, Neely (2009) compared servitized firms with pure manufacturing counterparts, and found that the relationship between servitization and profit as a percentage of sales is statistically significant for smaller firms (up to 3,000 employees). For the largest firms, the author found that pure manufacturing firms have a higher profit as a percentage of sales than servitized firms. The author emphasizes that it does not mean that larger firms should not servitize; it suggests that larger firms seem to face more difficulties to achieve the expected financial benefits with servitization. Crozet and Milet (2015) agree that the positive effects of servitization are more visible for small firms. In contrast, in a study with 46 servitized firms that declared bankruptcy and 146 matched survivors, Benedettini et al. (2013) found that successful servitized firms tend to be larger than unsuccessful ones, suggesting that the larger firms have an advantage over the smaller ones. Similarly, Böhm, Eggert and Thiesbrummel (2017) found that only larger firms achieved revenue growth when adopting a service strategy to overcome a financial crisis, suggesting that large-sized firms have more favorable conditions for success.

2.3.2 Firm age

Regarding firm age, Benedettini, Swink and Neely (2013), in a study that compared 46 servitized firms that declared bankruptcy and 146 matched survivors, found that successful servitized firms tend to be older than unsuccessful ones. However, this result must be considered as tentative due to the level of significance obtained in the statistical test. The authors explain that extant literature about bankruptcy and its dependence on age presents

mixed results: while some authors argue that older firms are favored, others found an increase in bankruptcy rates with age or even an inverted U-shaped relationship.

2.3.3 Level of country development

Neely (2009) suggests that there are more servitized firms in highly developed economies than in developing countries; the author understands that it is aligned with previous discussions about the necessity of developed economies to move up the value chain. The author found that the country with the highest level of servitization in 2007 was the United States, with a scale of 57.68% of servitization. In contrast, China presented the lowest level, with less than 1% of manufacturing firms involved in this process. Repeating the study in 2011, Neely, Benedettini and Visnjic (2011) verified that the level of servitization barely changed from 2007 to 2011 for many countries. The most relevant shift occurred in China, which moved from less than 1% of servitization in 2007 to 19.33% in 2011. Similarly, Amaral et al. (2017) compared firms in a developing country (Brazil) with a developed one (Italy) and found that firms in Brazil had a more expressive advancement in the service continuum, despite the fact that product revenue is still predominant in both economies.

Analyzing the relationship between scale of services and profitability, Kastalli and Van Looy (2013) defined a control for the level of development of the firm's country market, measured by the Gross National Product (GNP) per capita. The authors found that market development and country-specific differences have a strong and significant influence on the original relationship.

2.4 CONCEPTUAL MODEL

A conceptual model that summarizes the study constructs was developed and is summarized in the Figure 3 below. The effort on developing the service business positively affects the servitization level, which consequently exerts a direct and positive influence on firm performance. Besides, firm characteristics, such as firm size, firm age and country development, are expected to moderate the relationship between servitization level and firm performance.

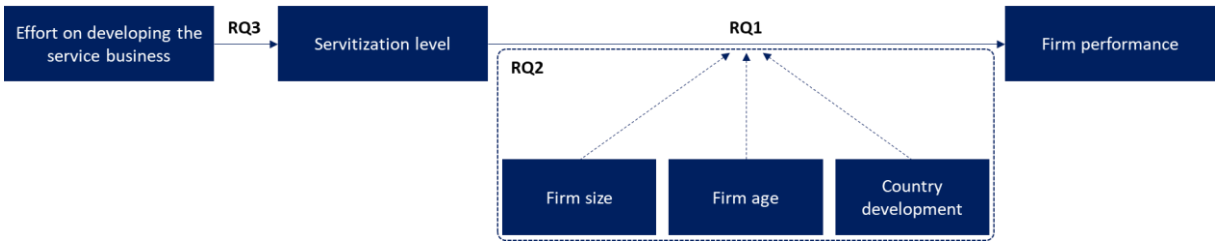


Figure 3 - Conceptual model

On one hand, the Research Questions 1 and 2 are more related to the concept of PSS and operationalization of the service business, in which the expansion of the service offerings is expected to bring positive results for the firm performance. On the other hand, the Research Question 3 explores servitization as an innovative transition, in which the investments and efforts on developing the service business are expected to increase the service level. The detailing of each research hypothesis is described in the following chapter.

3 RESEARCH DESIGN

3.1 RESEARCH HYPOTHESES

The research hypotheses were developed based on the three main research questions and objectives of this study: validating the relationship between servitization level and firm performance, identifying the moderating effects that influence on this relationship and verifying the significance of an antecedent.

- Research Question 1: Is the servitization level associated to better firm performance? A combination of two servitization level metrics (intensity of services provided and service ratio) and three firm performance indicators (sales increase, ROS and ROS increase) will be tested, totalizing six H1 sub-hypotheses. The variable to represent the intensity of services provided will be created by a manipulation of an IMSS answer. In the survey, respondents had to indicate, in a Likert scale (1-5), to what extent the following services are offered alongside with the products by the business unit: 1) Maintenance and repair of products sold to customers; 2) Installation/implementation services; 3) Rental/lease of products (with responsibility for maintenance, repair and operation); 4) Product upgrades (software, product modifications); 5) Help desk/customer support centre; 6) Training in using the products; 7) Consultancy services; 8) Spare-parts/consumables provision for customers. Therefore, the variable for the intensity of services provided will be calculated by the sum of the answers (totalizing from 8 to 40).
- Hypothesis 1: There is a positive and significant relationship between servitization level and firm performance.
    - H1a (X1-Y1): There is a positive and significant relationship between the intensity of services provided and sales increase.
    - H1b (X1-Y2): There is a positive and significant relationship between the intensity of services provided and ROS.
    - H1c (X1-Y3): There is a positive and significant relationship between the intensity of services provided and ROS increase.
    - H1d (X2-Y1): There is a positive and significant relationship between the service ratio and sales increase.

- H1e (X2-Y2): There is a positive and significant relationship between the service ratio and ROS.
- H1f (X2-Y3): There is a positive and significant relationship between the service ratio and ROS increase.

Adopting the variables that more relevantly represent the relationship between servitization and firm performance, the hypothesis 2 will be tested.

- Research Question 2: Do firm characteristics exhibit significant moderating effects on the relationship between servitization and firm performance? The moderating effects of firm size (based on number of employees and sales revenues), firm age and level of development of plant country will be analyzed individually, totaling four H2 sub-hypotheses. The variable to represent the level of development of plant country will be created by a manipulation of an IMSS answer. Based on the plant country indicated in the survey, the level of country development will be defined according to the country Human Development Index (HDI)[1]. Despite the fact that Kastalli and Van Looy (2013) have used the Gross National Product (GNP) per capita to control for the level of development, we decided to use the HDI. We consider that it is a more comprehensive metric for the level of development of a country since it includes other factors besides the economic position.
- Hypothesis 2: Firm characteristics positively moderates the effect of servitization on firm performance.
  - H2a (M1): Firm size (number of employees) positively moderates the effect of servitization on firm performance.
  - H2b (M2): Firm size (sales revenues) positively moderates the effect of servitization on firm performance.
  - H2c (M3): Firm age positively moderates the effect of servitization on firm performance.
  - H2d (M4): Level of development of plant country positively moderates the effect of servitization on firm performance.

[1]HDI is the best indicator of the development of a country, assessing health (life expectancy), education (years of schooling) and standard of living (gross national income per capita) (UNDP, 2017).

- Research Question 3: Does the effort put on developing the service business have an antecedent effect on the servitization level? The variable to represent the effort put on developing the service business will be created by a manipulation of an IMSS answer. In the survey, respondents had to indicate, in a Likert scale (1-5), the effort put in the last three years in implementing each one of the following activities: 1) Expanding the service offering to your customers (e.g. by investing in new service development); 2) Developing the skills needed to improve the service offering; 3) Designing products so that the after sales service is easier to manage/offer (e.g. design for maintenance). Therefore, the variable for the effort put on developing the service business will be calculated by the sum of the answers (totalizing from 3 to 15), and one hypothesis was defined.
- Hypothesis 3 (H3): There is a positive and significant relationship between the effort put on developing the service business and the servitization level.

The Figure 4 below summarizes the hypotheses that will be tested in this study.

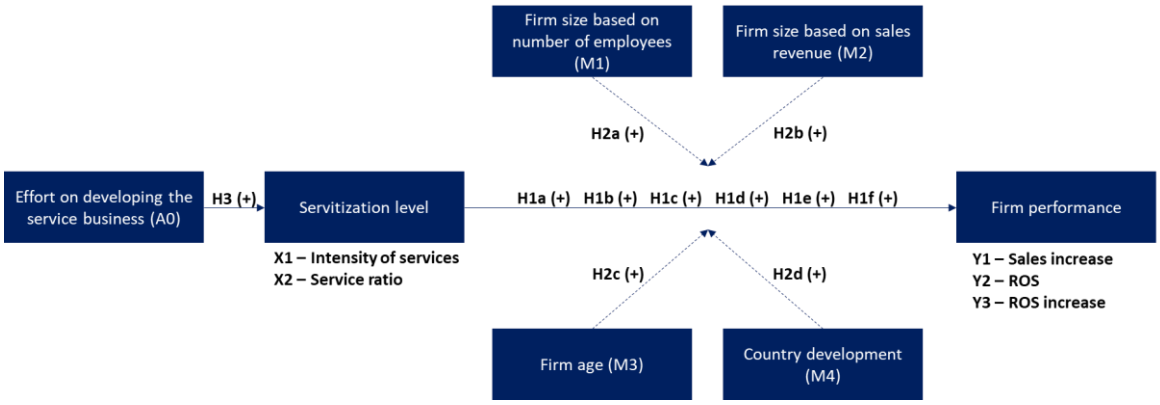


Figure 4 - Summary of research hypotheses

3.2 SAMPLE

The main benefit of using IMSS as a sample for this study is that participant firms personally provide data regarding the service business (% of sales derived from services, types of services provided, etc), different from other surveys that depend on the researchers' interpretation of annual reports, what may be more susceptible to misinterpretations.

Regarding the IMSS methodology (MANUFACTURING STRATEGY, 2017), the first step is designing the survey questionnaire. The main questions remain similar to previous

editions to allow for longitudinal comparisons. However, new questions are inserted to reflect evolving strategies and practices. Secondly, the questionnaire is tested with some pilot companies. Thirdly, when necessary, the questionnaire is translated to local languages and send out to companies. Each partner is responsible for coordinating the data collection in its own country, being also accountable for quality issues (sample selection, bias, etc). Finally, responses are compiled in a shared database. Conde (2015) explains that industrial managers and directors of the metal-mechanic factories are responsible for filling the survey, and each questionnaire refers to one specific factory, thus the same company may have filled more than one questionnaire.

Eligible companies to participate in the IMSS survey are those in the metal-mechanic industry, with the International Standard Industrial Classification (ISIC)[2] codes between 25 and 30, as detailed in the **Erro! Fonte de referência não encontrada.** below (MANUFACTURING STRATEGY, 2017).

Table 2 - Economic activity of IMSS participants

ISIC Code	Description
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment not elsewhere classified
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment

According to the survey website (MANUFACTURING STRATEGY, 2017), this industry was selected due to the following three main reasons:

- Financial and competitive robustness;
- Higher propensity to adopt advanced manufacturing practices;
- Possibility of more meaningful comparisons and benchmarks among different countries.

In regard to the last point, Tian et al. (2012) also reinforces that restricting the survey to the machine industry is crucial as the international coverage of the study already causes a lot of variations. Besides, due to the comprehensiveness of the questionnaire, it is more relevant to be industry specific.

[2]The ISIC is a classification developed by ONU to identify businesses according to their main economic activity.

Among the advantages of focusing in this industry, Oliva and Kallenberg (2003) complement that the maturity of the machine manufacturing industry, with low rates of market growth and innovation, stimulates the provision of services as a way to enhance profitability.

From the total of 931 answers received for the VI edition of IMSS, some filters were conducted for this study, among them:

- In case of missing data for any of the dependent or independent variables considered in the study, the plant was removed from the analysis (see research variables in the next section).
- The 6 plants with less than 19 employees – micro enterprises, according to (SEBRAE, 2013) – were disregarded. We believe that plants with this limited size would not have conditions to set official servitization programs.
- Outliers were also removed from the analysis. According to Hair Jr. et al. (2010), outliers should not be categorized as beneficial or problematic, and should be individually assessed to define whether their influence is helpful or harmful to the analysis, being respectively maintained or deleted. However, as this study is based on secondary data, it was not possible to explore each case individually, so that the researchers opted for disregarding all outliers. Despite limiting the study generalizability, it avoids distortions in the statistical tests, improving the multivariate analysis. Tukey (1977) was the first to define a rule of thumb for dealing with outliers and argued that the difference between the third quartile and the first quartile should be multiplied by a constant of 1.5 to define the outlier limits. Hoaglin and Iglewicz (1987) question this rule and propose a multiplier of 2.2, which was adopted in this study.

Some modifications were also necessary. For the purposes of this study, it is more interesting to analyze the plant age instead of the year of plant foundation, which was requested in the survey. Therefore, the age of plants was calculated by the difference between 2014 (year of IMSS research conclusion) and the provided plants' year of foundation. (This adjustment was not necessary for Japanese enterprises, which already provided the plant age in the survey.)

After conducting these filters and adjustments, the research sample included 539 responses, what represents 58% of the original sample. Hair Jr. et al. (2010) argue that multiple regression analysis require a minimum sample of 50 observations and preferably 100, what is achieved in this study. The following paragraphs explore the profile of the respondent plants considered in this research.

Even after the filtering, the sample maintained 22 analyzed countries; the participation of each country is presented in Table 3. For the purpose of this study, the participant countries were also categorized by their level of development based on their Human Development Index (HDI), calculated by the United Nations Development Programme (UNDP).

Table 3 - Respondents per country

Country	Quantity	%	HDI	Level of Country Development
China	60	11%	0.727	High
India	49	9%	0.609	Medium
Japan	48	9%	0.891	Very High
Hungary	40	7%	0.828	Very High
Netherlands	32	6%	0.922	Very High
Romania	30	6%	0.793	High
Finland	28	5%	0.883	Very High
Italy	27	5%	0.873	Very High
Canada	25	5%	0.913	Very High
Denmark	24	4%	0.923	Very High
USA	24	4%	0.915	Very High
Brazil	20	4%	0.755	High
Belgium	19	4%	0.890	Very High
Portugal	19	4%	0.830	Very High
Norway	16	3%	0.944	Very High
Slovenia	15	3%	0.880	Very High
Spain	15	3%	0.876	Very High
Sweden	14	3%	0.907	Very High
Switzerland	14	3%	0.930	Very High
Malaysia	8	1%	0.779	High
Germany	7	1%	0.916	Very High
Taiwan	5	1%	0.882	Very High
Total	**539**	**100%**		

As detailed in Table 4, the majority of the respondent countries sustain a very high level of development, and countries with low level are not included in IMSS. The participation of developing countries such as Brazil, India and China contributes for filling gaps in the literature.

Table 4 - Respondents per level of country development

HDI	Quantity	%
Medium	49	9%
High	118	22%
Very High	372	69%
Total	**539**	**100%**

Analyzing the age of the participant plants, the majority of them had between 11 and 50 years old when the IMSS survey was finalized (2014). The detailing of the age distribution of participants is described in the Table 5 below.

Table 5 - Respondents per age

Age	Quantity	%
2-10	55	10%
11-50	349	65%
51-100	127	24%
More than 101	8	1%
Total	**539**	**100%**

Regarding the size of the participants, both the number of employees and the sales revenue level can be considered. The respondents were categorized in large, medium and small based on the number of employees, according to a classification proposed by Sebrae (2013), as presented in Table 6; the distribution based on the sales revenue is shown in Table 7.

Table 6 - Respondents per size (number of employees)

Size	# Employees	Quantity	%
Small	20-99	132	24%
Medium	100-499	267	50%
Large	> 500	140	26%
Total		**539**	**100%**

Table 7 - Respondents per level of sales revenues

Sales (in Million €)	Quantity	%
< 10	127	24%
10-50	228	42%
50-100	84	16%
100-500	79	15%
> 500	21	4%
Total	**539**	**100%**

The diverting demographics of the sample favors the comparisons between study variables, which are detailed in the next section.

3.3 QUESTIONNAIRE AND OPERATIONALIZATION OF VARIABLES

In order to test the hypotheses about the relationship between servitization and firm performance (H1), the moderator effect of firm characteristics (H2) and the impact of the effort put on the service business on the servitization level (H3), the association between different IMSS variables will be analyzed, as proposed in the Research Hypotheses section.

The detailed information about all the variables included in this study is presented in the Table 8 below.

Table 8 - Research variables

Nature of Variables	Variables		IMSS Variables and Codes	Measurement	Mean	Std dev.	Minimum	Median	Maximum
Dependent Variables	Firm Performance (Y)	(Y1) Sales Increase	A4b - Sales (compared to 3 years ago)	Likert scale: much lower (1) to much higher (5)	3.20	1.02	1	3	5
		(Y2) Return on Sales	A4c - Return on Sales (%)	Close-ended question: < 0%; 0-5%; 5-10%; 10-20%; > 20%	2.95	1.01	1	3	5
		(Y3) Return on Sales Increase	A4d - Return on Sales (compared to 3 years ago)	Likert scale: much lower (1) to much higher (5)	2.92	0.97	1	3	5
Independent Variables	Servitization Level (X)	(X1) Intensity of services provided	S1 - Services offered by the business unit (manipulated)	Likert scale: none (1) to high (5), for a list of 8 services Manipulation: sum of the intensity of each service provided (totalizing 8-40)	21.72	7.71	8	22	40
		(X2) Service ratio	S2 - Percentage of sales based on sales of services	Open question: % of total sales	8.19	9.95	0	5	45
Moderators	Firm Characteristics (M)	(M1) Size based on number of employees	A1 - Size of the business unit (# of employees in 2012)	Open question: number	406.53	498.86	26	202	2500
		(M2) Size based on sales revenue	A4a - Sales (Million €)	Close-ended question: < 10; 10-50; 50-100; 100-500; > 500	2.33	1.11	1	2	5
		(M3) Age	Introduction - Year of plant establishment	Open question: year (converted to plant age)	37.87	25.19	3	31	124
		(M4) Level of country development	Introduction - Plant Country (manipulated)	Open question: country Manipulation: identification of level of country development based on HDI	2.60	0.65	1	3	3
Antecedent	Effort	(A0) Effort put on service	S3 - Effort put in the last 3 years into developing the service business (manipulated)	Likert scale: none (1) to high (5), for 3 actions Manipulation: sum of the level of effort on each action (totalizing 3-15)	8.67	2.99	3	9	15

A correlation matrix for these variables is presented in Table 9.

Table 9 - Variables correlations

Variables	Y1	Y2	Y3	X1	X2	M1	M2	M3	M4
Y2_ROS	.236**								
Y3_ROS increase	.456**	.320**							
X1_Intensity of services	.147**	.103*	.166**						
X2_Service ratio	0.020	0.069	0.070	.469**					
M1_Size (employees)	0.026	0.055	-0.033	-0.008	0.035				
M2_Size (sales revenue)	.121**	.121**	.090*	0.049	0.066	.458**			
M3_Age	-.163**	-0.057	-0.081	-0.020	0.013	0.021	.157**		
M4_Country development	-.109*	-.085*	-.100*	-.268**	-.231**	-0.075	.086*	.236**	
A0_Effort on service	.147**	.155**	.189**	.545**	.336**	-0.038	0.05	-.087*	-.261**

As expected, the independent variables (Y) are highly correlated between them, since all of them represent metrics of firm performance. Likewise, both X1 and X2 indicate the servitization level and are also significantly correlated. For these reasons, individual models for each combination of X and Y will be developed. The objective is identifying the relationship with the highest significance. Besides, some moderators are also correlated between them, so that their effects are also analyzed individually. The models development is explained in the next section.

3.4 DATA ANALYSIS

Regression models, using the SPSS software, were developed to analyze the relationship between servitization and firm performance, the moderator effect of firm characteristics, and the antecedent effect of effort put on the service business. The variables that belong to the interval scale category were treated as continuous metrics to make the study feasible.

The first step in data analysis was identifying the dependent (firm performance) and independent (servitization level) variables that presented the most significant linear relationship. To test it, linear regressions were modeled for each of the six combinations (three firm performance metrics and two servitization metrics), as the following:

$$\text{H1-linear: } Y = b_0 + b_1X_1$$

where

Y = firm performance

b_0 = intercept

b_1X_1 = linear effect of the independent variable

After identifying the dependent and independent variables that best represented the relationship between servitization and firm performance (H1), quadratic and cubic components were added to the model to identify the occurrence of a curvilinear effect. As explained in the Literature Review, even those authors that have identified a curvilinear effect have divergent views. While some authors found a quadratic relationship with different inflexion points, others identified a cubic correlation. In order to explore this point, a hierarchical regression analysis was conducted, according to:

$$\text{H1-linear: } Y = b_0 + b_1X_1$$

$$\text{H1-quadratic: } Y = b_0 + b_1X_1 + b_2X_1^2$$

$$\text{H1-cubic: } Y = b_0 + b_1X_1 + b_3X_1^3$$

where

Y = firm performance

b_0 = intercept

b_1X_1 = linear effect of the independent variable

$b_2X_1^2$ = quadratic effect of the independent variable

$b_3X_1^3$ = cubic effect of the independent variable

According to Hair Jr. et al. (2010), if the change in R^2 is statistically significant, then a curvilinear effect is present.

Based on H1 results, the moderating effects were added to the model. Considering a linear relationship between servitization level and firm performance, the moderating effects were measured as below for each moderating hypothesis (H2):

$$\text{H2: } Y = b_0 + b_1X_1 + b_2X_2 + b_3X_1X_2$$

where

Y = firm performance (ROS)

b_0 = intercept

b_1X_1 = linear effect of independent variable

b_2X_2 = linear effect of moderating variable

$b_3X_1X_2$ = moderator effect of moderating variable on independent variable

The significance of the moderator effect coefficient (b_3) indicates whether the moderating effect is present or not (HAIR JR. et al., 2010).

Finally, after validating the relationship between servitization and firm performance, we tested the significance of an antecedent variable, analyzing the relationship between the effort put on developing the service business and the servitization level. For this test, a simple regression model was developed, as the following:

$$H3: Y = b_0 + b_1X_1$$

where

Y = servitization level

b_0 = intercept

b_1X_1 = linear effect of the independent variable (effort put on service)

The results for these tests are presented in the next chapter.

4 FINDINGS

In this chapter, the results of the research hypotheses are presented and analyzed, based on the statistical tests indicated in the previous chapter.

4.1 HYPOTHESIS 1

Table 10 presents the results for Hypothesis 1, which tested the relationship between the servitization level and firm performance. As explained in the previous chapter, a combination of two independent and three dependent variables were tested, totalizing six models.

Table 10 - Results of the relationship between servitization and firm performance

Independent/Dependent	Y1_Sales increase	Y2_ROS	Y3_ROS increase
X1_Intensity of services	**H1a (X1-Y1)**	**H1b (X1-Y2)**	**H1c (X1-Y3)**
Adjusted R^2	0.020	0.009	0.026
P-value	0.001	0.017	0.000
X2_Service ratio	**H1d (X2-Y1)**	**H1e (X2-Y2)**	**H1f (X2-Y3)**
Adjusted R^2	-0.001	0.003	0.003
P-value	0.647	0.112	0.104

Considering a significance level of 5%, the intensity of services offered present a significant relationship with all dependent variables, while the service ratio is not significant correlated to any of them. In a significance level of 1%, the intensity of services is still significantly associated to the increase of sales and increase of ROS in the last three years. However, in all cases, the adjusted R^2 is smaller than 3%, what indicates a reduced explanatory power of the models.

As described in the research methodology, the model selected for conducting the next analysis would be the one that best represents the relationship between servitization and firm performance. For this reason, the model that correlates the intensity of services offered and the ROS increase was chosen – H1c (X1-Y3).

The next step was analyzing the presence of a nonlinear relationship through a hierarchical analysis.

Table 11 below presents the results for the quadratic analysis, in which Model 1 represents the linear relationship and Model 2 is the quadratic model. As observed in the

"Significance F Change" column, the change for Model 2 is not significant (p-value > 0.05), confirming that the relationship between the two variables is better represented by the linear model.

Table 11 - Results of a quadratic analysis (Intensity of services vs ROS increase)

	Model Summary	Change Statistics		
Model	**Adjusted R^2**	**R^2 change**	**F change**	**Sig. F change**
1 Linear	0.026	0.027	15.163	0.000
2 Quadratic	0.027	0.003	1.768	0.184

Sequentially, we analyzed the possibility of a cubic association, as presented in the Table 12 below. Likewise, Model 1 represents the linear relationship and Model 2 is the cubic model. "Significance F Change" column presents a non-significant change for Model 2 (p-value > 0.05), reinforcing that the relationship between the two variables is better represented by the linear model.

Table 12 - Results of a cubic analysis (Intensity of services vs ROS increase)

	Model Summary	Change Statistics		
Model	**Adjusted R^2**	**R^2 change**	**F change**	**Sig. F change**
1 Linear	0.026	0.027	15.163	0.000
2 Cubic	0.027	0.003	1.617	0.204

4.2 HYPOTHESIS 2

After validating the linear relationship between servitization (represented by the intensity of services offered) and firm performance (represented by the ROS evolution in the last 3 years), we analyzed the influence of moderators in this relationship. It is important to point out that we created *centered* product terms to control for multicollinearity between the independent variables and the moderator. First of all, we created a centered value for the intensity of services by subtracting the original values by the variable mean. The same step was done for each moderating variable (size based on number of employees, size based on sales revenue, age, and country development), subtracting their original values by their mean. Finally, we created the centered moderators by multiplying the centered intensity of services by each one of the centered moderating variables.

Table 13 below summarizes the significance of each moderator. The level of country development is the only moderator whose impact in the relationship between servitization and

firm performance is significant. The adjusted R^2 of the model changes from 2.6% without the moderator to 4.1% when under its influence.

Table 13 - Moderating effects (Intensity of services vs ROS increase)

Moderator	Significance
M1_Size_employees	**H2 (M1)**
Adjusted R^2 (model)	0.023
P-value (moderator)	0.855
M2_Size_sales	**H2 (M2)**
Adjusted R^2 (model)	0.029
P-value (moderator)	0.560
M3_Age	**H2 (M3)**
Adjusted R^2 (model)	0.028
P-value (moderator)	0.747
M4_Country_development	**H2 (M4)**
Adjusted R^2 (model)	0.041
P-value (moderator)	0.004

The identified beta for the country development moderator (β=-.137) indicates its negative effect. In order to clarify its impact, we plotted in a scatterplot (Figure 5) the relationship between the intensity of services (centered) and ROS increase under the influence of the three levels of country development (medium, high and very high).

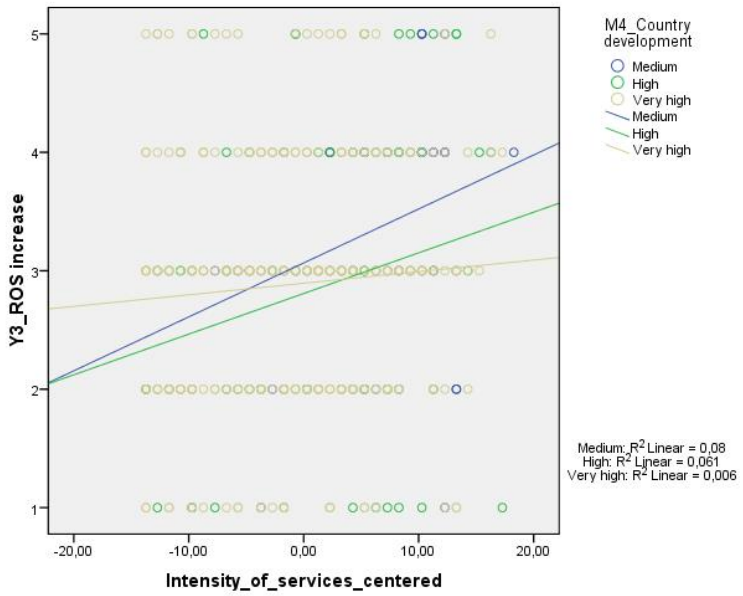


Figure 5 - Moderating effect of level of country development (Intensity of services vs ROS increase)

This graph indicates that the lower the level of country development, the stronger is the relationship between servitization level and firm performance. The blue line, which represents countries with a medium level of development, present a higher correlation between servitization level and firm performance than those countries with a very high level of development (yellow line).

Aiming to explore this influence of the level of country development, the relationship between servitization level and firm performance was analyzed in three segregated groups: firm in countries with a medium level of country development, firms in countries with a high level of country development, and firms in countries with a very high level of country development. The objective was to control for the level of country development. This analysis confirmed the finding that the relationship between servitization level and firm performance is highly influenced by the level of country development. While this relationship is significant for firms in mid- and high-developed countries, it is not significant for firms in very high-developed countries, as presented in the Table 14 below.

Table 14 - Intensity of services vs ROS increase, controlling for the level of country development

Level of Country Development	Significance
Medium	
Adjusted R^2	0.061
P-value	0.048
High	
Adjusted R^2	0.053
P-value	0.007
Very High	
Adjusted R^2	0.004
P-value	0.129

When doing a country aggregate analysis, investigating the differences between the countries' averages, the low significance of the relationship between servitization and firm

performance is again evident for very high-developed countries. As presented in the

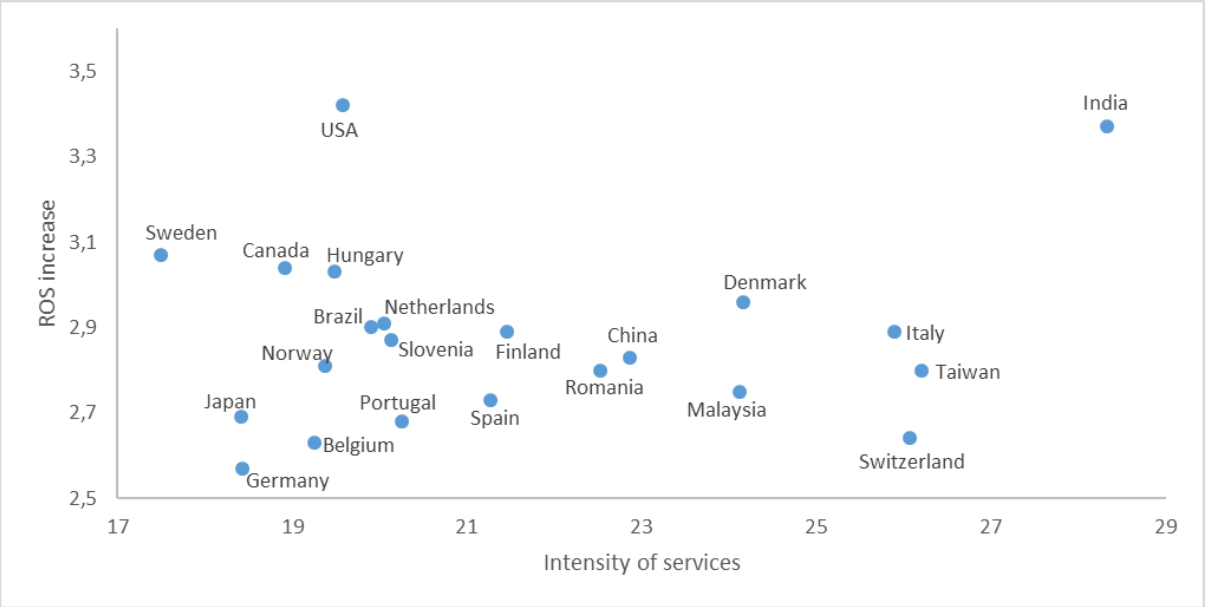


Figure *6* below, there are very high-developed countries with low servitization level and high firm performance (such as USA, Sweden, Hungary and Canada), as well as countries with high servitization level and low firm performance (such as Taiwan, Switzerland and Italy).

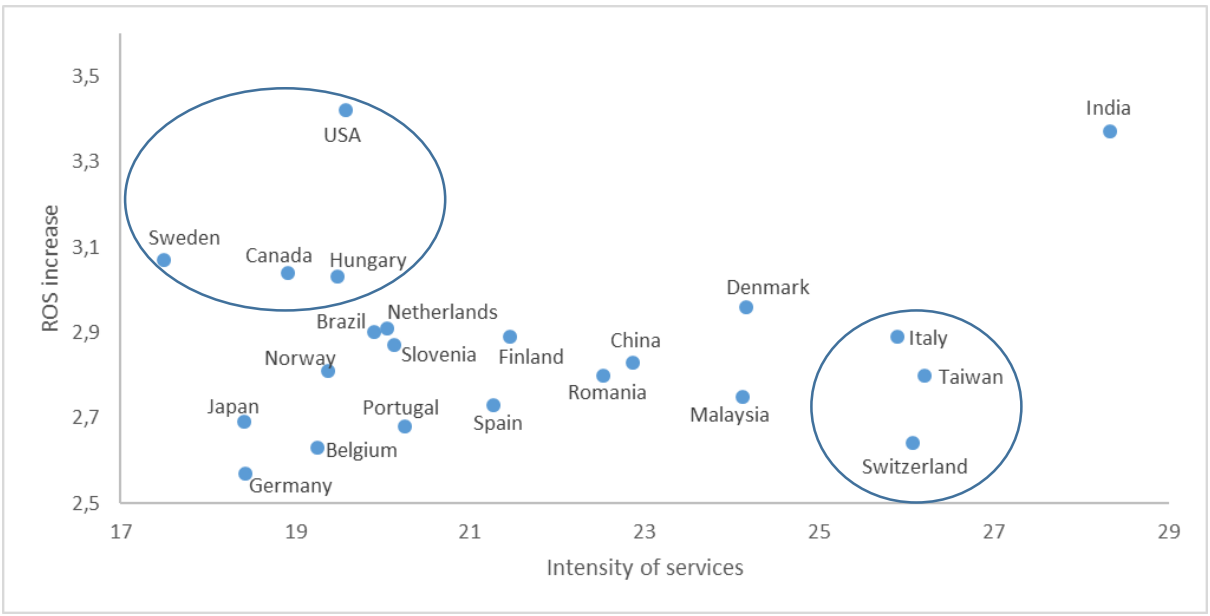


Figure 6 - Intensity of services vs ROS increase (countries' average)

4.3 HYPOTHESIS 3

The final step was analyzing the relevance of an antecedent variable, exploring the relationship between the effort put on developing the service business and intensity of services,

which was the defined proxy for the servitization level. In Table 15, we present the results for the model that tested this linear relationship (H3).

Table 15 - Results of the relationship between effort on service and servitization level

Antecedent	X1_Intensity of services
A0_Effort on service	H3
Adjusted R^2	0.296
P-value	0.000

At the significance level of 1%, there is a significant relationship between the dependent and independent variables. An adjusted R^2 of approximately 30% indicates the high explanatory power of this regression equation, confirming the soaring correlation between the effort put on developing service programs and the intensity of services provided.

4.4 TEST OF ASSUMPTIONS

Finally, it is important to test the assumptions of the model in order to draw (generalize) conclusions to a wider population (FIELD, 2005). Draper and Smith (1966, p. 86) explain that "the usual assumptions are that the errors terms are independent, have zero mean, a constant variance, and follow a normal distribution". The risk of gross violations to these assumptions is to produce a model that can return different results and lead to opposite conclusions when conducted with different samples (MONTGOMERY; PECK, 1992).

Firstly, we confirmed that there is no high correlation between two or more independent variables, as shown on Table 16. It validates the independency of the error terms and ensures that there is no perfect multicollinearity between variables. As presented previously in this chapter, the creation of *centered* variables controls from multicollinearity issues. Besides, the collinearity statistics tests also confirm the absence of multicollinearity between variables, as presented in the Table 17 below. The tolerance values are higher than 0.1 and the VIF (Variance Inflation Factor) is not higher than 3.

Table 16 - Correlation between independent variables

Variables	Intensity of services (centered)	Country development (centered)

Country development (centered)	-0.268	
Intensity of services (centered) * Country development (centered)	-0.081	0.430

Table 17 - Multicollinearity between independent variables

Variables	Tolerance	VIF
Intensity of services (centered)	0.927	1.079
Country development (centered)	0.760	1.316
Intensity of services (centered) * Country development (centered)	0.813	1.229

Secondly, aiming to certify that the error terms have zero mean and a constant variance, we tested for homoscedasticity, analyzing the behavior of the error terms in a scatterplot between the predicted dependent variable and the standardized residuals, as presented in the Figure 7 below. Likewise, we conducted the same process for the independent variable (Figure 8). The descending behavior in both graphs is probably due to the discrepancies between countries, since the data is ordered/grouped by country. This effect does not influence on the validity of the model.

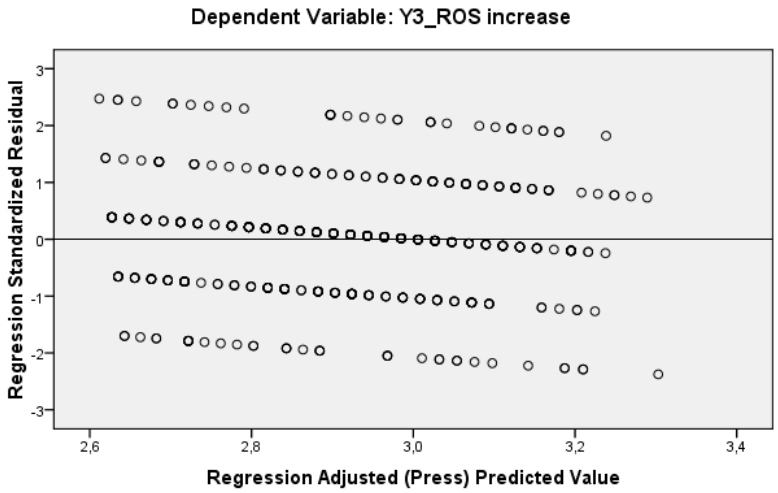


Figure 7 - Homoscedasticity (dependent variable)

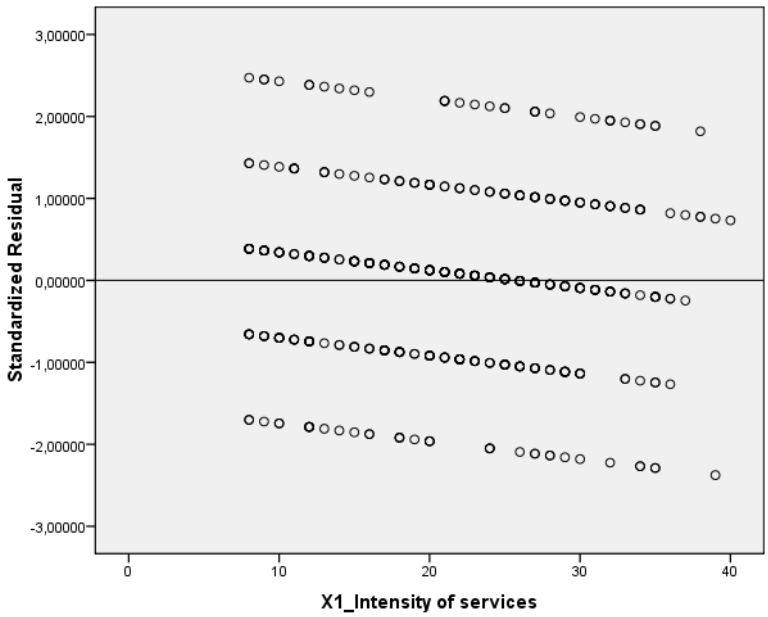


Figure 8 - Homoscedasticity (independent variable)

Finally, a simple method of checking the assumption of the normality of residuals is the PP plot, in which the residuals should lie approximately on a straight line (MONTGOMERY; PECK, 1992). As presented on Figure 9, despite some discrepancies, the analysis indicates a linear behavior, validating this assumption. Moreover, considering that the sample size adopted for this study is large, the normality of residuals is not expected to jeopardize the survey results.

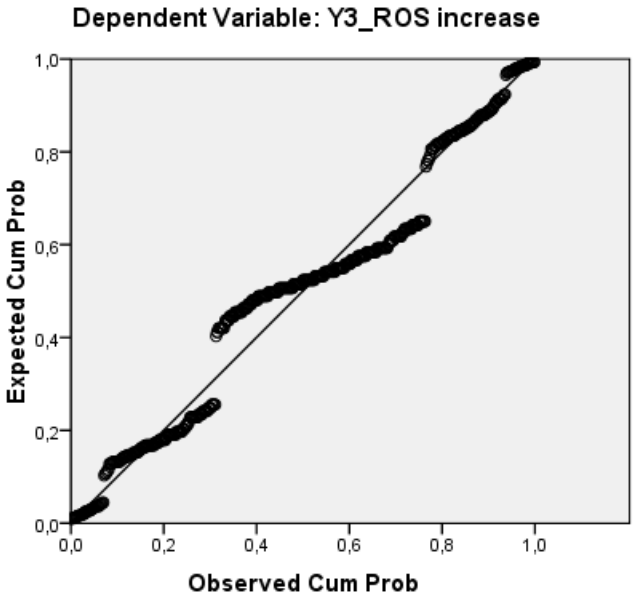


Figure 9 - Normal P-P plot

After confirming that the error terms are (1) independent (no perfect multicollinearity between variables), (2) have zero mean and a constant variance (homoscedasticity) and (3) follow a normal distribution, it is possible to validate the models developed, allowing for generalizations for a wider population.

4.5 SUMMARY OF RESULTS

The Table 18 presents the results of each survey hypothesis, considering the statistical tests presented in the previous section.

Table 18 - Research results

Variables	Hypothesis	Adjusted R^2	Standardized Beta
Intensity of services vs Sales increase	H1a	.020	.147**
Intensity of services vs ROS	H1b	.009	.103*
Intensity of services vs ROS increase	H1c	.026	.166**
Service ratio vs Sales increase	H1d	-.001	.020
Service ratio vs ROS	H1e	.003	.069
Service ratio vs ROS increase	H1f	.003	.700
Intensity of services^2 vs ROS increase	H1c'	.031	.304
Intensity of services^3 vs ROS increase	H1c''	.027	.160
Moderating effects (Intensity of services vs ROS increase)			
Firm size based on number of employees	H2a	.023	-.008
Firm size based on sales revenue	H2b	.029	.025
Firm age	H2c	.028	-.014
Level of country development	H2d	.041	-.137**
Antecedent effect			
Effort put on service vs Intensity of services	H3	.296	.545**

*p < .05 / ** p < .01

The Figure 10 below summarizes these survey hypothesis results. In a significance level of 5%, there is evidence of a positive relationship between the effort put on developing the service business and intensity of services offered. Likewise, there is evidence of a positive relationship between the intensity of services and firm performance – represented by sales increase, ROS or ROS increase. This relationship is not significant when adopting service ratio as the metric for servitization level. Regarding the moderating effects, in a significance level of 5%, there is evidence of a negative moderator effect of the level of country development on the relationship between servitization level and firm performance, what is not confirmed for the

other moderating effects analyzed – size based on number of employees, size based on sales revenue and age.

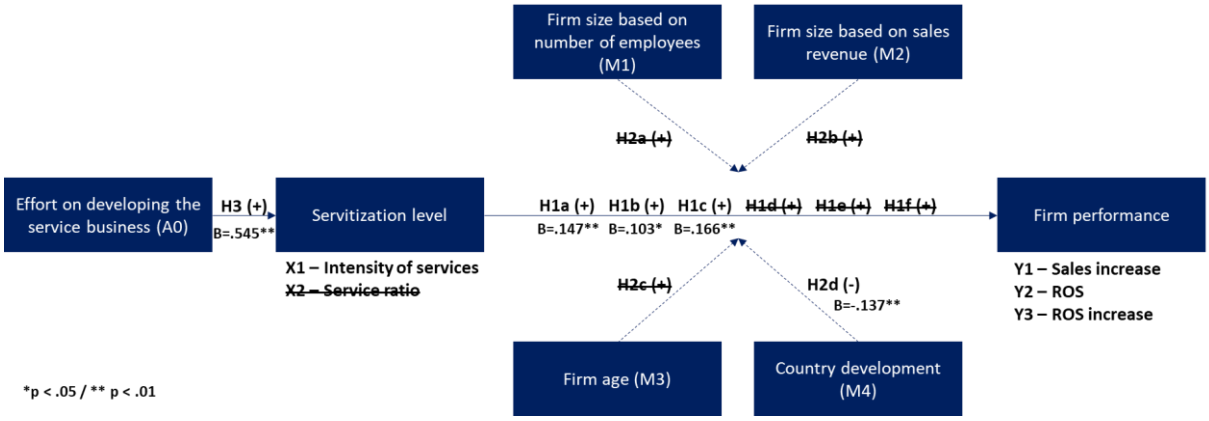


Figure 10 - Research results

5 DISCUSSION

Despite the mixed results from previous empirical studies, we expected to find a significant relationship between the effort in developing the service business and the servitization level, as well as between servitization and firm performance, impacted by moderating effects. As presented in the Research Design section, these significant relationships between variables were expected to be positive in all studied dimensions.

5.1 HYPOTHESIS 1

Regarding the first hypothesis, a positive and significant relationship between the servitization level and firm performance was expected, despite some contradictions.

Some authors, such as Neely, Benedettini and Visnjic (2011), did not found statistical significance in the relationship between servitized firms and current profitability or current enterprise value. Others found a negative effect between number of services provided and firm performance (BAVEJA; GILBERT; LEDINGHAM, 2004; BENEDETTINI; SWINK; NEELY, 2013; HANCOCK; JOHN; WOJCIK, 2005; NEELY, 2008; VISNJIC; NEELY; WIENGARTEN, 2012).

However, there is also a large number of researchers that identified a relevant association, recognizing an increase in total sales and/or profits after the development of the service business (CROZET; MILET, 2015; FANG; PALMATIER; STEENKAMP, 2008; GEBAUER; FLEISCH, 2007; KASTALLI; VAN LOOY, 2013; KOHTAMÄKI et al., 2013; MARTINEZ et al., 2010; OLIVA; GEBAUER; BRANN, 2012; SUAREZ; CUSUMANO; KAHL, 2013; TIAN et al., 2012; VISNJIC; WIENGARTEN; NEELY, 2014).

Nonetheless, despite identifying a positive and significant relationship for Hypothesis 1 (adjusted R^2: 2.6%; p-value: 0.000), we expected to find a higher explanatory power for this correlation. Besides, we only found a significant value when adopting the intensity of services as a proxy of servitization, what was not valid for service ratio. This finding goes in line with Crozet and Milet (2015), who found that servitization is related to better performance, even when the service ratio is low, and this correlation does not increase with higher shares of services. Contradictorily, different authors found a significant relationship even when adopting the service ratio as a proxy for servitization level (FANG; PALMATIER; STEENKAMP, 2008; KOHTAMÄKI et al., 2013; SUAREZ; CUSUMANO; KAHL, 2013).

More than that, some authors found a non-linear relationship between servitization and firm performance, even as a quadratic/U-shaped curve (FANG; PALMATIER; STEENKAMP, 2008; KOHTAMÄKI et al., 2013; SUAREZ; CUSUMANO; KAHL, 2013) or as a cubic one (KASTALLI; VAN LOOY, 2013). This curvilinear behavior was understandable and expected, considering the arguments presented by the authors that identified it: Kastalli and Van Looy (2013) explain that at the beginning, despite the low scale, there are some customers willing to pay for the new service offerings, bringing positive returns. However, at a second moment, the necessary investments make the margins decrease (VISNJIC; WIENGARTEN; NEELY, 2014). Then, with investments internalized and higher service scales, the positive margins are recuperated (FANG; PALMATIER; STEENKAMP, 2008; KASTALLI; VAN LOOY, 2013; SUAREZ; CUSUMANO; KAHL, 2013). Other authors also argue that the expected returns are only visible in the long run, when the learning effects from accumulating levels of service over time contribute for improving the results (KASTALLI; VAN LOOY, 2013; MARTINEZ et al., 2010; VISNJIC; WIENGARTEN; NEELY, 2014). Nevertheless, these curvilinear effects were not significantly validated in the current study.

Another point of attention, still regarding to the Hypothesis 1, is related to the dependent variables. Considering a significant level of 5%, the intensity of services is significantly correlated to all of the dependent variables: sales increase, ROS and ROS increase. The association between the intensity of services and increase in sales is expected and understandable, considering that more offerings are expected to generate more sales. Besides, the provision of services may stimulate the combined sales of goods. More interesting though is the significant correlation with ROS and ROS increase: the addition of service offerings increases the firm returns. Combining these results with the finding that the service ratio is not significantly associated to any of the dependent variables, we can conclude that the increase in service offerings generate higher margins even when representing a small proportion of the total sales revenue (service ratio). It is also important to highlight that the intensity of services is more significantly correlated to ROS increase than to ROS itself. It indicates that firms that added services to their offerings have increased their ROS in the last three years and, less significantly, have higher margins than those firms with less service offerings.

Summing up, the expected correlation between servitization level (measured by intensity of services provided) and firm performance (sales increase, ROS and ROS increase) was validated. However, we expected to find a higher explanatory power of the models and also a significant correlation between service ratio and firm performance, what was not

confirmed. Finally, curvilinear effects, which were projected to better represent this relationship, were not corroborated.

5.2 HYPOTHESIS 2

Adopting the variables that best represent the relationship between servitization and firm performance (intensity of services provided and ROS increase), the hypothesis 2 was tested: firm characteristics positively moderates the effect of servitization on firm performance.

When discussing about the moderating effect of size (based on number of employees and sales revenue), different authors present opposing views. While Benedettini, Swink and Neely (2013) found that successful servitized firms tend to be larger than unsuccessful ones, suggesting that the larger firms have an advantage over the smaller ones, Neely (2009) and Crozet and Milet (2015) believe that the positive effects of servitization are more visible for smaller firms. We expected to find a positive effect of size in the relationship between servitization level and firm performance, considering that bigger firms usually have more available resources, what could favor the development of the service business. Nevertheless, we did not find a significant moderating effect of firm size in the relationship between servitization and firm performance.

Regarding the age moderating effect, Benedettini, Swink and Neely (2013) found that successful servitized firms tend to be older than unsuccessful ones, but recognize that the extant literature also presents mixed results: while some authors argue that older firms are favored, others found an increase in bankruptcy rates with age. Despite these controversial findings, we expected to find a positive and significant moderating effect of age, suggesting that the experience of older firms would favor them in reaping the benefits of servitization. However, this hypothesis was not validated in our study: age does not affect the relationship between servitization and firm performance.

Finally, we analyzed the effect of the level of country development on the original model. Kastalli and Van Looy (2013) found that market development and country-specific differences have a strong and significant influence on the relationship between scale of services and profitability; the authors have considered this variable as a control variable, not exploring its effect. Our original assumption was that the higher the level of development, the higher would be effect on the relationship between servitization and firm performance, considering that more developed countries usually have more access to resources, what could favor the development of the service business. We actually found a significant effect of this moderator,

but we were not expecting to verify the following inverted effect: the lower the level of country development, the stronger is the relationship between servitization and firm performance. Countries with a medium level of development present a higher correlation between servitization level and firm performance than those countries with a very high level of development. One possible explanation is that plants in developed countries were first-movers in developing their service businesses, so that the benefit of a ROS increase is no longer so evident, different from plants in developing countries that may be going through this process more recently. Other potential reason is that the market for developed countries is already mature and stable, so that servitization strategies do not bring the expected level of sales and returns.

In summary, we were expecting to find a positive and significant moderating effect of size (based on number of employees and sales revenue), age and level of country development, in the relationship between servitization (measured by the intensity of services offered) and firm performance (measured by ROS increase). However, the level of country development was the only moderator whose impact was significant, changing the model adjusted R^2 from 2.6% to 4.1% when under its influence.

5.3 HYPOTHESIS 3

Regarding the relationship between the effort in developing the service business and firm results, Gebauer and Fleisch (2007) have found a positive correlation, suggesting that service revenue and overall profitability are enhanced when investments are done in service business. Despite this direct relationship between investments in the service business and firm performance proposed by the authors, we considered the effort put on developing the service business as an antecedent, which would impact the servitization level and consequently increase the firm performance.

As expected, we found a significant and positive relationship between the first two variables, with an adjusted R^2 of 29.6%, indicating the high explanatory power of model and confirming our preliminary assumption. This high and positive relationship between the effort in developing the service business and the servitization level proposes the servitization process as an innovative transition, dependent on investments at new capabilities, as presented by Bustinza et al., (2015). It indicates that firms that intend to increase their servitization level should invest in developing their service business, what should be confirmed with a longitudinal study.

6 CONCLUSION

6.1 CONCLUSION

This study has aimed at validating the relationship between servitization level and firm performance, as well as identifying the firm characteristics and antecedents that influence on it. Despite being among the most significant developments in modern industrial business, this theme still produces mixed results. Therefore, in order to explore this relationship, we analyzed secondary data from 539 plants from 22 countries that participated in the International Manufacturing Strategy Survey (IMSS).

Initially, we validated that the servitization level (measured by the intensity of services provided) has a positive and significant correlation with firm performance (measured by sales increase, ROS or ROS increase). However, the explanatory power of the models is low, with adjusted R^2 not higher than 2.6% in all cases. Besides, when adopting service ratio as the metric for the servitization level, we did not find a significant relationship with firm performance, what is aligned with the findings from Crozet and Milet (2015), but also contradicts other previous studies. Likewise, we did not verify significance for quadratic and cubic models.

Regarding the interaction effects, level of country development significantly moderates the relationship between the servitization level (measured by intensity of services provided) and firm performance (measured by ROS increase). Interestingly, the lower the level of country development, the stronger is the relationship between servitization level and firm performance. Countries with a medium level of development present a higher correlation between servitization level and firm performance than those countries with a very high level of development. One possible argument is that countries in developing economies are going through the servitization process more recently, so that the benefits of this transition are still visible, different from highly developed countries, which were first-movers. Other explanation is that developed countries have a more stable and mature economy, being more difficult to reap the benefits from servitization strategies. Unlike previous researches, we did not validate a moderating effect of other firm characteristics such as age and size (based on number of employees or sales revenue).

Finally, we confirmed the existence of a positive and significant antecedent relationship between the effort put on developing the service business and the servitization level (measured by the intensity of services offered). It suggests that firms that intend to increase their servitization level should invest in developing their service business.

Summing up, at a first moment, without the firm's segmentation by level of country development, the study results were almost inconclusive, with a low explanatory power. However, when we added the level of country development effect and consequently executed the analysis individually for each group of countries, an interesting finding was visible. The high participation of firms in countries with a very-high level of development (about 70% of the sample) may have contributed for reducing the explanatory power of the general model, since the relationship between servitization level and firm performance is not significant at this level of development.

After all, we validated our main hypothesis, which was the significant relationship between servitization level and firm performance. As it is only valid when adopting the intensity of services as a metric for the servitization level (as service ratio is not significantly associated to any of the dependent variables), we also can conclude that the increase in service offerings generate higher margins even when representing a small proportion of the total sales revenue (service ratio). Our main managerial implication was investigating in what conditions the service transition strategies will more strongly contribute for firm performance, what should be explored as a way to overcome the dreaded *service paradox*.

6.2 LIMITATIONS

This study has some limitations, the most relevant of which is the restriction to the metal-mechanic industry. Despite the fact that it presents advantages, such as the reduction of risk of uncontrollable interfere from cross-industry factors, the external validity of the findings may be limited, impacting the generalizability to other industries (EGGERT et al., 2011; HAUGLAND; MYRTVEIT; NYGAARD, 2007). However, it is possible to assume that the results can be transferred to industries with similar characteristics.

Besides, as IMSS is a self-reported survey, the data can be biased, mainly when related to past events or when the answers can favor the respondent (BENEDETTINI; NEELY; SWINK, 2015). Nonetheless, as the company identity is not disclosed and the results can be used by respondents as industry benchmarks, we believe that the predisposition to data distortion is deterred.

The use of simple regression analysis as the main statistical technique may have limited our findings related to multiple relationships between variables, what could have been analyzed with tools such as Structural Equation Modeling (SEM). However, as our study aimed to identify the impact of each variable separately, this technique was not adopted. Besides, we

considered that the additional results would not compensate the stronger effort that would be necessary.

Another limitation of using secondary data source is the restriction of figures to investigate other moderating effects, which might be relevant but could not be extracted from IMSS. Moreover, the use of stationary data, collected between 2013 and 2014, do not allow for the identification of causality between service transition and firm performance; our study is limited to evidencing a correlation between servitization level and firm returns.

Despite these limitations, the objectives of the study could be achieved and we believe to have contributed for the servitization literature and practice, exploring the firm characteristics and antecedents that impact on the relationship between service strategies and firm performance.

6.3 SUGGESTIONS FOR FUTURE STUDIES

Firstly, future efforts in other industries should be conducted to complement this study, validating the findings to a broader scale (KASTALLI; VAN LOOY, 2013).

Future studies should also explore the relationship between servitization and firm performance using other methodologies. Public-traded reports can overcome the self-report limitations and primary surveys could be used to investigate other moderating effects. Moreover, adopting other performance valuation measures (besides sales and return on sales) could provide a more comprehensive view of the impact of service strategies on firm results (FANG; PALMATIER; STEENKAMP, 2008). Besides, working with other statistical techniques, such as SEM, may bring insights about the multiple relationships of dependent and independent variables.

Another interesting topic that may be explored in future studies is a comparison between the servitization of Business-to-Business (B2B) and Business-to-Consumer firms (B2C). Despite the current bias towards B2B applications (BAINES et al., 2017), about 70% of firms analyzed in this study attend the final customer in some way (B2C interactions). The sample diversification may contribute for understanding the impact of this characteristic on servitization transition.

Micro enterprises (firms with less than 19 employees) were disregarded in the study since we believe they are not big enough to have a servitization strategy defined. However, a curious subject to be explored is the servitization process in micro and small enterprises, comparing it with the motivations, challenges and results achieved by bigger firms.

Kowalkowski, Gebauer and Oliva (2016) explain that many Small and Medium Enterprises (SMEs) are shifting towards services.

One of the main findings of this study is that the lower the level of country development, the stronger is the relationship between servitization level and firm performance. Unfortunately, IMSS does not include countries with a low HDI. Working with a database that includes this country band may contribute for validating the findings of the current study.

Additional studies could explore actions for leveraging firm characteristics that exert a positive impact on the association between servitization and firm performance. There are opportunities for leveraging internal and external conditions that maximize the revenue and profit growths generated by servitization strategies (BAINES et al., 2017; REINARTZ; ULAGA, 2008).

Finally, longitudinal research should be conducted in order to assess the causal effect of servitization on firm performance, what is not possible to identify with the use of stationary data. Besides, longitudinal studies should also be adopted to confirm a causal relationship between the investments made in developing the service business and the increase of service offerings, what can be considered as the real servitization process. Exploring this process as well as the elements that support this transition (ADRODEGARI; PASHOU; SACCANI, 2017; BAINES et al., 2017) could contribute to optimize the impact on firm performance.

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