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SERVITIZATION OF MANUFACTURING FIRMS OVER TIME: AN EMPIRICAL INVESTIGATION IN THE ELEVATOR INDUSTRY

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“There is no elevator to success. You have to take the stairs.”

Author: Zig Ziglar

Abstract

The boundaries between manufacturing and service firms are breaking down across the world, as an increasing number of manufacturing companies are competing through a portfolio of integrated products and services rather than products alone. The process through which this service-led competitive strategy is attained is commonly referred to as ***servitization***.

The structure of the global economy is changing as products mature and markets globalize, leading to an increased level of competition, changes in consumer expectations and requirements, and reduced margins. Manufacturing firms seem to be aware of the value inherent in offering the services needed for running and maintaining the products they manufacture. Services seem to provide a more constant income, higher profit margins and require less asset allocation than manufacturing. Although servitization does not represent a panacea for manufacturers, it is a concept of significant potential value, providing routes for manufacturers to move up the value chain and exploit higher value business activities.

The addition of service offerings to the portfolio of traditionally product-oriented companies may force the manufacturer to redesign its business model. Therefore, the understanding of how integrated product-service business models impact the economic success of manufacturing firms must be improved. Furthermore, the transformational issues faced by manufacturers seeking to servitize, should be deeper understood.

Considering this, the present thesis was conceived so as to mitigate identified research gaps and contribute to the field in three different but related ways. The first objective was to understand what factors affect servitization intensity over time. The second objective was to gain a deeper understanding of what factors affect the financial performance of the servitized manufacturing firm over time. Finally, the third objective was to understand how external and internal factors promote or hinder servitization of a manufacturing firm over time.

Additionally, manufacturing firms will be provided a framework for a technical analysis to properly decide whether they should servitize and with which intensity.

This research is based on a longitudinal and dynamic approach of one single industry: the elevator industry. Studying a single industry allows for the natural control of a number of contextual factors that may influence servitization, as well as for more granular insight into the factors that impact it. The elevator industry covers a broad spectrum of service offerings, making it an interesting and rich setting to conduct research on. Moreover, the industry is highly servitized, and the transition to services in the elevator industry is not a new issue.

We hope this thesis may add real value to servitization by providing strategies and approaches that are useful to both the scientific community and the manufacturing firms.

Resumo

As fronteiras entre empresas industriais e de serviços estão a cair em todo o mundo, à medida que um número crescente de empresas industriais compete através de um portfólio de produtos e serviços integrados, em vez de apenas através de produtos. O processo pelo qual essa estratégia competitiva orientada para os serviços é obtida é geralmente apelidado de ***servitização***.

A estrutura da economia mundial está a mudar à medida que os produtos amadurecem e os mercados se tornam globais, levando a um aumento do nível de concorrência, a mudanças nas expectativas e exigências dos clientes e a margens reduzidas. As empresas industriais estão cientes do valor inerente à oferta dos serviços necessários para executar e manter os produtos que produzem. Os serviços parecem fornecer uma receita mais constante, margens de lucro mais elevadas e requerem menos alocação de ativos, do que a produção de bens. Embora a servitização não represente uma panaceia para os fabricantes, é um conceito com um valor potencial significativo, que poderá fornecer orientação para que os produtores possam subir a cadeia de valor e passem a explorar actividades de negócio de maior valor.

A adição de serviços ao portfólio de oferta de empresas tradicionalmente orientadas para o fabrico de bens, pode forçar o fabricante a ter de redesenhar o seu modelo de negócios. Portanto, é necessário melhorar o conhecimento de como os modelos de negócio integrados de serviços e bens afetam o sucesso económico das empresas industriais. Também os problemas transformacionais das empresas industriais que procuram servitizar deverão ser estudados com mais profundidade.

Considerando isto, a presente tese foi concebida com o objetivo de mitigar lacunas de investigação e contribuir para a área de estudo de três formas diferentes, porém relacionadas. O primeiro objetivo foi o de perceber quais os fatores que afetam a intensidade de servitização ao longo do tempo. O segundo objetivo foi o de obter uma compreensão mais profunda de quais os fatores que afectam o desempenho financeiro da empresa industrial servitizada ao longo do tempo. Finalmente, o terceiro objetivo foi o de entender como os fatores externos e internos promovem ou dificultam a servitização de uma empresa industrial ao longo do tempo.

As empresas industriais receberão ainda uma estrutura para uma análise técnica poderem decidir de uma forma adequada se deverão servitizar e com que intensidade.

Esta investigação é baseada numa abordagem longitudinal e dinâmica de uma única indústria: a indústria de ascensores. O estudo de uma única indústria permite o controlo natural de vários fatores contextuais que podem influenciar a servitização, bem como uma visão mais granular dos fatores que a impactam. A indústria dos ascensores cobre um amplo

espectro de ofertas de serviços, tornando-a um cenário interessante e rico para realizar pesquisas. Além disso, a indústria é altamente servitizada, e a transição para os serviços nesta indústria não é uma questão nova.

Esperamos que esta tese possa acrescentar valor real ao estudo da servitização, fornecendo estratégias e abordagens úteis para a comunidade científica e para as empresas industriais.

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“There is no Elevator to success. You have to take the stairs.” (Zig Ziglar)

But taking the stairs requires a lot of hard work, time, energy and support. This long climb was only possible because of a group of very special people.

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List of Abbreviations

ADS - Advanced Services

BAS - Basic Services

B2B - Business To Business

CEO - Chief Executive Officer

CNC - Computer Numerical Control

ELA - European Lift Association

EU - European Union

GDP - Gross Domestic Product

HVAC - Heating, Ventilation, and Air Conditioning

ICT - Information and Communication Technologies

OEM - Original Equipment Manufacturer

R&D - Research and Development

ROA - Return on Assets

ROE - Return on Equity

SNEL - Safety Norms for Existing Lifts

1. Introduction

Manufacturing and service industries are often seen as largely independent from each other, since they have significant differences that result from the perishable, complex, intangible, heterogeneous, inseparable nature of services and service activities (Brax, 2005; Baines *et al.*, 2009c; 2010). Vargo and Lusch (2004) presented the service-dominant logic, stating that the customer acts as co-creator of value with the firm (through an ongoing relationship) and goods act as vehicles for the delivery of services. The production and delivery systems are separate in manufacturing, but inseparable in services, therefore requiring a different management approach (Brax, 2005). The literature has examined this phenomenon through the lens of a product-service dichotomy (Gebauer *et al.*, 2012). According to these authors the dichotomy overemphasizes the distinction between product (in this text goods and products will be used indistinctly) and service and, in doing so, does not recognize the diversity of manufacturing companies and the variety of services they offer. Vandermerwe and Rada (1988) argue that the relationship between goods and services is a complex one, since there is a good deal of substitution between goods and services, but also a total complementarity between them: essentially all products produce services and companies buy goods in order to produce services. Accordingly, for example, many information services are embodied and carried in goods and many services are already built into goods.

Thus, the boundaries between manufacturing and service firms seem to be breaking down across the world (Vandermerwe and Rada, 1988; Mont, 2002; Baines *et al., 2009a*; Neely, 2009; Johnstone *et al.*, 2009; Perona *et al.*, 2017). Today an increasing number of manufacturing companies are competing through a portfolio of integrated products and services rather than products alone (Baines and Lightfoot, 2014; Sousa and da Silveira, 2017). This is a service-led competitive strategy and the process through which it is achieved is commonly referred to as servitization. Simply put, servitization can be defined as a process of creating value for the company and for the customer by adding services to products.

Servitization seems to demand manufacturers to adopt new and alternative practices and technologies to those traditionally associated with production operations. A prevailing challenge is to understand and devise these differences and their underpinning rationale.

Manufacturing firms are beginning to realize the strategic importance of service in gaining a competitive advantage. The integrated product-service offerings can therefore be distinctive, long-lived, and easier to defend from competition of lower-cost economies', being a conscious and explicit strategy for market differentiation.

The present thesis provides new strategies and approaches to servitization that add value to servitization to both the scientific community and the manufacturing firms. The work is based on a longitudinal and dynamic approach on one single industry: the elevator industry.

This industry covers a broad spectrum of service offerings, making it an interesting and rich setting to conduct research on servitization.

In the next sections the origins and the different definitions of servitization will be addressed.

1.1 Servitization

1.1.1 Origins and history of servitization

There are a multitude of concepts and terms that have been introduced to describe the phenomenon of the convergence between manufacturing and service industries (see Table 1). This multitude of concepts result from the motivation and the geographic places of origin of the research activities (Baines *et al.*, 2009a). Research communities developed independently and mostly in isolation from each other (Baines *et al.* 2009a; Dachs *et al.*, 2012). These concepts of convergence can be found in the management literature, the marketing literature and the literature on sustainability.

Baines *et al.* (2009c) identified five communities of researchers engaged with servitization: the servitization community (contributions have their origins in the managerial and business practitioner literature, mostly from de USA, the UK and Western Europe); the product service system (PSS) community (having its origins in Northern Europe in the late 1990s, mainly with contributions from the environmental and social sciences); the services marketing community; the service operations community and the services science community (with origins in the IT sector, focusing on service as a system of interacting parts that include people, technology and business).

According to Baines *et al.* (2009a) the servitization concept was originated in the USA in the late 1980s, and there is an overlap between servitization and product-service system concepts. Although these concepts have emerged from differing perspectives on the world, Baines *et al.* (2009c) argue that they are converging towards a common conclusion that manufacturing companies should be focussing on selling integrated solutions.

Table 1 – Perspectives of servitization, sorted by year of first appearance

Concept	Description	Perspective	Studies
Servitization	"[…] manufacturing companies are offering 'bundles' of customer-focused combinations of goods, services, support, self-service, and knowledge with services beginning to dominate in order to add value to core product offerings" (Vandermerwe and Rada, 1988)	Servitization community	Vandermerwe and Rada, 1988; Baines *et al.* , 2009a, 2009b, 2009c; Neely, 2009; Baines *et al.* , 2010; Martinez *et al.* , 2010; Baines *et al.* , 2011; Biege *et al., 2012;* Bastl *et al.,* 2012; Dachs *et al.* , 2012; Baines *et al.* , 2013; Ahamed *et al.* , 2013; Finne *et al.* , 2013; Kastalli and van Looy, 2013; Lightfoot et al., 2013; Baines and Lightfoot, 2014; Kindström and Kowalkowski, 2014; Smith *et al.,* 2014; Saccani *et al.,* 2014; Turunen and Finne, 2014; Viljakainen and Toivonen, 2014; Alghisi and Saccani, 2015; Benedettini *et al.* , 2015; Goda and Kijima, 2015; Kohtamäki and Helo, 2015; Visnjic *et al.* , 2016; Baines *et al.* , 2017; Benedettini *et al.* , 2017; Bigdeli *et al.* , 2017; Brax and Visintin, 2017; Coreynen et al., 2017; Green *et al.* , 2017; Kanninen *et al.* , 2017; Kowalkowski *et al.* , 2017; Luoto *et al.* , 2017; Lütjen *et al* , 2017; Martinez *et al.* , 2017; Perona *et al.* , 2017; Sousa and da Silveira, 2017; Spring and Araujo, 2017; Ambroise *et al.* , 2018; Bigdeli *et al.* , 2018; Coreynen *et al.* , 2018; Crowley *et al.* , 2018; Grubic, 2018; Kroh *et al.* , 2018; Rabetino *et al.* , 2018; Raja *et al.* , 2018; Ruiz-Alba *et al.* , 2018; Wang *et al.* , 2018; Ayala *et al.* , 2019; Doni *et al.* , 2019; Gebauer and Binz, 2019; Gomes *et al.* , 2019; Raddats *et al.* , 2019; Sousa and da Silveira, 2019; Visnjic *et al.* , 2019; Baines *et al.* , 2019
Servicisation	"The role of services in providing value is ever more important. Not long ago, most of a product's value added came from the production processes that converted raw materials into useful forms […] Now, however, value added is increasingly likely to come from technological improvements, styling features, product image, and other attributes that only services can create." (Quinn *et al.* , 1990)	Services science community	Quinn *et al.,* 1990; Mont, 2000; Orsdemir *et al.,* 2013
After-sales services	"[…] there is a need to ensure that the operations strategy not only supports the new product sales, but also conforms to the after-sales service supply. Thus, it is essential to understand and appreciate how the industrial service operations of the firm are related to its manufacturing processes." (Oliva and Kallenberg, 2003)	Service operations community	Armistead and Clark, 1991; Oliva and Kallenberg, 2003; Johansson and Olhager, 2004; Johansson and Olhager, 2006; Saccani *et al,* 2006; Cohen *et al.* , 2006; Saccani *et al.* , 2007; Brax and Jonsson, 2009; Johnstone *et al.* , 2009; Hypko *et al.* , 2010; Kurata, 2010; Inderfurth and Kleber, 2013
Product services	"Product services are defined as the set of all potential additional services a supplier can supplement his product offering with, in order to differentiate his offering relative to the competitors' as perceived by (potential) customers and distributors. Product services are relevant either prior to the sale or after the sale of a product and may include such services as guarantee conditions, financial and/or operational leasing possibilities, and technical assistance." (Frambach *et al.* , 1997)	Services marketing community	Frambach *et al.* , 1997; Mathieu, 2001a
Industrial Business Services	"Industrial business services have typically been divided into two broad categories: (1) maintenance and repair services, e.g., equipment repair, janitorial services, usually supplied under contract; and (2) business advisor services, e.g., legal, accounting, advertising, management consulting, typically new task-buying situations." (Boyt *et al.* , 1997)	Services marketing community	Boyt *et al.* , 1997; Nuutinen and Lappaleinen, 2012
Going downstream	"[…] providing services is more lucrative than making products, the old foundations for success in manufacturing are crumbling. Smart manufacturers are creating new business models to capture profits at the customer's end of the value chain". The manufacturers "moved beyond the factory gate to tap into the valuable economic activity that occurs throughout the entire product life cycle." (Wise and Baumgartner, 1999)	Services science community	Wise and Baumgartner, 1999

Table 1 – Perspectives of servitization, sorted by year of first appearance (cont.)

Concept	Description	Perspective	Studies
Integrated solutions	"Demand for integrated solutions is driven by the trend for large businesses to outsource systems integration and operational activities. Governments are also demanding far-reaching answers to their needs for major public projects — such as railways, hospitals and defense systems — which are designed, built, operated and financed by private companies." (Davies et al., 2006)	Services science community	Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Windahl *et al.* , 2004; Neu and Brown, 2005; Davies *et al.* , 2006; Windahl and Lakemond, 2006; Brax and Jonsson, 2009; Bastl *et al,* 2012
Servicizing	"The emergence of product-based services which blur the distinction between manufacturing and traditional service sector activities. In a servicizing environment, the notion of straightforward buying and selling softens and diversifies into a spec- trum of property rights arrangements, in- cluding leasing, pooling, sharing and take- back." (White *et al.* , 1999)	Product Service System community	White *et al.* , 1999; Rothenberg, 2007; Agrawal and Bellos, 2016
Support services	"Customer support is an essential element in the successful marketing of many products—from domestic appliances to high-tech computer networks. Many aspects of support are strongly influenced by a product's design and so customer support requirements should be evaluated during new product development." (Goffin and New, 2001)	Services science community	Goffin and New, 2001
Full-service contracts	Full service is defined as 'comprehensive bundles of products and/or services, that fully satisfy the needs and wants of a customer related to a specific event or problem'. The trend towards full service is primarily driven by the demand side. Industrial firms increasingly demand turnkey solutions to problems instead of products that only partially solve their needs (Stremersch et al., 2001).	Services marketing community	Stremersch *et al.,* 2001
Hybrid offerings	Define a hybrid offering as a combination of 'one or more goods and one or more services, creating more customer benefits than if the good and service were available separately. (Galbraith, 2002)	Services marketing community	Galbraith, 2002; Ulaga and Reinartz, 2011
Product-service systems	"A product-service system (PSS) can be defined as consisting of tangible products and intangible services designed and combined so that they jointly are capable of fulfilling specific customer needs. [...] Many see PSSs as an excellent vehicle to enhance competitiveness and to foster sustainability simultaneously" (Tukker, 2004)	Product Service System community	Mont, 2002; Mont, 2004; Tukker, 2004; Davies *et al.* 2006; Baines *et al.,* 2007; Durugbo and Riedel, 2013; Peillon *et al.* , 2015; Costa *et al.* , 2017; Grubic and Jennions, 2018
Servicification	"Service is […] an important part of an offering provided by a manufacturing firm. [...] Analysis of industries' activities in providing integrated offerings of products and services has revealed that a key to success of such business is securing the access by providers to products in use. The reasons include the capability to measure the performance, and to control and maintain, when necessary, the products." (Sakao *et al.* , 2009)	Product Service System community	Oliva and Kallenberg, 2003; Sakao and Shimomura, 2007; Sakao *et al.,* 2009; Lodefalk, 2010
Industrial services	"[…] the intersection of manufacturing and service, and defined as the supply of after-sales services, including tangibles such as spare parts and consumables, related to the maintenance of industrial goods." (Johansson and Olhager, 2004)	Service operations community	Johansson and Olhager, 2004
Service infusion	"Some business and government leaders have recognized the opportunities for service-led growth. Many are working diligently to transform manufacturing and other goods- dominant organizations into goods and services or solutions enterprises. Yet integrating and aligning goods, services, and solutions strategies, as well as developing and managing ser- vice portfolios, are challenging and novel for many firms." (Ostrom *et al.* , 2010)	Services science community	Brax, 2005; Gebauer *et al.* , 2005; Lay *et al.* 2010; Grönroos and Helle, 2010; Ostrom *et al.*, 2010; Gebauer *et al.* , 2011; Fundin *et al.,* 2012; Finne *et al.,* 2013; Kowalkowski *et al.*¸ 2012; Kowalkowski, 2013; Gebauer *et al.* , 2014; Kindström and Kowalkowski, 2014; Zeithaml *et al.* , 2014; Ostrom *et al.* , 2015

But is servitization something new? According to Schmenner (2009) servitization is not particularly new. In his research he argues that it has antecedents that go back 150 years and that supply chains have always been a mix of manufacturing and service steps, meaning that manufacturers have been seeking to expand to services in order to reduce their dependence on distributors. Before that, Levitt (1972, pp. 41) stated that “there are only industries whose service components are greater or less than those of other industries. Everybody is in service”. Bitner (1997) defends that all businesses are service businesses in some form, and many are learning that effective service and innovative services can be their competitive edge. Spring and Araujo (2009) also defend that the interchangeability between products and services has a long history, arguing that although the word may be new, servitization and related concepts are not.

1.1.2 Definitions of servitization

The term servitization was first used by Vandermerwe and Rada (1988). They argued that manufacturing companies are offering ‘bundles’ of customer-focused combinations of goods, services, support, self-service, and knowledge with services beginning to dominate in order to add value to core product offerings. In their paper, the authors noted that this approach could lead firms beyond ‘servicing’ where a good is repaired or maintained by the manufacturer or ‘moments of truth’ where the firm comes face-to-face with its customer. Servitization “involves a different strategic thrust, level of organizational complexity and an order where the old traditional managerial recipes no longer fit” (Vandermerwe and Rada, 1988, p. 315).

Simply put, servitization can be seen as a **process** of creating value by adding services to products (Brax, 2005; Baines et al., 2009a; 2009b), with value emerging as a result of co-creation between customer, provider and supplier (Ng *et al.*, 2012).

In the literature, servitization is also described as a **transformation process** giving manufacturing companies the possibility to compete through product-service systems (PSS) rather than products alone (Baines *et al.*, 2007; 2009a; 2010; 2013). A Product-Service System can be defined as an integrated product and service offering that delivers value in use. Neely (2012) proposes a similar definition, by stating that servitization is a transformation process, which involves a manufacturing firm innovating its capabilities and processes so that it can better create mutual value through the shift from selling products to selling Product-Service Systems.

Although almost all manufacturers offer services, servitization deals with the **shift** by manufacturers from selling products coupled with a few essential services (e.g. training, spares, etc.), to using services as the base of their competitive strategy (Baines *et al.,* 2010).

This is a services-led competitive strategy. Thus, servitization can be seen as a conscious and explicit strategy for market differentiation and ultimately competitive advantage (Lightfoot *et al.,* 2011).

Traditionally, manufacturing companies have focused on product-related strategies aimed at technological innovation, quality improvement and/or cost reduction, depending on their market position. But a change in the business environment have made it difficult to rely exclusively on these traditional strategies (Lay *et al.*, 2010). There seems to be a need of manufacturing companies to defend themselves against product competition particularly from lower cost economies (Baines *et al.,* 2009a, 2009b), who seem to gain advantage by low labour rates and rapidly growing local markets. Lay *et al.* (2010) and Gebauer *et al.* (2012) argue that manufacturing companies tend to be also confronted with the globalization of markets, heightened consumer awareness, shifts in customer demand and the continuing need for profit growth. As a response to these new challenges, and in order to survive, an increasing number of manufacturing companies are shifting their focus from pure manufacturing to a combination of products and services (Neely, 2009; Lay *et al.*, 2010; Gebauer *et al.*, 2012), that is distinctive and long-lived (Baines *et al.,* 2009b). These companies tend therefore to offer services and solutions, often delivered through their products, or at least in association with them (Neely, 2009). Spring and Araujo (2009) refer that servitization can also involve a shift from selling to various forms of leasing, hiring and 'paying for the use of'. Therefore, servitization can also be defined as "any **strategy** that seeks to change the way in which product functionality is delivered to its markets" (Slack, 2005, p.326). Differentiating through services rather than purely through products seems to be growing since it becomes more difficult to differentiate only on products (Ryals and Rackham, 2012). The manufacturing companies offering (complex) packages of both product and service seem to be generating superior customer exchange value and, consequently, enhance their competitive edge (Smith *et al.*, 2014).

Manufacturing is not just about product innovation, process technologies and production (Baines *et al.,* 2009a; 2009b; 2010; 2011a). Some manufacturers seem to be abandoning a product-centric paradigm to embrace **a broader view of manufacturing**. Servitization may challenge the perception that manufacturers can only compete through faster, cheaper or better products. Instead, it is about seeing the manufacturer as a service provider that, far from focusing only on production, sets out to improve the processes of its customers through a business model, rather than product-based innovation. Dachs *et al.* (2012) regard servitization as a **form of innovation** and assume that servitization is a complement to technological innovation to some extent.

We will adopt the definition proposed by Baines (2013, pp.101): “Servitization is the process by which a manufacturer changes its business model to provide a holistic solution to the customer, helping the customer to improve its competitiveness, rather than just engaging in a single transaction through the sale of a physical product”. By business model we understand the firm unique model that recounts how it creates and captures value, sometimes also called the appropriation mechanisms (Kindström and Kowalkowski, 2015).

To illustrate the meaning of servitization in practice, some examples are now presented:

- Spring and Araujo (2009) refer the example of paint suppliers to automotive original equipment manufacturers (OEMs). The coatings division of the BASF Group (the world’s leading chemical company) develops, produces and markets a high-quality range of innovative automotive OEM coatings, automotive refinishes as well as decorative paints. Because of the current highly cost-conscious procurement strategies adopted by the car manufacturers, suppliers often assume the role of system partner as well. BASF deploys a service team to ensure that painting can continue efficiently and flawlessly around the clock. This reduces the customers’ material consumption, saves on the staff needed in the areas of material requirements planning, warehouse and process technology, and lowers the touch-up rate. Parts of this concept may also include a different invoicing method. With cost-per-unit (CPU) invoicing, the car manufacturer no longer pays for the amount of paint delivered but instead for each perfectly coated body (BASF, 2019).

- Product-based differentiation in the automotive industry is increasingly difficult and companies cannot compete on products alone. Many automotive companies realised enormous growth opportunities in the service area (Godlevskaja *et al.*, 2011). Daimler, a leading multinational premium car manufacturer, decided to provide car-sharing services through its Car2Go program. The company offers cars and features one-way point-to-point rentals. Users are charged by the minute with hourly and daily rates also available. The rates are all-inclusive and cover rental, gas, insurance, parking, and maintenance. The service forgoes the typical centralized rental office, and cars are user-accessed wherever parked via a downloadable smartphone app (Agrawal and Bellos, 2016). This business model shift responds also to the increasing societal concern over issues, such as natural resource depletion and environmental degradation. Having car manufacturers on board may provide better opportunities for environmental improvements and for closing the life cycle of cars (Mont, 2004).

- Rolls-Royce Aerospace is generating a large portion of their business revenues through availability-based and capability-based maintenance contracts (Baines *et al.* 2011b). 'Power-by-the-Hour' offered to airlines where, although the engine is sold, the service and support contract for the engine is negotiated on the basis of 'hours flown'. The company offers a performance-based contract in which its compensation is tied to product availability (i.e. hours flown) (Baines *et al.,* 2009b). Also Volvo Aero, a manufacturer of aircraft engines, provides 'power-by-the-hour' solutions, under which customers pay based on the amount of time they use the engines (Agrawal and Bellos, 2013).

- Xerox typically provides a 'document management solution' (Baines *et al.,* 2009b). The producer, rather than the customer, selects and provides the equipment and consumables, monitors performance, and carries out servicing and disposal. In return it receives payment as the customer uses the printing capability (Baines *et al.,* 2009b; Agrawal and Bellos, 2013). In 2001, Xerox was facing bankruptcy, and in order to survive it pursued a service transformation from selling and producing office equipment to optimizing business process operations of customers. Today, over 80 percent of total revenues is annuity-based revenue that includes contracted services, equipment maintenance, consumable supplies, and financing services (Kindström and Kowalkowski, 2015).

- Caterpillar is an equipment and power systems manufacturer that provides through-life support systems for all of its equipment and power systems (condition monitoring). Caterpillar has shifted its strategy from solely manufacturing and selling construction equipment to adopting a leasing and remanufacturing strategy (Robotis *et al.*, 2012). Caterpillar guarantees costs per operating hour of equipment, which include all maintenance and repair activity, as well as a guarantee that the equipment will be available (Grubic and Jennions, 2018). Remote monitoring technologies are used to track the state of assets and make predictions about service and support requirements. Real time data is used to help optimizing the performance of the client's business, by minimizing equipment downtime and operating costs. Caterpillar clients are requesting long-term partnerships, where the manufacturing company take on and manage risk that the client used to carry.

- Hilti is a world-leading manufacturer of power tools for the construction, building maintenance, energy and manufacturing industries, mainly for the professional end-

user. Following its customers' needs, Hilti moved from selling power tools to leasing them as a service. Instead of selling power tools to its customers, the Fleet Management (FM) offering allows customers to use a defined set of tools (i.e. a tool fleet) for a fixed period of three to five years for a fixed monthly rate, which covers all the costs with tools from a customer, including their use, service and repair costs. All the tools in the fleet are regularly replaced with the latest models. This helps to avoid costly downtime and to comply with the latest safety standards. Not only is FM delivering many benefits to Hilti's customers, it also allows Hilti to cooperate even more closely with its customers and raise the barrier for the competition while ensuring a consistent revenue stream (Michel, 2013). The introduction of the new business model contributed significantly to the success of Hilti, since it sustainably differentiated the company from its competitors (Casadesus-Masanell *et al.*, 2017).

1.2 Motivation

Although, servitization is not a novel topic (as seen in section 1.1.1), there are several reasons to research on it.

First, the structure of the global economy is changing as products mature and markets globalize, leading to an increased level of competition, changes in consumer expectations and requirements, and reduced margins (Bikfalvi *et al.*, 2013). In times of economic crisis the value chain of goods manufacturers is becoming less attractive as the demand for products becomes increasingly stagnated. Under such circumstances, manufacturing firms seem to be aware of the value inherent in offering the services needed for running and maintaining the products they manufacture (Wise and Baumgartner, 1999). Services seem to provide a more constant income, higher profit margins and require less asset allocation than manufacturing (Davies *et al.*, 2007). Although, servitization does not represent a panacea for manufacturers, it is a concept of significant potential value, providing routes for manufacturers to move up the value chain and exploit higher value business activities. (Baines *et al.*, 2009a). Services, more than ever, may offer opportunities for manufacturing firms in developed countries to create value (Neely, 2012).

Second, the addition of service offerings to the portfolio of traditionally product-oriented companies may force the manufacturer to redesign its business model (Baines et al., 2009a) and to create a novel organizational structure. The adoption of a servitization strategy may bring with it significant cultural and corporate challenges (Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999; Brax, 2005; Slack, 2005). Therefore, we need to improve our understanding of how integrated product-service business models impact economic success

of manufacturing firms (Neely, 2009; Fang et al., 2008; Kastalli and Van Looy, 2013; Ostrom *et al.*, 2015; Bigdeli *et al.*, 2017). Also the transformational issues that manufacturers seeking to servitize face, should be deeper understood (Oliva and Kallenberg, 2003; Davies et al., 2006).

Third, case study-based research is the most common methodological approach in previous literature (Oliva and Kallenberg, 2003; Neu and Brown, 2005; Davies *et al.*, 2007; Kindström and Kowalkowski, 2009; Matthyssens and Vandenbempt, 2010). This approach seems to be appropriate for an in-depth exploration of the mechanisms related to services and for building hypotheses about relationships between independent and dependent variables (Lay, 2014). However, to test these hypotheses, broader longitudinal studies with large-scale and observations should also be used. The long-term dynamics between the variables should be addressed.

Fourth, the importance of researching this subject relies on the consolidation and formalization of knowledge on servitization so that the opportunities can be widely accessed (Baines and Lightfoot, 2013). We are interested in advancing the knowledge frontier of the Servitization field.

This study deals specifically with the servitization of the manufacturing firm. Although a common perception is that servitization is confined to manufacturing, some studies show that this is not always necessarily the case (Vardermerwe *et al.*, 1988; Kowalkowski *et al.*, 2017a*)*. Service sector firms can also servitize by increasing the bundling of their service offerings (Baines *et al.*, 2019). It is also important to notice, that some manufacturing firms may follow a strategy to move away from or reduce service provision, the so called deservitization process (Finne *et al.*, 2013; Valtakoski, 2017; Kowalkowski *et al.*, 2017a). Nevertheless, the scope of our study is restricted to manufacturing firms engaging with servitization and excludes service businesses or those manufacturing firms undergoing deservitization.

A detailed identification of literature gaps will be presented in the next section.

1.3 Identification of literature gaps

From the literature review several literature gaps were identified, and grouped into four categories, concerning the research design, servitization intensity, capabilities and performance.

Gaps concerning the research design. The research design refers to the overall strategy that is chosen to integrate the different components of the study in a coherent and logical way, thereby, ensuring that the researcher will effectively address the research problem; it

constitutes the blueprint for the collection, measurement, and analysis of data (De Vaus, 2001).

Gap 1. Much research has been dedicated to the design and benefits of integrated product service offerings from a manufacturer perspective. The previous literature analysed servitization mostly from an organisational level perspective (Oliva and Kallenberg, 2003; Gebauer *et al.*, 2010; Baines *et al.*, 2017). More recently, some authors suggest that the organisational environment may also affect servitization of the manufacturing firm (Turunen and Finne, 2014; Baines *et al.*, 2017; Bigdeli *et al.*, 2017). Thus, servitization seems to be driven from both the outside and within the company (Turunen and Finne, 2014; Baines *et al.*, 2017; Bigdeli *et al.*, 2017). Notwithstanding, only a limited number of empirical studies have investigated in a holistic manner how external and internal factors promote or hinder servitization over time (Bigdeli *et al.*, 2017).

Gap 2. The evidence base used is relatively sparse. There are only a few authors that used large scale empirical data, e.g. Davies (2004), Fang *et al.* (2008), Neely (2009), Suarez *et al.* (2013), Kastalli and Van Looy (2013), Eggert *et* al. (2014) and Visjnic *et al.* (2019). Thus, there is a dearth of evidence on antecedents and performance outcomes of servitization based on large-scale studies (Gebauer et al., 2012; Baines and Lightfoot, 2014; Eloranta and Turunen, 2015; Sousa and da Silveira, 2017).

Gap 3. There is also little evidence recording the evolution of servitization within manufacturing industries (Baines *et al.*, 2009c), and its impacts on the manufacturer. In the literature one can only find a few longitudinal studies. There is a strong need for more longitudinal studies (Bigdeli *et al.*, 2017; Baines *et al.*, 2017) being in line with the argument that servitization is a long-term, often incremental process (Gebauer *et al.*, 2012).

Gap 4. The case studies normally used to support the arguments presented, result mostly from a few large manufacturers (e.g. Ulaga and Reinartz, 2011; Kastalli and van Looy, 2013), but they still constitute only snapshots of the servitization process. It emphasises the need of a view of servitization that is longitudinal and dynamic, contrasting with the cross-sectional approaches that dominate extant empirical research, arising from the difficulty in accessing data. More retrospective case studies are needed to help understanding the dynamics of servitization over time.

Gaps concerning the servitization intensity:

Gap 5. The scale or intensity of servitization is usually very difficult to obtain and measure. The simplest operationalization of servitization levels is simply to equate service provision with the share of revenue generated by services (Gebauer *et al*., *2005;* Fang *et al.*, 2008; Suarez *et al.*, 2013). One important reason for the relatively rare use of quantitative methods is likely to be the difficulty in collecting data on service provision. Because most manufacturing firms do not report services separately in their financial reports, secondary databases cannot usually be used to develop or test hypotheses regarding service provision.

Gap 6. Prior research has rarely examined the drivers of servitization in highly servitized industries (Kastalli and van Looy, 2013). Studying highly servitized industries is especially important, since it enables the evaluation of the extent to which drivers of servitization play out over a long period of time.

Gaps concerning the capabilities. Capabilities refer to a firm's capacity to deploy combinations of resources to achieve a desired goal (Amit and Schoemaker, 1993):

Gap 7. Much of the existing literature is normative and prescriptive, focusing upon what organisations aspire to do, but offer little insights into how attempts to integrate products and services occur, or the challenges organisations encounter (Johnstone *et al.,* 2009; Ostrom *et al.*, 2015), when developing or deploying capabilities.

Gap 8. Despite the theoretical attractiveness of the concept, the implementation of servitization in practice seems to be significantly more complex and sector determined than referred in the literature. There seems to be a lack of a detailed understanding of how product-service strategies are operationalized (Johnstone *et al.*, 2009). Delivering services seems to be more complex than manufacturing products and requires different approaches to product – service design, organisational strategy and organisational transformation (Baines *et al.*, 2009a).

Gaps concerning the performance. We define performance as an assessment of how well an organization executes on its most important parameters (Morgan, 2012):

Gap 9. Our understanding of the impact of servitization on the performance of product firms is still much incomplete (Gebauer *et al*., 2012; Kohtamäki *et al.*, 2015; Sousa and Da Silveira, 2017; Raddats *et al.*, 2019). For instance, it cannot yet be reliably stated which factors and how they affect the impact of servitization on the performance of manufacturing firms, over time (Ulaga and Reinartz, 2011; Kohtamäki *et al.*, 2015; Gebauer *et al.*, 2016; Benedettini *et al.*, 2015).

Gap 10. While early studies on servitization primarily focused on the strategic and marketing benefits of servitization, the financial impact of servitization is not total clear. Most of the cases presented do not describe changes in financial performance over time. Thus, scholars have called for an in-depth understanding of the financial performance outcomes of servitization (Eggert *et al.*, 2014; Bigdeli *et al.,* 2017).

Gap 11. It is not yet possible to indicate reliably what kind and/or intensity of service provision will lead to improved performance under which circumstances. The extant evidence suggests a complex relationship between service provision and firm performance (Fang *et al.*, 2008; Cusumano, 2008; Gebauer *et al.*, 2012; Suarez *et al.*, 2013). Therefore, the simple advice 'to add services' is not likely to always produce satisfactory performance outcomes for manufacturing firms (Mathieu, 2001a; Brax, 2005; Gebauer *et al.*, 2005; Neely, 2009; Eggert *et al.*, 2011; Ulaga and Muenkhoff, 2011; Ryals and Rackham, 2012; Gebauer *et al.*, 2012; Kohtamäki *et al.*, 2013; Ostrom *et al.*, 2015; Coreynen *et al.*, 2017; Sousa and Da Silveira, 2017).

In the next section, the empirical setting will be addressed.

1.4 Industry Choice | Empirical setting

1.4.1 The elevator industry

This study focuses on the elevator industry. This industry includes firms that sell, produce, assemble and maintain elevators, and comprises two main business segments: new installations (goods) and services.

The new installations business segment includes the selling, production and assembly of new passenger and freight elevators in new or existing buildings.

In the service business segment, elevator firms are providing basic services and advanced services (Mathieu, 2001a; Baines and Lightfoot, 2014; Sousa and Da Silveira, 2017). Basic services aim to install and maintain basic product functionality. This category of services covers the bundling of some extra services to the sale of goods, and the manufacturer may offer services that are needed during the use phase of the good (Tukker, 2004; Baines *et al.*, 2013). The basic services include spare parts provision, warranty, modular-based preventive maintenance contracts, which can be tailored according to customer requirements, repair, overhaul / modernization (upgrade of single components to ensure reliability and improve performance, or modernization of key systems such as control systems or door operator units, or major modernization of the complete elevator system), and condition monitoring.

Advanced services relate to working closely with customers to co-create value that goes beyond basic product operation, involving the adaptation of the product use to the customer's

unique needs and usage situation (Sousa and Da Silveira, 2017). Advanced services include customer support agreement, risk and revenue sharing contracts or revenue-through-use contract (Baines *et al.*, 2013), such as modular-based full maintenance contracts, which can be tailored according to customer requirements, and consultancy services, for example, energy efficiency improvement programs.

The business model is based on a life-cycle approach. The average product lifecycle for elevators can be estimated within the range of 20 to 25 years. The elevator firm provides customers with solutions for the entire lifetime of their elevators, starting from new equipment installation. In this business area, customers include mainly builders, general contractors and developers. The use of the equipment triggers the second business, targeting customers such as facility managers and building owners. Regular maintenance is required to keep equipment running smoothly. As the equipment ages, larger repairs and replacements of parts are required to maintain its optimal performance. Eventually, full replacement becomes necessary to ensure modernization. The new equipment business is more cyclical in nature and fuels the growth of the maintenance business in the long term. Service, on the other hand, brings stability to the business over economic cycles (because even in times of recession, maintenance is required to keep equipment running smoothly) and in turn, the end of the useful life time of the equipment creates potential for modernization.

Being a long-lived equipment, elevators are technically complex and demand high safety requirements and, consequently, ongoing maintenance and inspection. Thus, elevator manufacturing companies tend to provide services and bundle them with the products they sell, for a long time. The continuous usage of an elevator over time tends to increase fault-occurrence probability, which requires quick troubleshooting. Although elevators are designed, produced and installed through accurate quality processes, if left without maintenance they could lose not only their original functions, but also be subject to low performance and safety accidents (Park and Yang, 2010). In order to assess the reliability and efficiency of the elevators, the maintenance program is a significant part of the overall elevator system. The safe operation of elevators, which entails the provision of proper and quality maintenance services, is crucial to numerous end-users (Lee, 2011), especially in high-rise buildings. Therefore, many countries have regulations that govern the maintenance activities in the elevator industry. These regulations significantly affect the industry as they provide norms for the maintenance and modernization of elevators. There is for instance, a legal obligation of providing maintenance services on a regular basis in several EU countries. Mature markets such as Europe and United States also operate under some established legislations regarding the modernization of elevators. Europe introduced the Safety Norms for Existing Lifts (SNEL) legislation in 2003, which was enacted as a law in most Western European EU member states by 2007.

Thus, the elevator industry is chosen for this research, since:

1. The elevator industry covers a broad spectrum of service offerings, from basic to advanced services (Mathieu, 2001a; Baines and Lightfoot, 2014; Sousa and da Silveira, 2017), making it an interesting and rich setting to conduct research on. Johnstone *et al.* (2009) argue that the aerospace industry, presents an ideal opportunity for joining up product and service offerings, since there are low rates of production, small total outputs and high per-unit costs. Original equipment manufacturers are expected to be highly responsive to requirements of customers who have a degree of control over the final product. The same arguments hold also for the elevator industry.
2. Moreover, the industry is highly servitized - in 2017, services accounted for more than 54% of the global revenues (2017 annual reports from Otis, Schindler, Kone and Thyssenkrupp). Thus, transition to services in the elevator industry is not a new issue. For example, elevator firms Kone and Thyssenkrupp have more than half of their total revenues coming from services and are often considered as worldwide exemplars of successful servitized manufacturers (Jacob and Ulaga, 2008; Fischer *et al.*, 2010; Kothamäki *et al.*, 2015).
3. This industry can be used to highlight and test several theoretical findings. It is possible to access quantitative data of almost all elevator companies that are operating in Portugal over a period of 13 years including information about service revenues. Therefore, a longitudinal study of the impact of servitization on performance may be developed. This is complemented by a worldwide analysis of the main multinational manufacturing elevator companies, also over time. An in-depth retrospective case study developed from semi-structured interviews of senior managers of a multinational elevator manufacturing company operating in Europe, will allow access to very detailed and in-depth information concerning servitization in this industry for the last thirty years. The researcher has been working in this industry for over 30 years and has inside evidence and deep knowledge about it.
4. Elevators are a technical complex equipment that demand high safety requirements and therefore ongoing maintenance and inspection. Elevators are also a long-lived equipment. Thus, elevator manufacturing companies tend to provide services and bundle them with the products they sell, for a long time.
5. Although the legal obligation of providing maintenance services on a regular basis (at least in European Countries like Portugal, Spain and Germany) seems to be a driver for servitization, the elevator manufacturing firms provide several other services.

6. There is a very large installed base and providing services through the entire product life (which normally is around 20-25 years) of this equipment could represent a significant market opportunity.
7. Studying a single industry allows for the natural control of a number of contextual factors that may influence servitization intensity (Turunen and Finne, 2014), as well as for a more granular insight on the factors that impact the performance of manufacturing firms (Suarez *et al.*, 2013; Eggert *et al.*, 2014; Kohtamäki *et al.*, 2015). These in depth insights are unobtainable from cross-industry accounting data (Kastalli and Van Looy, 2013).
8. Until now, nothing in the literature has been written in detail about servitization and this industry. The research will embrace the listed worldwide elevator manufacturing companies and also all the elevator firms in a single industry in one single country, over time.

1.4.2 The worldwide business landscape

The worldwide elevator market (including new equipment installation and service) was valued at 59.150 million Euros in 2017. Out of this, 46% consisted of new equipment revenues and the remaining 54% were generated through service provision.

Globally, the elevator industry has been dominated by four key players (also known as the "Big-Four"): Otis Elevator Company (17% market share in 2017), Schindler Holding Ltd. (15%), ThyssenKrupp Elevator AG (15%) and Kone Corporation (13%), which together control 60% of the worldwide market. These four original equipment manufacturers (OEMs) are followed by four Japanese firms - Mitsubishi, Hitachi, Toshiba and Fujitec. Together these eight companies control over 90% of the world market of elevators (Source: the annual reports of the cited manufacturers). In each regional market, there are also several smaller national and regional elevator firms that fight for a local market share, mainly in the service business segment.

The elevator market has shown a positive trend both in new installations as well as units in operation over the last 13 years. In 2017, there were approximately 14.5 million elevators in operation worldwide from 8.3 million in 2005. The new installations market accounted for 825.000 elevators sold in 2017, from 370.000 in 2005. The growth of the maintenance base of each supplier is mainly driven by conversions from new equipment sales, by acquisitions of smaller regional or local elevator companies and by wins from competition (equipment manufactured by other brands).

Service and product revenues have been growing fast. Despite this, the servitization intensity (service revenues divided by total revenues) has remained in a narrow interval (51% - 65%) (an average of 57%) over the period 2005-2017.

1.4.3 The Portuguese business landscape

According to ELA – European Lift Association, the installed base of the elevator industry in Portugal was approximately 152.600 elevators in 2017, evolving from 110.500 elevators in 2006. The elevator industry in Portugal was worth 288 Million Euros in 2017 - 95 Million Euros generated by new installations (products) and 193 Million Euros from services. Thus, around 67% of the global revenues in this industry are generated through services. While there are many elevator companies operating (76 in 2017), this industry faces a very high concentration on the supply side. The market share of the first five companies represents 73%. Although total revenues fell, on average, more than 28% in 10 years, service revenues remained stable and contributed to a stable average operating profit margin of 15%, absorbing the decline in product revenues.

Because of the critical aspect ‘safety of end-users’, there is a legal obligation that all elevators, which are installed and are in use, have regular maintenance: in Portugal, a monthly periodicity is defined by law. The owner of the elevator must sign a maintenance contract with a certified elevator company. All large product firms offer maintenance services to its installed base, but not only an Original Equipment Manufacturer (OEM) is able to provide the service. There are several smaller companies providing maintenance to elevators produced or installed by other manufacturing elevator companies.

The maintenance contract lasts for at least one year, and three to five years is the typical duration. There are monthly, quarterly, half-year and yearly payment plans providing a stable source of revenue for the manufacturing elevator company. Two main types of maintenance contracts are defined by law in Portugal: (a) The simple maintenance contract, which comprises the preventive maintenance, the functional check and care of all safety devices and setting and adjustment work of the elevator (all other services, as repairs, spare parts, overhauls must be paid for on a separate bill); (b) the full maintenance contract, which involves the preventive maintenance and the corrective maintenance (that is, repairs and supply of spare parts). This service contract covers all costs which can be incurred in connection with the operation of an elevator system. Therefore the whole risk with the operation of the elevator remains with the service provider.

The importance of services measured by the share of service revenues in percentage of total turnover of the product company has been steadily increasing, from approximately 49% of servitization intensity in 2006 to approximately 67% in 2017. The majority of the actual

revenues for companies in the elevator industry are generated through services, not products, which demonstrates the strong prevalence of servitization for the firms in this industry.

The next section describes the research objectives.

1.5 Research objectives

Taking into account the aforementioned gaps (see section 1.3), this research extends the literature by addressing the following three research questions (RQ):

- RQ1 - What factors affect servitization intensity over time?
- RQ2 - What factors affect the financial performance of the servitized manufacturing firm over time?
- RQ3 - How do the external and internal factors promote or hinder servitization of a manufacturing firm over time?

This study contributes to fill these gaps by developing and empirically testing hypotheses with longitudinal data from the elevator industry. Figure 1 details the underlying research framework, which includes the research questions, the conceptual model used for each and the methodology developed. The research questions are analysed in three distinct stages, one stage for each RQ (and research objective).

Information will be obtained:

i. From a content analysis of financial annual reports and other business reports of the world-wide listed elevator manufacturing companies.
ii. From a panel data analysis of financial data of product firms of the elevator industry in Portugal (from a secondary database).
iii. Through an in-depth retrospective case study of a multinational elevator company operating in Europe.

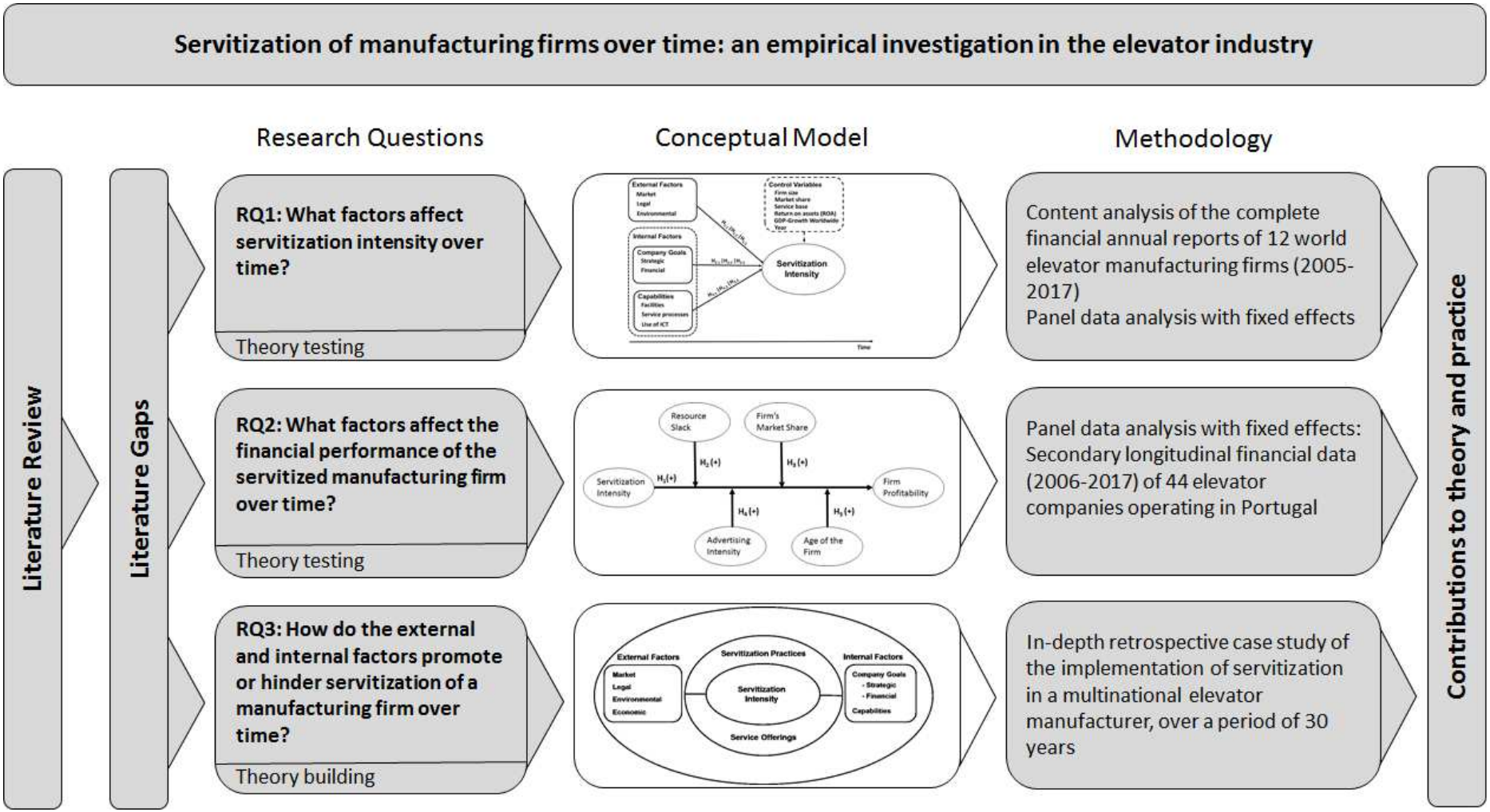


Figure 1 – Research framework

1.5.1 Objective 1: Understanding what factors affect servitization intensity over time

In the first stage of the research the purpose is to theoretically articulate and empirically test an integrated model of external and internal factors that affect the servitization intensity (measured as % of revenues from services) of manufacturing firms over time. We study manufacturers from the worldwide elevator industry, which is highly servitized (service revenues represent more than 50% of overall revenues). Hypotheses are tested based on statistical analyses of qualitative (obtained through content analysis) and quantitative (panel) data from annual financial reports of the main listed elevator manufacturing firms from different countries, between 2005 and 2017.

1.5.2 Objective 2: Understanding what factors affect the financial performance of the servitized manufacturing firm over time

The second stage of the research investigates factors that may moderate the impact of servitization on firm financial performance (profitability) over time in a highly servitized industry. We do so by studying the elevator industry in a single country (Portugal) over a period of twelve years. A panel data model on the impact of servitization intensity on firm profitability over time and associated moderating factors was developed. The model is tested with quantitative data of 44 product elevator firms obtained from a financial database over the period 2006-2017.

1.5.3 Objective 3: Understanding how the external and internal factors promote or hinder servitization of a manufacturing firm over time

Finally, stage three aims at understanding how the external and internal factors promote or hinder servitization of a manufacturing firm over time.

This stage of research is based on an in-depth retrospective case study of the implementation of servitization in a multinational elevator manufacturer, over a period of 30 years. The case study drew on multiple sources of evidence, including semi-structured interviews with senior managers, memos of workshops with the company´s key decision makers, company's internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company, and participant observation by the author at the company's premises during the research period.

The next section describes the research design.

1.6 Research design

Knowledge generation is advanced through triangulation, i.e. the use and combination of different methods to study the same phenomenon, so as to avoid sharing the same weaknesses (Voss *et al.*, 2002). Describing a phenomenon and striving to understand it fully requires qualitative methods and developing and validating the interrelationships among the principal components of a phenomenon requires statistical analysis of data. (MacCarthy *et al.*, 2013). These authors conclude that qualitative research and quantitative research are inextricably linked due to the path dependency of knowledge development and potentially provide a reinforcing cycle to generate robust theory. Or, as Meredith (1998, p. 453) argues: "[...] the explanation of quantitative findings and the construction of theory based on those findings will ultimately have to be based on qualitative understanding".

Thus, to address the gaps defined in section 1.3, the research design used a combination of methods through different stages to pursue the objectives mentioned in section 1.5 (see Figure 1).

To gain a better understanding of what factors affect servitization intensity over time, stage 1 involved a qualitative study using content analysis of the financial annual reports, sustainability and other relevant reports of the main multinational companies that operate worldwide (over the last 13 years). This method was considered adequate because it provides an in-depth understanding of the factors that affect servitization intensity over time (Beattie *et al.*, 2004; Montabon *et al.*, 2007; Benedettini *et al.*, 2015, 2017).

The research focus then moved to studying the factors that affect the performance of the servitized manufacturing firm over time. In stage 2 we adopted a quantitative study to respond to the challenge of understanding each factors impact on the financial performance of the servitized manufacturing firm over time. Using longitudinal quantitative data from the SABI database, which contains financial data (over the last 12 years) from all the elevator companies that operate in Portugal, the companies' financial performance was used to test hypotheses associated with the research question RQ2.

Finally, a retrospective case-study about a multinational elevator manufacturing company was applied in stage 3. The research is based on an in-depth retrospective case study of one elevator manufacturing firm with operations in a European country (hereafter referred to as Up-Down Elevators). Case research is considered one of the most powerful research methods in operations management (Voss *et al.*, 2002), in particular for examining how and why questions, as well as longitudinal issues (Yin, 1994; Voss *et al.*, 2002). It is also suitable for developing new theory (Eisenhardt, 1989; McCutcheon and Meredith, 1993; Yin, 1994; Voss *et al.*, 2002).

The following sections detail each stage of the dissertation research process and the applied methodologies (see figure 2).

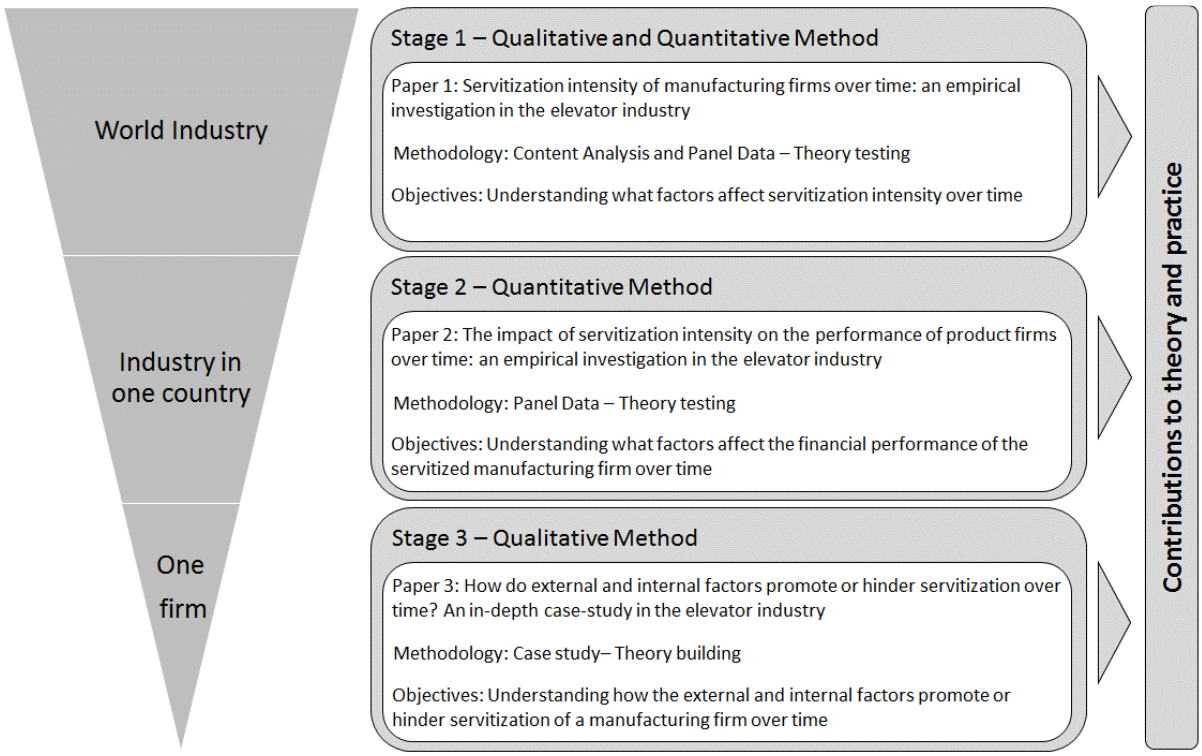


Figure 2 – Process employed in the dissertation and papers' organization

1.6.1 Stage 1

In Stage 1 of the research design (see Table 2), we test our model with qualitative (obtained through content analysis) and quantitative data from annual financial reports, sustainability and other relevant reports of the main listed elevator manufacturing firms from different countries, over time. These data provide in-depth insights, which are unobtainable from cross-industry accounting data (Kastalli and Van Looy, 2013). This strategy was chosen to pursue objective 1 of understanding what factors affect servitization intensity over time (theory testing).

Content analysis is defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Weber, 1990; Stemler, 2001; Montabon *et al.*, 2007). A good description of the method is provided by Boyatzis (1998).

Content analysis gained legitimacy as a methodology in the field of management in the 1980s (Benedettini *et al.*, 2015), and may be applied to annual reports (Smith and Taffler, 2000; Vanstraelen *et al.*, 2003; Beattie *et al.*, 2004; 2007). As Stemler (2001) states, content analysis extends far beyond simple word counts. This technique is particularly rich and meaningful since it relies on coding and categorization of the data being subject to analysis. An '*a priori*'

coding scheme will be used, meaning that the categories will be established prior to the analysis based upon some theory (Stemler, 2001; Weber, 1990).

Content analysis is, therefore, a suitable approach for converting the information of the annual reports and other official reports from firms into data needed for our study. We followed the procedures of the method defined by Krippendorff (1980) and Weber (1990): 1. the choice of the framework used to classify information; 2. the definition of the recording unit; 3. the coding; 4. and the assessment of reliability.

After having coded for the factors and gathered all needed data from the annual reports of the firms, a panel data analysis was conducted. Longitudinal data or panel data are repeated measurements at different points in time on the same firm. Regressions can then capture both the variation over firms and the variation over time (Cameron and Trivedi, 2009). The panel data model has a number of advantages relative to cross-sectional or time series models. First, it has a greater ability to capture dynamic effects over time and to identify causal effects (Hsiao, 2007). Second, it develops a more accurate inference of model parameters due to a larger sample size, controlling for the impact of omitted or missing variables that are correlated with the explanatory variables (Hsiao, 2003; Baltagi, 2005). Finally, it is better able to identify and measure effects that are simply not detectable in pure cross-section or pure time-series data (Baltagi, 2005), by clearly isolating the main factors affecting the outcome (servitization) over time.

We used panel data analysis with fixed effects to control for time-invariant, unobserved heterogeneity among firms. This allows for the analysis of the impact of variables that vary over time and remove the effect of time-invariant characteristics. We also verified that the panel data with random effects model was not statistically significant. We followed the procedures defined by Cameron and Trivedi (2009).

Table 2 – Stage 1: sample design and data collection

Stage 1 **Qualitative method to understand what factors affect servitization intensity over time**	
Method	Content analysis + Panel data analysis with fixed effects
Theoretical contribution	Theory testing
Sample design and data collection	• 12 listed world elevator manufacturing firms. • Content analysis of the complete annual reports and other relevant reports from 2005 to 2017. • Quantitative data from annual reports.
Remarks	The sample of 12 public listed world elevator manufacturing firms accounts for more than 65% of the world market in 2017. This industry is highly servitized: on average (in the period 2005-2017), 57% of total revenues were generated through services.

1.6.2 Stage 2

In Stage 2 of the research design, a quantitative study with secondary longitudinal financial data of product elevator companies operating in Portugal is undertaken (see Table 3) for theory testing.

This approach is based on the analysis of secondary longitudinal financial data obtained from the database SABI – Bureau van Dijk. These data cover the period 2006-2017 for all the elevator companies that operate in Portugal. For our study we only considered the servitized companies, i.e. firms that report product and service revenues. Therefore, we ended up with 44 elevator firms that provided both products and services (at least in one of the years considered). The remaining companies are pure product or pure service firms.
Since the approval of the 'Plano Oficial de Contas' (POC) – The official Chart of Accounts (until 31.12.2009) and thereafter the new Chart of Accounts - 'Sistema Nacional de Contabilidade' (SNC) a separation between product revenues and service revenues has been imposed. This means that all companies operating in Portugal are obliged to report the revenues generated with products and services separately. Therefore it will be possible to calculate the servitization intensity for all the elevator companies and help explaining the different servitization levels (servitization intensity) by crossing this information with other financial data on a company-based level.

Starting from the company level it shall be possible to calculate the aggregate figures for the elevator industry in Portugal. Hence, an industry-wide analysis can be performed. The financial data of the industry may then be crossed with the installed base figures. From the European Lift Association (ELA) the global installed base numbers for each period are to be obtained. This data can then be crossed with the financial data. The installed base figures of each company cannot be accessed, since the elevator companies operating in Portugal are not obliged to communicate these to the official authorities. A calculation of the aggregate values for the whole industry will then follow, and these financial data will be crossed with figures of the installed base.

Profitability is assessed by the commonly used measure of operating margin (or return on sales), defined as the firm's operating profit divided by total sales of the firm (Suarez et al., 2013; Sousa and da Silveira, 2017). We use operating margin instead of net margins because net margins can be influenced by other financial factors such as tax benefits that do not correspond to service operations. Our measure of profitability is a good proxy for overall firm performance given the context of our study. This indicator also meets universal acceptance between researchers.

Other more traditional measures, such as return on assets (ROA) or return on equity (ROE), are not typically used within this industry.

We employ a panel data model with the firm performance as dependent variable. Regressions can then capture both the variation over firms and the variation over time (Cameron and Trivedi, 2009). It must be defined if a fixed-effects (the firm-specific effect is a random variable that is allowed to be correlated with the explanatory variables) or if a random-effects (the firm-specific effect is a random variable that is uncorrelated with the explanatory variables) treatment of unobserved heterogeneity is better suited. The Hausman specification test (Cameron and Trivedi, 2009), which is significant, indicates that the random-effects treatment of unobserved heterogeneity is not appropriate. Therefore, we use panel data analysis with fixed effects to control for time-invariant, unobserved heterogeneity among firms, since it is used to analyse the impact of variables that vary over time and remove the effect of time-invariant characteristics. The panel data is strongly balanced, meaning that almost all firms have data for all the years considered. From a methodological point of view, a simultaneous assessment of regression equations control for potential correlations. Therefore, investigating financial performance outcomes within a single analytical framework should produce more reliable results (Eggert *et al.*, 2014).

Table 3 – Stage 2: sample design and data collection

Stage 2 **Quantitative method to understand what factors affect the performance of the servitized manufacturing firm over time**	
Method	Panel data analysis with fixed effects
Theoretical contribution	Theory testing
Sample design and data collection	• The first step was to identify all elevator companies operating in Portugal, regardless of size (i.e. number of employees) and incorporation date. A resulting list of 114 elevator companies was then cross-checked with the official authorized companies listed in the site of General Direction of Geology and Energy from the Portuguese Ministry of Economics in order to guarantee that all elevator companies were considered. • For our study we only considered the servitized companies, i.e. firms that report product and service revenues. Therefore, we ended up with 44 elevator firms that provided both products and services (at least in one of the years considered). The remaining companies are pure product or pure service firms. • Quantitative data: secondary longitudinal financial data obtained from the database SABI – Bureau van Dijk, from 2006 to 2017.
Remarks	The sample of the 44 portuguese product elevator firms accounts for more than 85% of the portuguese market in 2017. This industry in Portugal is highly servitized: on average (in the period 2006-2017), 61% of total revenues were generated through services.

1.6.3 Stage 3

In Stage 3 we adopted an in-depth retrospective case study of the implementation of servitization in an elevator manufacturer, over a period of more than 30 years (see Table 4) for theory building. It will be hereafter referred to as Up-Down Elevators.

Leonard-Barton (1990, p. 249) defines case study as “a history of a past or current phenomenon, drawn from multiple sources of evidence. It can include data from direct observation and systematic interviewing as well as from public and private archives. In fact, any fact relevant to the stream of events describing the phenomenon is a potential datum in a case study, since context is important”.

Case research is considered one of the most powerful research methods in operations management (Voss *et al.*, 2002), in particular for examining how and why questions, as well as longitudinal issues (Yin, 1994; Voss *et al.*, 2002). It is also suitable for developing new theory (Eisenhardt, 1989; McCutcheon and Meredith, 1993; Yin, 1994; Voss *et al.*, 2002).

Through semi-structured interviews to senior managers we examined more deeply the longitudinal patterns that might arise of how the relevant factors promote or hinder the different servitization levels and its causes/explanations. By investigating a contemporary phenomenon within its real-life context (Yin, 1994), the case study can also be used to examine more deeply and validate previous empirical results (Voss *et al.*, 2002).

A retrospective case research can be particularly valuable. As Voss *et al.* (2002, p. 202) argue “[o]ne of the most difficult but most important things we try to identify in research is the relation between cause and effect. The longer the period over which phenomena are studied, the greater the opportunity to observe at first hand the sequential relationships of events”.

The case method was adopted because it permitted the collection of rich qualitative data through participant observation. As a manager of the manufacturing firm analyzed, the researcher was directly involved in managerial decisions, allowing him to leverage on his field experience and to contribute with new and unique insights to the subject matter (Iacono *et al.*, 2009). Due to the concerns over confidentiality, access to in-depth fieldwork is not easily granted to outsiders. The literature recognizes “the knowledge-yielding character of inquiry from the inside, and legitimizes the contribution of industry practitioners to management research” (Iacono *et al.* 2009, p.44). According to Yin (1994), participant observation provides an opportunity to gain access to events and groups that otherwise would be inaccessible to the researcher. Through participant observation the researcher may also perceive reality from the viewpoint of someone “inside” the case study rather than external to it (Yin, 1994). Despite its advantages, this data collection technique may lead to some potential biases: the influence

of the researcher over participants' behaviours, the impact of the researcher's own beliefs (Iacono *et al.*, 2009), and the potential lack of objectivity, for instance following a commonly known phenomenon and become a supporter of the group or organization being studied (Yin, 1994). Finally, the researcher may "not have sufficient time to take notes or to raise questions about events from different perspectives, as good observer might" (Yin, 1994, page 89). To mitigate these potential problems, interviews were conducted by two researchers, with one researcher handling the interview questions, while the other recorded notes and observations (Eisenhardt, 1989). Therefore, the "interviewer has the perspective of personal interaction with the informant, while the note taker retains a different, more distant view" (Eisenhardt, 1989, p. 538).

In order to enhance reliability and validity, we developed a research protocol, using a pre-defined conceptual framework as a lens for analysis. This protocol contained the procedures and general rules that should be followed during data collection and indicates from whom or where different sets of information are to be sought. The core of the protocol was the set of questions to be used in interviews. It outlines the subjects to be covered during an interview, states the questions to be asked and indicates the specific data required. This ensured that all areas of enquiry were covered.

A single case was chosen, because it is an unusually revelatory, extreme opportunity for research access and may lead to deep insights that are unobtainable in quantitative studies (Yin, 1994). Thus, single-case research typically exploits opportunities on a significant phenomenon under rare or extreme circumstances (Eisenhardt and Graebner, 2007). Up-Down Elevators was selected because of: i) in-depth access to the company (people and archival documents); ii) access to relevant information over 30 years (from 1989 until 2018); iii) the firm not only produces goods (elevators) but also provides all sort of services to the installed base.

Following the triangulation principle (Voss et al., 2002), our data consists of a wide range of material: semi-structured interviews with senior managers, memos of workshops with the company´s key decision makers, the company's internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company, publicly available information and site visits and participant observation by the author on the company's premises during the research period.

Since interviews are a highly efficient way to gather rich, empirical data (Eisenhardt and Graebner, 2007), we used numerous and highly knowledgeable informants who view the focal phenomena from diverse perspectives. These informants included organizational actors from different hierarchical levels, functional areas, groups and geographies (Eisenhardt and

Graebner, 2007). The interviews lasted 60-120 minutes and were conducted over a period of two months. Throughout the study, following each interview a thematically arranged outline describing the covered issues was written. Interviews were carried out until theoretical saturation was reached, that is, when no new information emerged. There were a total of 15 semi-structured interviews carried out: 2 Co-CEOs, 2 senior service managers, 2 senior new installation managers and 7 service managers and 2 new installations managers. All of them were recorded. Detailed write-ups were prepared and sent to the interviewees to validate the data and maintain participant engagement in the research process.

Data analysis took place in three phases – data reduction, data display, and conclusion drawing – following the guidelines of Miles and Huberman (1994).

Phase one consisted of documenting and coding the data. It is important to try to reduce data into categories (Miles and Huberman, 1994; Voss *et al.*, 2002). “Data reduction refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data” (Miles and Huberman, 1994 p. 10). From the literature review and the conceptual framework we created a provisional “start list” of codes prior to fieldwork. This step consisted of coding interview write-ups, company documentation (internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company), and field notes, in order to reduce and map data into categories.

In phase two, we produced a set of tabular displays that gave the depth of understanding that is needed for case analysis. A display is a visual format that presents information systematically so that the user can draw valid conclusions (Voss *et al.*, 2002). Since we are dealing with a retrospective case an analysis of the sequence of events was also drawn.

Phase three was concerned with the conclusion drawing. Thereafter a pattern analysis of the data was conducted using a causal network. A causal network is a “display of the most important independent and dependent variables in a field study and of the relationships among them’’ (Miles and Huberman, 1994, p. 153). Causal networks are associated with analytic texts describing the meaning of the connections among factors. This has been used in operations management by Sousa (2000), following Miles and Huberman’s (1994) guidelines. Next, we searched for relationships among the constructs and variables. These methods were not linear, but formed a recursive, process-oriented, analytic procedure that continued until we grasped the emerging theoretical relationships.

A case study database with all available interview transcripts, case study write-ups, and other documents was put together in order to increase reliability (in line with Kowalkowski *et al.*, 2013). This case study database was then used for subsequent data analysis.

Table 4 – Stage 3: sample design and data collection

Stage 3 **Qualitative method to understand how external and internal factors promote or hinder servitization of a manufacturing firm over time**	
Method	In-depth retrospective case study
Theoretical contribution	Theory building
Sample design and data collection	• One multinational elevator manufacturer, operating in an european country • Following the triangulation principle, our data consists of a wide range of material: semi-structured interviews with senior managers, memos of workshops with the company´s key decision makers, the company's internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company, publicly available information and site visits and participant observation by the author on the company's premises during the research period. • Since interviews are a highly efficient way to gather rich, empirical data (Eisenhardt and Graebner, 2007), we used numerous and highly knowledgeable informants who view the focal phenomena from diverse perspectives. These informants included organizational actors from different hierarchical levels, functional areas, groups and geographies (Eisenhardt and Graebner, 2007). The interviews lasted 60-120 minutes and were conducted over a period of two months. Throughout the study, following each interview a thematically arranged outline describing the covered issues was written. Interviews were carried out until theoretical saturation was reached, that is, when no new information emerged. • There were a total of 15 semi-structured interviews carried out: 2 Co-CEOs, 2 senior service managers, 2 senior new installation managers and 7 service managers and 2 new installations managers. All of them were recorded. Detailed write-ups were prepared and sent to the interviewees to validate the data and maintain participant engagement in the research process.
Remarks	The manufacturer Up-Down is highly servitized: on average (in the period 2005-2017), 65% of total revenues were generated through services.

In the next section the thesis outline will be presented.

1.7 Thesis outline

This section outlines the organization of the dissertation and summarizes the constituent chapters. The first chapter introduced the research, explained its main motivations and challenges, and overall objectives. The theoretical background was briefly discussed, in order to introduce the most relevant topics and gaps associated to servitization and its impact on firm financial performance. This chapter also described the research design undertaken, which, following the dissertation rationale is divided in three major stages, as depicted in Figure 2.

The main body of this dissertation are chapters 2, 3 and 4, each covering a different research stage and objective. Since the contents of these chapters come from three papers, each is self-contained. As shown in Figure 2, the first stage of research (paper I) involved a qualitative and quantitative study that theoretically articulates and empirically tests an integrated model of external and internal factors that affect servitization intensity of manufacturing firms over time.

Stage two of the research design (paper II) involved a quantitative study to fill the gaps of understanding the impact of servitization intensity on the financial performance of manufacturing firms over time.

The third stage of the research design (paper III) entails a case study approach to help understanding how the external and internal factors promote or hinder servitization of an elevator manufacturing firm over a period of more than 30 years.

The overall results and contributions of the dissertation are discussed in Chapter 5, taking in consideration the main objectives defined in Chapter 1. In this chapter we also present the managerial implications and future research directions, taking into account a dynamic view of servitization.

2. Paper I

Servitization intensity of manufacturing firms over time: an empirical investigation in the elevator industry.

This paper was submitted to the International Journal of Operations & Production Management (IJOPM).

Abstract

Purpose - The purpose of this paper is to theoretically articulate and empirically test an integrated model of external and internal factors that affect the servitization intensity (% of revenues from services) of manufacturing firms over time.

Design/methodology/approach – The authors study manufacturers from the worldwide elevator industry, which is highly servitized (service revenues represent more than 50% of overall revenues). Hypotheses are tested based on statistical analyses of qualitative (obtained through content analysis) and quantitative data from annual financial reports of the main listed elevator manufacturing firms from different countries, between 2005 and 2017.

Findings – Based on the longitudinal and dynamic analysis of panel data, the authors find that, contrarily to previous literature, external factors do not appear to have an impact on servitization intensity over time. Instead, servitization intensity seems to be mainly driven by factors that are controlled by the manufacturer, such as company goals and capabilities.

Practical implications – Manufacturers who wish to increase their servitization intensity over time in highly servitized industries should: 1) maintain a strategic focus on revenue increase; 2) strengthen the development of key capabilities over time, namely, the development of service facilities in close proximity to the customer and service processes. Moreover, in order to produce sustainable results over time, servitization should not be only a reaction to the external context, but rather a deliberate management decision associated with the setting of suitable goals and development of appropriate capabilities.

Originality/value – To the best of our knowledge this is the first longitudinal study to analyse the factors that impact servitization intensity, using qualitative and quantitative data from manufacturers over a long period of time in a highly servitized industry worldwide. It extends existing research by empirically examining longitudinal and dynamic impacts of key drivers of servitization intensity of manufacturing firms.

Keywords Servitization, Content analysis, Longitudinal study, Elevator industry, Highly Servitized Industry

Paper type Research paper

1. Introduction

The boundaries between manufacturing and service firms are breaking down across the world (Baines *et al., 2009a*; Neely, 2009; Johnstone *et al.*, 2009; Perona *et al.*, 2017), as an increasing number of manufacturing companies are competing through a portfolio of integrated products and services rather than products alone (Baines and Lightfoot, 2014; Sousa and da Silveira, 2017). The process through which this service-led competitive strategy is attained is commonly referred to as ***servitization***.

Much research has been dedicated to the design and benefits of servitization. However, our understanding of the factors that drive servitization intensity in manufacturing firms is much incomplete. First, only a few empirical studies have addressed in an integrated manner both the external and internal factors that may impact servitization intensity. Second, such research is mostly based on case studies of a few large manufacturers (e.g. Ulaga and Reinartz, 2011; Kastalli and van Looy, 2013) and there is a dearth of large scale empirical evidence. Third, most research to date has captured only snapshots of the servitization process (Gebauer *et al.*, 2005). Since servitization is a long-term, often incremental process (Gebauer *et al.*, 2012), there is a strong need for longitudinal studies (Bigdeli *et al.*, 2017; Baines *et al.*, 2017) to examine how external and internal factors influence servitization intensity over time. Studying highly servitized industries is especially important, since it enables the evaluation of the extent to which drivers of servitization play out over a long period of time. Prior research has rarely examined the drivers of servitization in highly servitized industries.

To address the aforementioned gaps, this study theoretically articulates and empirically tests an integrated model of external and internal factors that affect the servitization intensity of manufacturing firms over time. To do so, we draw on panel data from the worldwide elevator industry. The elevator industry covers a broad spectrum of service offerings, from basic to advanced services (Mathieu, 2001a; Baines and Lightfoot, 2014; Sousa and da Silveira, 2017), making it an interesting and rich setting to conduct research on. Moreover, the industry is highly servitized - in 2017, services accounted for more than 54% of the global revenues (2017 annual reports from Otis, Schindler, Kone and Thyssenkrupp). The transition to services in the elevator industry is not a new issue. For example, elevator firms Kone and Thyssenkrupp have more than half of their total revenues coming from services and are often considered worldwide exemplars of successful servitized manufacturers (Jacob and Ulaga, 2008; Fischer et al, 2010; Kothamäki et al, 2015). Studying a single industry allows for the natural control of several contextual factors that may influence servitization intensity (Turunen and Finne, 2014), as well as for a more granular insight into the factors that impact it (Suarez *et al.*, 2013; Eggert *et al.*, 2014; Kohtamäki *et al.*, 2015).

We test our model with data from annual financial reports of the main listed elevator manufacturing firms from different countries, between 2005 and 2017. We draw on both qualitative data (obtained through content analysis) and quantitative data. These data provide in-depth insights which are unobtainable from cross-industry accounting data (Kastalli and Van Looy, 2013). The panel data model that we employ has several advantages over cross-sectional or time series models. First, it has a greater ability to capture dynamic effects over time and to identify causal effects (Hsiao, 2007). Second, it develops a more accurate inference of model parameters due to a larger sample size, controlling for the impact of omitted or missing variables that are correlated with the explanatory variables (Hsiao, 2003; Baltagi, 2005). Finally, it is better able to identify and measure effects that are simply not detectable in pure cross-sectional or pure time-series data (Baltagi, 2005), by clearly isolating the main factors affecting the outcome (servitization) over time.

Based on the longitudinal analysis, we find that, contrarily to previous literature, external factors do not appear to have an impact on servitization intensity over time. Instead, servitization intensity seems to be mainly driven by factors that are controlled by the manufacturer. By addressing an under-researched aspect of servitization, this study makes an important contribution to the theoretical foundations of the servitization literature.

The paper is structured as follows. In the following section, we present the literature review and the theoretical background. In section 3, the hypotheses are developed. Section 4 introduces the methodology, sample selection, model, data collection and statistical methods. We formally test our hypotheses in section 5, followed by the discussion in section 6. The paper concludes with the main contributions, limitations and opportunities for future research.

2. Theoretical background

In the early stages of the research on servitization, the factors that seemed to drive manufacturing companies to pursue a servitization strategy were generally divided into three broad categories - *financial*, *strategic* and *market* rationales (Mathieu, 2001a; Oliva and Kallenberg, 2003; Baines *et al.*; 2009a; Neely, 2009).

Financial factors are associated with the positive impact on revenues and/or on margins that manufacturers may achieve while providing (more) services. Many studies refer that services seem to yield a higher sales margin than products (Wise and Baumgartner, 1999; Gebauer *et al.*, 2005; Johnstone *et al.*, 2009). Services also seem to better balance the effects of economic cycles, through more stable revenues (Brax, 2005; Mallaret, 2006; Gebauer *et al.*, 2006; Gebauer and Fleisch, 2007; Gebauer *et al.*, 2010; Eggert *et al.*, 2014).

Strategic factors are largely related to the achievement of competitive advantage. Services may be used to differentiate the offering from competitors' (Lightfoot *et al.*, 2011; Ryals and Rackham, 2012; Smith *et al*., 2014) and to create growth opportunities in mature markets (Antioco *et al*, 2008). *Market* factors are generally associated with the provision of services to satisfy demand for more services from existing customers, improving customer satisfaction and strengthening customer confidence and supplier credibility (Oliva and Kallenberg, 2003; Brax, 2005; Neely, 2012; Ryals and Rackham, 2012; Neely, 2013; Benedettini *et al.,* 2017). More recently, additional factors have been considered, such as *environmental*, *legal* and *capabilities*. Environmental factors are associated with business models in which customers share access to assets, rather than physically owning them, thereby reducing the environmental impact of production (Neely, 2012; Bocken *et al.*, 2014; Porter and Heppelmann, 2014; Doni *et al.*, 2019). *Legal* factors should also be considered (Bigdeli *et al.*, 2017; Sousa and da Silveira, 2019), as through legislation governments can impose the provision of certain types of service in some industries (Turunen and Finne, 2014). For instance, in the aerospace and elevator industries, this factor seems to contribute to servitization (Franco *et al.*, 2016, 2017, 2018). Finally, moving to service provision requires new *capabilities* (Gebauer *et al.*, 2005; Antioco *et al*., 2008; Baines *et al*., 2009b; Kowalkowski *et al*., 2011; Paiola *et al.*, 2013; Raddats *et al.*, 2015; Story *et al.*, 2017). In our study, we examine three diverse types of capabilities: developing facilities in close proximity to the customer, developing service processes and using service-based information and communication technologies (ICT) (Ostrom *et al.*, 2010; Baines and Lightfoot, 2014; Raddats *et al.*, 2015; Grubic, 2018).

Following the literature that argues that servitization seems to be driven from both the outside and from within the company (Turunen and Finne, 2014; Bigdeli *et al.*, 2017), we distinguish between external and internal factors. External factors are exogenous factors associated with the organisational environment and circumstances that impact the manufacturing firm (Sousa and Voss, 2008; Baines *et al.*, 2017) – these include the *market*, *legal* and *environmental* factors. On the other hand, internal factors are associated with direct managerial decision-making and are subdivided into *company goals* and *capabilities*. Company goals refer to voluntary decisions concerning the provision of services associated with expected benefits, which include the *strategic* and *financial* factors. Capabilities refer to a firm's capacity to deploy combinations of resources to achieve a desired goal (Amit and Schoemaker, 1993), and include the development of service facilities, service processes and the use of ICT. Table 1 lists the aforementioned factors mapped against these categories.

In our study, we assess the servitization intensity of the manufacturing firm through the share of revenues generated by services, in line with Gebauer *et al.* (2005), Fang *et al.* (2008) and Suarez *et al. (*2013).

The research model is presented in Figure 1 and will be detailed in section 3. Hypotheses were developed on the relationship between each factor and servitization intensity.

Table 1 – Classification of factors driving servitization intensity.

Categories		Factors		Rationale	Studies	Hypotheses
External		**Market**	1.1	Customer's demand for more services	Vandermerwe and Rada, 1988; Mont, 2002; Oliva and Kallenberg, 2003; Brax, 2005; Baines et al., 2009a; Johnstone *et al.* , 2009; Neely, 2012; Gebauer *et al.* , 2012; Ryals and Rackham, 2012; Neely, 2013; Kohtamäki *et al.* , 2013; Benedettini *et al.* , 2016	$H_{1.1}$
		Legal	1.2	Implementing services legal requirements	Turunen and Finne, 2014; Franco *et al.* , 2016; Franco et al., 2017; Franco et al., 2018; Sousa and da Silveira, 2019	$H_{1.2}$
		Environmental	1.3	Pressures for the mitigation of environmental impact	Mont, 2002; Mont, 2004; Tukker, 2004; Neely, 2009; Baines *et al.* , 2009a; Neely, 2012; Neely, 2013; Bocken *et al.* , 2014; Porter and Heppelmann, 2014; Doni *et al.* , 2019	$H_{1.3}$
Internal	Company Goals	**Strategic**	2.1	Strategies based on locking in customers	Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999; Mathieu, 2001a; Brax, 2005; Gebauer *et al.* , 2008; Neely, 2009; Baines *et al.* , 2009b; Baines et al., 2009a; Johnstone *et al.* , 2009; Neely, 2012; Gebauer *et al.* , 2012; Neely, 2013; Benedettini *et al.* , 2016	$H_{2.1}$
			2.2	Strategies based on providing custom-made products	Oliva and Kallenberg, 2003; Davies, 2004; Windahl *et al.* , 2004; Gebauer *et al.*, 2005; Neely, 2009; Lay *et al.*, 2010; Dachs *et al.* , 2012; Coreynen *et al.* , 2017; Sousa and da Silveira, 2019; Doni *et al.* , 2019	$H_{2.2}$
		Financial	2.3	Fostering to increase revenues	Shapiro and Mathe, 1993; Wise and Baumgartner, 1999; Mathieu, 2001a; Oliva and Kallenberg, 2003; Gebauer *et al.* , 2006; Gebauer and Fleisch, 2007; Johnstone *et al.* , 2009; Baines *et al., 2009a;* Gebauer *et al.* , 2010*;* Kastalli and van Looy, 2013*; Eggert* et al*., 2014;* Benedettini *et al.* , 2016; Sousa and da Silveira, 2017; Kowalkowski *et al.* , 2017	$H_{2.3}$
	Capabilities	**Capabilities**	3.1	The development of facilities in close proximity to the customer	Baines *et al.* , 2011b; Ulaga and Reinartz, 2011; Baines and Lightfoot, 2014	$H_{3.1}$
			3.2	The development of service processes	Mathieu, 2001b; Oliva and Kallenberg, 2003; Baines et al., 2009b; Neely, 2009; Johnstone et al., 2009; Baines et al., 2009b; Benedettini et al., 2009; Gebauer et al., 2010; Lightfoot et al., 2011; Baines et al., 2011a; Baines *et al.* , 2011b; Ulaga and Reinartz, 2011; Gebauer et al., 2012; Baines and Lightfoot, 2014; Bocken et al., 2014; Porter and Heppelmann, 2014	$H_{3.2}$
			3.3	Fostering the use of information and communication technologies (ICT)	Benedettini *et al.* , 2009; Lightfoot *et al.* , 2011; Neely, 2013; Kowalkowski *et al.* , 2013; Porter and Heppelmann, 2014; Baines and Lightfoot, 2014; Grubic, 2014; Coreynen *et al.* , 2017; Jaakkola *et al.* , 2017; Grubic, 2018; Kroh *et al.* , 2018	$H_{3.3}$

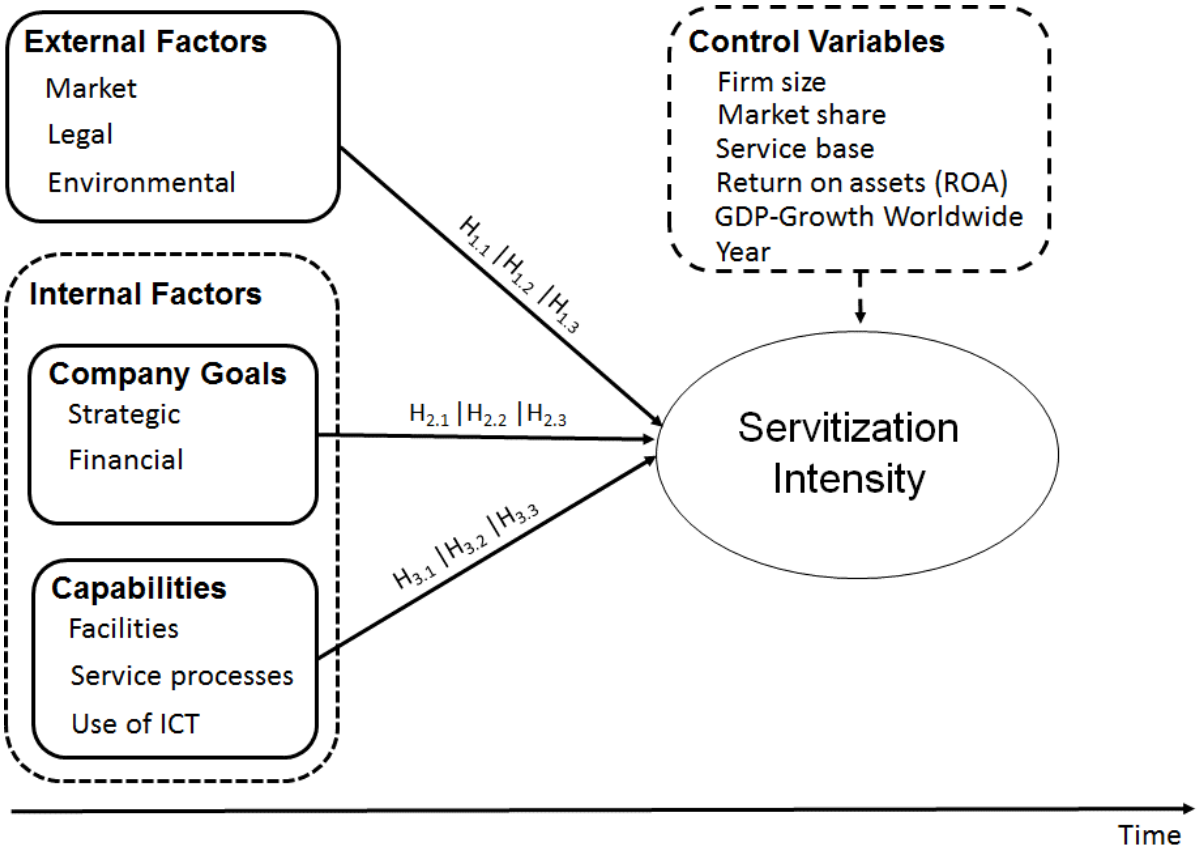


Figure 1 – Research model.

3. Hypotheses

External factors - Market

For a customer, services provided by the manufacturer may reduce the risk and decrease (or at least stabilise and make predictable) the maintenance and support costs that are incurred with the product operation. Therefore, customers have an incentive to demand more services (Vandermerwe and Rada, 1988; Oliva and Kallenberg, 2003; Brax, 2005; Baines *et al.,* 2009a; Ryals and Rackham, 2012; Benedettini *et al.*, 2017), such as contracting for capability (Johnstone *et al.*, 2009; Neely, 2012). Customers also tend to demand more customisation since they are more informed than ever before and seem to impose service-based contracts from their providers (Mont, 2002; Neely, 2013). As a reaction to market demand, manufacturing companies tend to add services to products with the goal of creating value for customers and ultimately for themselves (Baines *et al.*, 2009a). These arguments lead to the following hypothesis:

> **Hypothesis 1.1 ($H_{1.1}$)**: Customers' demand for more services has a positive impact on servitization intensity

External factors - Legal

Political forces may shape the legislation of an industry, significantly affecting servitization (Turunen and Finne, 2014). In certain industries, the provision of services, namely maintenance or modernisation services to the installed base, may result from a legal obligation (Turunen and Finne, 2014; Franco *et al.*, 2016; 2017; 2018). The impact of these legal factors on servitization intensity is most visible in tightly regulated industries where the absence of maintenance services usually triggers a human risk (Turunen and Finne, 2014). For example, in the aerospace industry, aircraft can only be operated in case they are released to service by qualified professionals after regular maintenance. In the elevator industry, the EU, for instance, introduced the Safety Norms for Existing Lifts (SNEL) legislation in 2003, which included a demand for stopping accuracy, which calls for controlled drive systems and ultimately implies replacing the drive, control and hoisting systems. As this legal factor may lead to the provision of additional services, such as the modernisation or overhaul of existing equipment, we propose the following hypothesis:

> **Hypothesis 1.2 ($H_{1.2}$)**: Implementing services legal requirements has a positive impact on servitization intensity.

External factors - Environmental

Pressures to mitigate the environmental impact of products may lead manufacturers to adopt servitization as it may indeed impact positively the environment. The adverse environmental impact of products may be reduced if manufacturing firms change their business models (Doni *et al.*, 2019) and customers revise their conception of ownership (Neely, 2009, 2012). Bocken *et al.* (2014) argue that one way to reduce the environmental impact is to deliver functionality rather than ownership, for example by means of sharing, renting and leasing schemes to customers (Mont, 2002). Mont (2004) proposes that servitization changes the incentives for the customer and manufacturer, by encouraging both to follow actions that minimise the environmental impact of the product. If the costs of the use and disposal phases are internalised, the manufacturer will tend to be more responsible for its products through take-back, recycling and refurbishment, and will reduce waste throughout the product's life cycle (Mont, 2002). In case the responsibilities for resource consumption are internalised, the manufacturer will also tend to design products that are more efficient in their use phase (Porter and Heppelmann, 2014), last longer and are more easily upgraded and repaired. A shift may occur from buying products to buying services, potentially minimising the environmental impacts. Hence, we propose the following hypothesis:

> **Hypothesis 1.3 ($H_{1.3}$)**: Pressures for the mitigation of environmental impact have a positive impact on servitization intensity.

Company goals - Strategic

Competing based on maintaining loyal customers is an increasingly favoured strategy by manufacturing firms. Servitization may be used to lock-in customers throughout a product's life span and earn their loyalty (Wise and Baumgartner, 1999; Johnstone *et al.*, 2009). By offering services, companies gain insight into their customers' needs and can develop more tailored offerings (Baines *et al.,* 2009a; Vandermerwe and Rada, 1988). The service component tends to influence the purchasing decision (Baines *et al., 2009b)* and to create customer loyalty to the point where the customer can become dependent on the supplier. A broader service provision may also increase the quality and longevity of customer relationships (Gebauer *et al.*, 2008; Benedettini *et al.*, 2017). A superior service increases not only repeat sales but also first-time sales, thus enhancing market share, because it strengthens overall customer satisfaction and confidence, as well as the supplier's credibility (Mathieu, 2001a). Therefore, we posit the following hypothesis:

> **Hypothesis 2.1 ($H_{2.1}$)**: Strategies based on locking-in customers have a positive impact on servitization intensity.

The type of products offered is often seen as a potential determinant of the service output and servitization intensity of a manufacturing firm (Oliva and Kallenberg, 2003; Lay *et al.*, 2010; Dachs *et al.*, 2012). Products which are complex, technologically innovative, capital intensive and long-lasting tend to favour service provision (Davies, 2004; Windahl *et al.*, 2004; Neely, 2009; Lay *et al.*, 2010). In the case of complex custom-made products (as elevators in the high-rise segment, CNC-Machines in the industrial segment or HVAC-Systems in big office buildings), customers may not have the necessary know-how to maintain and repair the equipment. A customer who buys a custom-made product which incorporates many parts and offers various functionalities may need more training, consulting, and maintenance or operation services than a buyer of standardised products. In addition, it will likely not make economic sense for customers to do the maintenance and repair themselves. Therefore, the manufacturers offering customised products have the opportunity to strategically design new ways of generating value through services along the entire supply chain (Davies, 2004; Gebauer *et al.*, 2005). The strong push toward customisation and faster innovation is leading companies to enhance their provision of additional services (Coreynen *et al.*, 2017; Doni *et al.*, 2019). These arguments lead to the following hypothesis:

> **Hypothesis 2.2 ($H_{2.2}$)**: Strategies involving the provision of custom-made products have a positive impact on servitization intensity.

Company goals - Financial

Manufacturing companies which aim at increasing revenues, are more likely to adopt servitization (Baines *et al.*, 2009a; Eggert *et al.*, 2014; Benedettini *et al.*, 2017; Kowalkowski *et al.*, 2017). This is because servitization can significantly contribute to increased revenues. Customers may derive greater value from buying a solution from a single supplier, rather than buying separate products and services from different providers (Sousa and da Silveira, 2017). This greater value may lead to a higher price of the product-service bundle that the customer is prepared to accept, since they may experience a procurement cost reduction (Sousa and da Silveira, 2017) or rely on the supplier's manufacturing competencies, for example, to perform product maintenance (Kastalli and van Looy, 2013). Services may also enhance the value of the goods and act as a potential generator of additional demand for products from both new and existing customers (Johnstone *et al.*, 2009). According to Mathieu (2001a), a superior service tends to increase both first time and repeat sales, leading to an increase in revenues. We thus suggest the following hypothesis:

> **Hypothesis 2.3 ($H_{2.3}$)**: Fostering to increase revenues has a positive impact on servitization intensity.

Capabilities

Manufacturing companies appear to adopt facilities that are located in close physical proximity to the customer base in order to support service delivery (Baines *et al.*, 2011b). These facilities may positively impact product performance and availability, because the manufacturer can respond with higher agility. Service staff show higher availability when a failure occurs and provide corrective actions more quickly and precisely, ensuring a faster fault diagnosis and response to a problem (Baines and Lightfoot, 2014). Thus, this capability may enable responsive and reliable maintenance, increasing the provision of services, namely the delivery of spare parts and repairs. Local facilities may also create and sustain a strong relationship between the manufacturer and the customer at the day-to-day operations level, ensuring good communication and an improved understanding of how products should be used and perform (Baines and Lightfoot, 2014). Finally, a network of facilities in close physical proximity to the customer seems to represent a key factor to provide not only after-sales services effectively, but also other services (Ulaga and Reinartz, 2011), such as overhauls or modernisations. This analysis leads to the following hypothesis:

> **Hypothesis 3.1 ($H_{3.1}$)**: The development of facilities in close proximity to the customer has a positive impact on servitization intensity.

The change from a traditional to a servitized manufacturer requires significant changes in existing processes and the development of new service processes (Baines *et al.*, 2009b). For example, the process of designing services is significantly different from the process of designing products since services are, by their nature, fuzzy and difficult to define (Slack, 2005; Baines *et al.*, 2009a). Services need to be designed to support the customers' business goals and practices and need to consider both product and service features that are consistent with the delivery of through-life performance. The service development process should have a long-term orientation, be holistic, balanced, iterative, and collaborative with the customer so that it produces benefits for the manufacturer and the customer in the long run (Kanninen *et al.,* 2017). Service processes can be seen as the chain of local and central actions to produce the service (Kowalkowski *et al.*, 2011). Therefore, we set forth the following hypothesis:

> **Hypothesis 3.2 ($H_{3.2}$)**: The development of service processes has a positive impact on servitization intensity.

Technology, and particularly information and communication technologies (ICT) such as the ability to capture, analyse and obtain insights from "big data", enabled by embedded sensors, advanced analytics and the internet of things, opens up new opportunities for service innovation and service provision (Kowalkowski *et al.*, 2013; Neely, 2013, Coreynen *et al.*, 2017; Martinez *et al.*, 2017; Jaakkola *et al.*, 2017; Grubic, 2018; Kroh *et al.*, 2018). The adoption of technology by manufacturers while providing services may be explained by the need to deliver asset performance, availability and reliability at a minimum cost (Benedettini *et al.*, 2009; Lightfoot *et al.*, 2011; Grubic, 2014). Manufacturers benefit from the direct access to product usage data, enabling them to increase service revenues by providing higher value to the customers' value-creating process (Kowalkowski *et al.*, 2013; Grubic, 2018). Through the use of ICT, manufacturing firms will be able to offer better customer service and support, and to transform their product offerings (Kowalkowski *et al.*, 2013). For example, the monitoring of the asset (as a provision of a service) may lead to an improvement in product functionality and performance (Porter and Heppelmann, 2014; Baines and Lightfoot, 2014). Thus, manufacturers may get valuable feedback for the R&D of new products and services. Therefore, we propose:

> **Hypothesis 3.3 ($H_{3.3}$)**: Fostering the use of ICT has a positive impact on servitization intensity.

4. Methodology

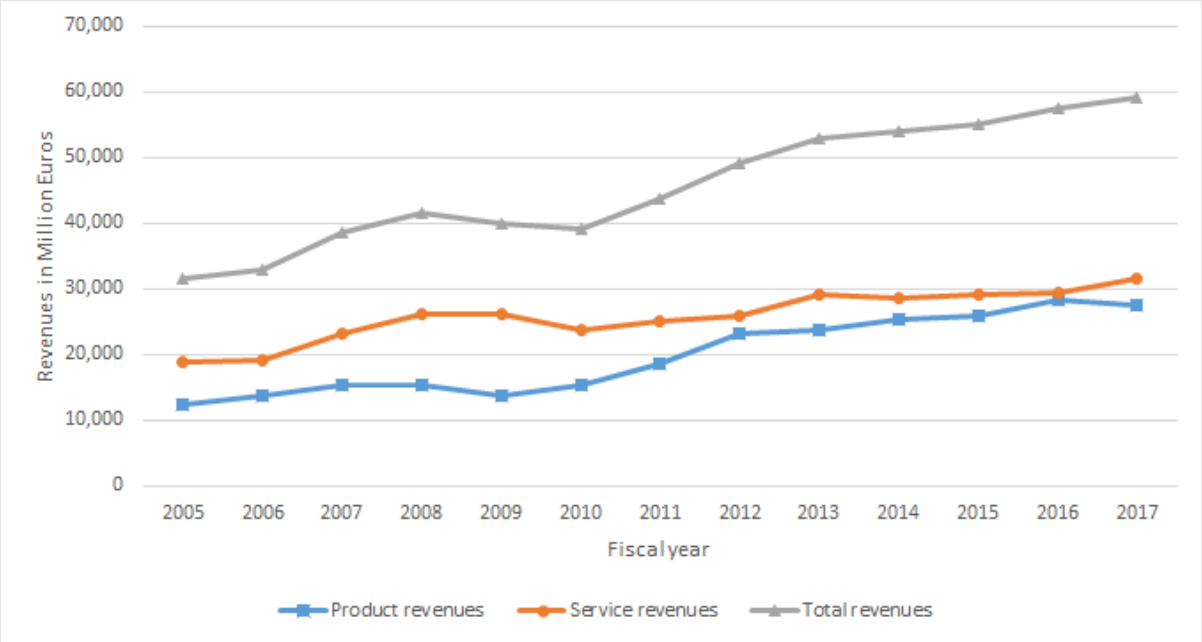
4.1 Empirical setting

This study focuses on the worldwide elevator industry, including firms that produce, assemble and maintain elevators. The elevator industry is usually divided into two main business segments: new installations (goods) and services. The former comprises the selling, production and assembly of new passenger and freight elevators, in new or existing buildings. In the latter, elevator firms provide several services, such as the delivery of spare parts, warranty, modular-based preventive and full maintenance contracts (which can be tailored according to customer requirements), repairs, overhauls, modernisations and condition monitoring.

The business model in this industry is based on a life-cycle approach. The elevator firm may provide customers with services for the entire lifetime of their elevators, which may average 20 to 25 years. Regular maintenance is required to keep the equipment running smoothly. As the equipment ages, larger repairs and replacements of parts are required to maintain optimal performance. Eventually, modernisation by full replacement becomes necessary. The new equipment business is more cyclical in nature and fuels the growth of the maintenance business in the long term. Maintenance services, on the other hand, brings stability to the business over economic cycles (because even in times of recession, maintenance is required to keep the equipment running smoothly) and in turn, the ageing equipment creates potential for modernisation.

As long-lived equipment, elevators are technically complex and demand high safety requirements and, consequently, regular maintenance and inspection. Thus, elevator manufacturing companies tend to provide services and bundle them with the products they sell, for a long time. The continuous usage of an elevator over time tends to increase the fault-occurrence probability, which requires quick troubleshooting. Although elevators are designed, produced and installed through accurate quality processes, if left without maintenance they could lose not only their original functions but also be subject to low performance and safety accidents (Park and Yang, 2010). Therefore, many countries have regulations that govern maintenance activities in the elevator industry. These regulations significantly affect the industry as they provide norms for the maintenance and modernisation of elevators. There is, for instance, a legal obligation of providing maintenance services regularly in several EU countries. Mature markets such as Europe and the United States also operate under established legislation regarding the modernisation of elevators. Europe introduced the Safety Norms for Existing Lifts (SNEL) legislation in 2003, which was enacted as a law in most Western European EU member states by 2007.

The worldwide elevator market (including new equipment installation and services) was valued at 59,150 million euros in 2017. Out of this, 46% consisted of new equipment revenues and the remaining 54% were generated through service provision. Figure 2 shows the evolution of product (new installation), service and total revenues between 2005 and 2017.

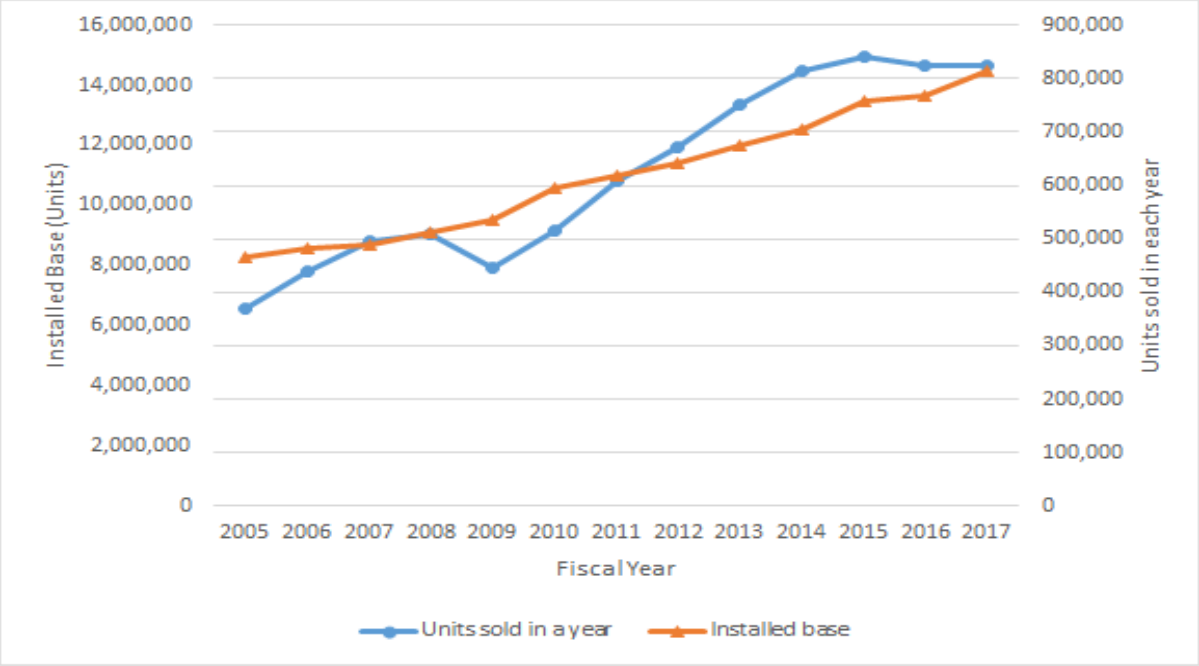


Sources: Otis, Schindler, Kone, Thyssen (annual reports)

Figure 2 – Evolution of the product revenues, service revenues and total revenues in the worldwide elevator industry.

The following information was drawn from the annual reports of the cited manufacturers. Globally, the elevator industry has been dominated by four key players (also known as the “Big-Four”): Otis Elevator Company (17% market share in 2017), Schindler Holding Ltd. (15%), ThyssenKrupp Elevator AG (15%) and Kone Corporation (13%), which together control 60% of the worldwide market. These four original equipment manufacturers (OEMs) are followed by four Japanese firms - Mitsubishi, Hitachi, Toshiba and Fujitec. Together, these eight companies control over 90% of the world market of elevators. In each regional market, there are also several smaller national and regional elevator firms that compete for a local market share, mainly in the service business segment.

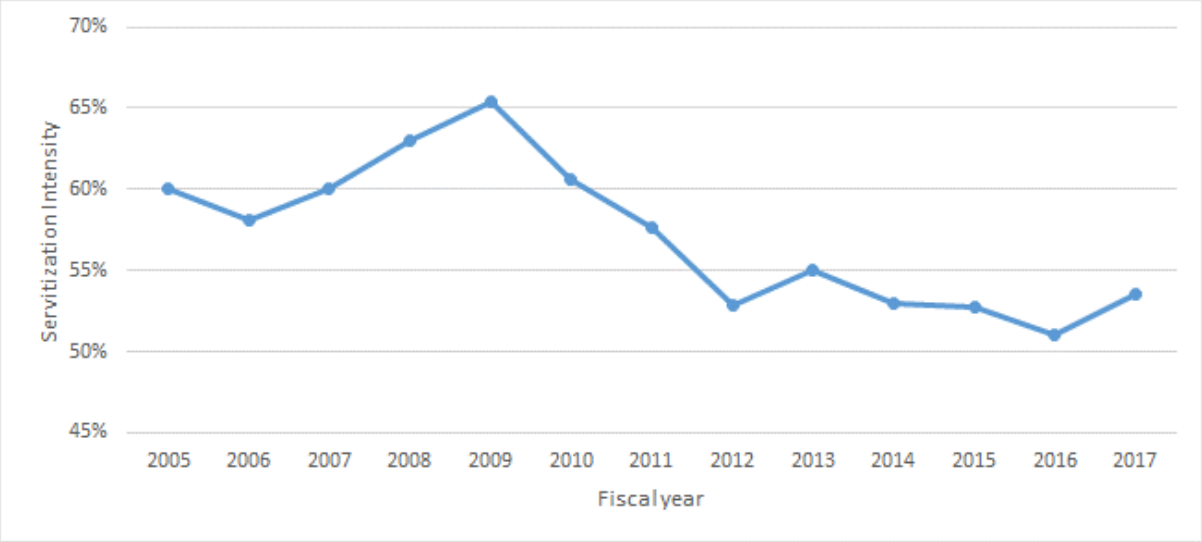
The elevator market has shown a positive trend both in new installations and units in operation over the last 13 years (see Figure 3). In 2017, there were approximately 14.5 million elevators in operation worldwide, from 8.3 million in 2005. The new installations market accounted for 825,000 elevators sold in 2017, from 370,000 in 2005. The growth of the maintenance base of each supplier is mainly driven by conversions from new equipment sales, acquisitions of smaller regional or local elevator companies and winning customers from the competition (equipment manufactured by other brands).



Sources: Otis, Schindler, Kone, Thyssen (annual reports)

Figure 3 – Evolution of the installed base and of units sold (per year).

Service and product revenues have been growing fast. Despite this, the servitization intensity (service revenues divided by total revenues) has remained in a narrow interval (51% - 65%) (an average of 57%) between 2005 and 2017 (see Figure 4).



Sources: Otis, Schindler, Kone, Thyssen (annual reports)

Figure 4 – Revenue contribution of services in the worldwide elevator industry worldwide (Servitization intensity).

4.2 Data

We tested our hypotheses through a content analysis of publicly available reports of the main publicly-held multinational elevator companies that operated worldwide between 2005 and 2017. A list of potential elevator manufacturing firms was drawn from two sources: Credit Suisse Studies and the Thomson-Reuters database. This resulted in a sample of 12 international elevator firms (see Table 2) which account for more than 65% of the market (in 2017).

Table 2 – Sample of elevator manufacturing firms considered in this study.

Name	Year of Incorporation	Home Country	Stock Exchange
Alimak HEK Group AB	1948	Sweden	Nasdaq Stockholm Ltd.
Fujitec Co., Ltd.	1948	Japan	Tokyo and Osaka Stock Exchanges
Hyundai Elevator Co Ltd	1984	South Korea	Korea Stock Exchange
Kleemann Hellas S.A.	1983	Greece	Athens Stock Exchange
Kone Corporation	1910	Finland	Nasdaq Helsinki Ltd.
Orona Group	1964	Spain	(*) Not listed
Otis Elevator Company	1853	U.S.A	New York Stock Exchange
Savaria Corporation	1979	Canada	Toronto Stock Exchange
Schindler Holding Ltd.	1874	Switzerland	Swiss Stock Exchange
Symax Lift (Holding) Co., Ltd	2009	Canada	Toronto Stock Exchange
ThyssenKrupp Elevator AG	1999	Germany	Frankfurt Stock Exchange
Zardoya Otis, S.A.	1974	Spain	Madrid, Barcelona, Valencia

(*) presents the annual reports in the web-site

Large scale empirical studies addressing servitization intensity have been hampered by the difficulty to obtain reliable data on service provision (Neely, 2009; Baines and Lightfoot, 2014). This is because, in most industries, manufacturing firms do not report services separately in their financial reports, precluding the use of secondary data. The elevator industry, however, is an exception, since most companies publish data on service provision. Therefore, it is possible to compute the servitization intensity metrics over time.

The data for each firm consisted of the complete annual financial and sustainability reports and other relevant reports (e.g. the capital markets day reports) between 2005 and 2017. There were several reasons for using the companies' annual financial and sustainability reports. First, the annual reports of publicly-held companies addressed the areas we researched and were easy to obtain (in line with Montabon *et al.*, 2007). Second, it is also a way of analysing the past strategy that the company communicated to the market, over a long period (Smith and Taffler, 2000; Beattie *et al.*, 2004). Third, listed companies use internationally accepted reporting standards (Beattie *et al.*, 2004), leading to consistency

across firms. Finally, since annual reports are public, companies tend to inform the stakeholders about their strategies, helping investors and creditors to better understand the company's economic risk and value (Beattie *et al.*, 2008). Although Dempsey *et al.* (2010) argue that poorly performing firms may have an incentive to publish less transparent financial disclosures, the annual report is a key document for publicly-held companies which is audited and subject to a great deal of scrutiny from stakeholders. Therefore, there are considerable pressures on its authors to be accurate and honest (Smith and Taffler, 2000).

All the reports were originally downloaded in the English language to avoid the risk of bad translations and misinterpretations of the original narratives developed by the companies. To make valid comparisons across companies and to determine the industry's aggregate figures, all financial data were converted into euros using the appropriate spot exchange rate on the 31st of December of each year. The web page versions of the reports were chosen over the printed versions to get the reports expeditiously. These versions were downloaded by the researchers between 03.04.2018 and 23.06.2018. We obtained 145 observations from 12 companies in existence between 2005 and 2017 for which electronic versions of annual reports were available from the companies' sites.

4.3 Content analysis

Content analysis is defined as a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding (Weber, 1990; Stemler, 2001; Montabon *et al*., 2007). Krippendorff (1980, p.51) notes that "content analysis research is motivated by the search for techniques to infer from data that would be too costly, no longer possible, or too obtrusive by the use of other techniques". A good description of the method is provided by Boyatzis (1998).

Content analysis gained legitimacy as a methodology in the field of management in the 1980s, and is not restricted to the domain of textual analysis, but may be applied to other areas, such as internet sites (Schafer, 2002; Waters, 2007) and annual reports (Smith and Taffler, 2000; Vanstraelen *et al.*, 2003; Beattie *et al.*, 2004; 2007). Accounting researchers have often used content analysis to analyse and evaluate narratives in annual reports (see, for example, Beattie *et al.*, 2008). Although Montabon *et al.*'s (2007) review showed that the use of content analysis as a means of gathering data in operations management seems to be quite rare, in recent years several studies have used this approach (see, for example, Benedettini *et al.*, 2015, 2017). Content analysis is, therefore, a suitable approach for converting the information of the annual reports and other official reports from firms into data needed for our study. The application of the method consists of different phases (Weber, 1990): 1. the choice of the

framework used to classify information; 2. the definition of the recording unit; 3. the coding; 4. and the assessment of reliability.

This technique is particularly rich and meaningful since it relies on the coding and categorisation of the data being subjected to analysis. An *a priori* coding scheme is used, meaning that the categories are established before the analysis based upon some theory (Weber, 1990; Stemler, 2001). Content analysis can be either computer-aided or human-coded (Beattie *et al.*, 2004). We use human-coded content analysis because it allows for the quantitative assessment of reliability, as well as for the analysis and interpretation to be done quantitatively for statistical analysis (Montabon *et al.*, 2007). The use of quantitative methods requires the units of coding to be scored in some way (Boyatzis, 1998). For this study, a set of categories (the factors used in the model) was developed based on the conceptual framework (Figure 1) and with the specific intent of capturing the factors affecting the servitization intensity over time. This detailed coding instrument included, for each factor, the elements recommended by Boyatzis (1998) to achieve a code with the maximum probability of producing high inter-rater reliability and validity (Beattie *et al.*, 2004). Appendix 1 presents the full coding instrument, that includes, for each category (factor) the following elements: 1. a label, comprising factor code and name; 2. a description of how to identify when the factor occurs (i.e. how to flag the factor); 3. a description of any qualification or exclusion to the identification of the factor; and 4. examples to eliminate possible confusion when looking for a factor.

The unit of analysis is the firm. For each firm, a detailed content analysis was undertaken for the entire narrative content of each of the yearly reports. Each report was coded for pre-defined factors, stated in the coding instrument. To classify the qualitative information from each report, we used a detailed scoring system. Each paragraph was coded as follows: with a score of 0, if providing no information; with a score of 1, if providing qualitative information. In the latter case, the text from the report was copied into the coding sheets used for data collection in order to support the later coding decision. The repetition of a certain disclosure in different sections of an annual report is a communication strategy used for emphasis and reinforcement and signals the importance placed by the management upon these messages (Beattie and Jones, 2001). Therefore, the amount of disclosure was measured by counting the frequency at the factor level.

Finally, for each firm we computed the median count for each factor over the years considered using the frequency at the factor level computed above. Using the median, we then assigned a score to each pair factor-year, as follows: 0, if no information on the factor was provided in the report for that year; 1, if the factor count in that year was above zero, but below or equal

to the median (low intensity); 2, if the factor count in that year was higher than the median (high intensity).

Additional information was gathered during the content analysis (when available in the annual reports): revenues (from product and services, and total), operating profit, total assets, units sold, installed base, number of employees, cost of employment, R&D expenditure, investment, costs of goods sold, current assets, and current liabilities.

A major concern in using the content analysis method is its reliability. Krippendorff (1980) identifies three types of reliability: accuracy, reproducibility and stability. Accuracy was ensured by the use of two coders (one of the authors and one independent researcher) and the following defined coding procedure: a). Before the start of the analysis, the coders attended a training session in which they were briefed on the objectives of the research and trained on how to fill in the coding sheets used for data collection. The researchers explained the coding process for a sample firm. Coders were given a list of definitions and a coding matrix for each elevator firm. b). Four annual reports were analysed simultaneously by the two coders in order to identify the potential differences between the coders and to standardise the coding classification. Second, the reproducibility of the content analysis was assessed by the Scott's *pi* reliability measure, which is defined by Krippendorff (1980) as

Scott's *pi* = 1- ((100 - % of observed matches) / (100 - % of expected matches)

Scott's *pi* was 78% in the first annual report coding, 85% in the second, and 70% and 79% in the third and fourth annual report codings, respectively. The cut-off level for acceptability ranges from 70% (Boyatzis, 1998) to 80% (Krippendorff, 1980). Thus, the levels of reliability attained were generally highly satisfactory (Beattie *et al.*, 2004). Therefore, it was decided that only one rater (one of the researchers) would develop the coding of the remaining documents.

Third, the stability of the content analysis was verified by coding the annual report a week later in a second round of coding. This was then analysed and yielded a Scott's *pi* result of 95%. Based on this, the information provided by the coder could be deemed reliable.

4.4. Panel data with fixed effects model

After having coded for the factors and gathered all needed data from the annual and other relevant reports of the firms, a panel data analysis was conducted. Longitudinal data or panel data are repeated measurements at different points in time on the same firm. Regressions can then capture both the variation over firms and the variation over time (Cameron and Trivedi, 2009).

We used panel data analysis with fixed effects to control for time-invariant, unobserved heterogeneity among firms. This allows for the analysis of the impact of variables that vary over time and remove the effect of time-invariant characteristics. We also verified that the panel data with random effects model was not statistically significant. We followed the procedures defined by Cameron and Trivedi (2009).

The panel data is strongly balanced, meaning that almost all firms have data for all the years considered. The control variables were chosen based on the literature. In line with Vanstraelen *et al.* (2003), we controlled for factors related to the management environment, including the firm size (measured by the natural logarithm transformation of the number of employees), the firm market share, the service base of the firm (measured by the natural logarithm transformation of the number of elevators under maintenance), and the profitability of the firm (return on assets - ROA). We also controlled for factors related to the operating context, using the annual global GDP growth in % (Source: World Bank) and a yearly variable to capture the annual effects.

Table 3 defines the variables in the model.

Table 3 – List of variables used in the model.

Dependent variable		
Variable		**Description**
Servitization intensity of firm *i* in year *t*.	$Serv\_Intensity_{i,t}$	Share of services in % of total revenues of the firm *i* in year *t*.
Independent variables		
Variable		**Description**
"Customers' demand for more services" of firm *i* in year *t*.	$STCD_{i,t}$	Score of "2" in year *t*, if firm *i* has a frequency of disclosure above its median across all years, "1" if the frequency is equal or below its median across all years, or "0" if no information is provided.
"Implementing services legal requirements" of firm *i* in year *t*.	$LEGF_{i,t}$	
"Fostering the mitigation of environmental impact" of firm *i* in year *t*.	$ENVF_{i,t}$	
"Strategies based on locking in customers" of firm *i* in year *t*.	$STLI_{i,t}$	
"Strategies involving the provision of custom-made products" of firm *i* in year *t*.	$TYPM_{i,t}$	
"Fostering to increase revenues" of firm *i* in year *t*.	$FIIR_{i,t}$	
"The development of facilities in close proximity to the customer" of firm *i* in year *t*.	$FACI_{i,t}$	
"The development of service processes" of firm *i* in year *t*.	$PROC_{i,t}$	
"Fostering the use of Information and Communication Technologies (ICT)" of firm *i* in year *t*.	$TECF_{i,t}$	
Control variables		
Variable		**Description**
Firm size of firm *i* in year *t*.	$Firm\_Size_{i,t}$	Size of the firm as the number of employees of the firm *i* in year *t*.
Market share of firm *i* in year *t*.	$Market\_Share_{i,t}$	Market share of firm *i* in year *t*.
Installed service base of firm *i* in year *t*.	$Serv\_Inst\_Base_{i,t}$	Installed service base (number of equipments under maintenance) of firm *i* in year *t*.
Profitability of firm *i* in year *t*.	$ROA_{i,t}$	Return on Assets of the firm *i* in year *t*.
Gross domestic product growth for year *t*	$GDP\_Growth\_World_t$	Economic growth over the period evaluated (in year *t*).
Year *t*	$Year_t$	Captures the expected yearly effects.

The underlying model to explain the servitization intensity of firm *i* in period *t* can be stated as follows:

$$Serv\_Intensity_{i,t} = \beta_0 + \beta_1 STCD_{i,t} + \beta_2 LEGF_{i,t} + \beta_3 ENVF_{i,t} + \beta_4 STLI_{i,t} + \beta_5 TYPM_{i,t} + \beta_6 FIIR_{i,t} + \beta_7 FACI_{i,t} + \beta_8 PROC_{i,t} + \beta_9 TECF_{i,t} + \beta_{10} \ln(Firm\_Size_{i,t}) + \beta_{11} Market\_Share_{i,t} + \beta_{12} \ln(Serv\_Inst\_Base_{i,t}) + \beta_{13} ROA_{i,t} + \beta_{14} GDP\_Growth\_World_t + \theta_j Year_t + \varepsilon_{it},$$

where β_j denotes the coefficient of each regressor in the model, θ_j denotes the coefficient of each year, and ε_{it} is the idiosyncratic error term.

5. Analysis and results

To test the research hypotheses, we estimated a panel data model with fixed effects using the STATA 13 Software program. Table 4 summarises the descriptive statistics for all measures, pooled across firms and years. The factor “fostering the mitigation of environmental impact” was not referred to by any of the manufacturing firms in the sample as a factor that affects servitization in this industry. Therefore, hypothesis $H_{1.3}$ could not be tested.

Table 5 presents the results for the full model of panel data analysis with fixed effects.

Table 4 – Descriptive statistics and correlation matrix.

Variable	Mean	SD	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Servitization Intensity	0.388	0.220	0.003	0.773	1.000														
2. Customers' demand for more services	0.303	0.720	0	2	0.171	1.000													
3. Implementing services legal requirements	0.421	0.742	0	2	-0.039	0.201	1.000												
4. Strategies based on locking in customers	0.848	0.793	0	2	0.542	0.251	0.145	1.000											
5. Strategies involving the provision of custom-made products	0.972	0.781	0	2	0.120	0.064	0.092	0.273	1.000										
6. Fostering to increase revenues	0.683	0.847	0	2	0.248	0.068	0.015	0.196	0.092	1.000									
7. The development of facilities in close proximity to the customer	1.069	0.751	0	2	0.264	0.243	0.022	0.286	0.275	0.100	1.000								
8. The development of service processes	0.834	0.898	0	2	0.411	0.186	0.043	0.364	0.142	0.086	0.274	1.000							
9. Fostering the use of ICT	0.752	0.902	0	2	0.349	0.138	0.136	0.675	0.227	0.133	0.200	0.318	1.000						
10. Firm size	8.643	1.847	4.804	11.13	0.702	0.211	0.227	0.547	0.269	0.282	0.176	0.296	0.386	1.000					
11. Market share	0.061	0.072	2E-04	0.257	0.435	0.156	0.311	0.392	0.315	0.228	0.173	0.178	0.262	0.875	1.000				
12. Firm service installed base	11.228	3.786	0	14.51	0.712	0.172	-0.105	0.504	0.421	0.260	0.374	0.305	0.346	0.679	0.571	1.000			
13. Profitability ROA	0.138	0.111	-0.03	0.501	0.571	-0.064	0.050	0.345	-0.007	0.168	-0.007	0.101	0.159	0.364	0.321	0.333	1.000		
14. World GDP growth	3.766	1.445	-0.1	5.6	-0.006	0.026	0.081	-0.009	0.007	-0.094	0.022	0.106	0.012	0.026	0.036	0.010	0.009	1.000	
15. Year	2011	3.639	2005	2017	0.027	-0.238	-0.162	0.173	0.226	0.087	-0.065	0.053	0.377	0.050	-0.016	0.066	-0.047	-0.239	1.000

Table 5 – Results of the panel data analysis.

	Variables	Hypotheses	Servitization Intensity Fixed Effects Model	
External	STCD - Customers' demand for more services	$H_{1.1}$	-0.0017	
			(0.0043)	
	LEGF - Implementing services legal requirements	$H_{1.2}$	-0.0003	
			(0.0045)	
Company Goals	STLI - Strategies based on locking in customers	$H_{2.1}$	0.0006	
			(0.0056)	
	TYPM - Strategies involving the provision of custom-made products	**$H_{2.2}$**	**-0.0100**	*
			(0.0045)	
	FIIR - Fostering to increase revenues	**$H_{2.3}$**	**0.0064**	†
			(0.0035)	
Capabilities	**FACI - The development of facilities in close proximity to the customer**	**$H_{3.1}$**	**0.0094**	*
			(0.0045)	
	PROC - The development of service processes	**$H_{3.2}$**	**0.0114**	**
			(0.0045)	
	TECF - Fostering the use of Information and Communication Technologies (ICT)	**$H_{3.3}$**	**-0.0101**	*
			(0.0048)	
	Intercept		**-6.7996**	**
			(2.4536)	
	Firm size		**-0.0520**	**
			(0.0199)	
	Market share		**-1.2588**	***
			(0.2852)	
	Firm service base		-0.0520	
			(0.0199)	
	Return on Assets (ROA)		-0.0558	
			(0.0822)	
	World GDP growth		-0.0016	
			(0.0018)	
	Year		**0.0038**	**
			(0.0012)	
	F-test (model)		5.71	***
	Degrees of freedom		119	
	R^2		0.9839	
	$R^{2\ adjusted}$		0.9805	
	Number of observations		145	
	Number of groups		12	

Notes: Standard errors are in parentheses.

† significant at the 10% level; * significant at the 5% level; ** significant at the 1% level; *** significant at the 0.1% level

From the full model, we find support for the following hypotheses: $H_{2.3}$ "fostering to increase revenues" (b = 0.0064, $p < 0.10$), $H_{3.1}$ "the development of facilities in close proximity to the customer" (b = 0.0094, $p < 0.05$), and $H_{3.2}$ "the development of service processes" (b = 0.0114, $p < 0.01$).

We do not find support for the remaining hypotheses. Contrary to expectations, the relation between “strategies involving the provision of custom-made products”, and “fostering the use of ICT” and servitization intensity is negative (b = - 0.0100, $p < 0.05$ and b = - 0.0101, $p < 0.05$, respectively). Thus, hypotheses $H_{2.2}$ and $H_{3.3}$ are not supported. These results, which at a first sight seem counterintuitive, will be discussed in Section 6. Finally, we found no statistically significant support for hypotheses $H_{1.1,}$ $H_{1.2}$ and $H_{2.1}$.

Regarding the control variables, our results suggest that servitization intensity over time is influenced by firm size and market share: smaller firms and firms with lower market shares tend to servitize more than larger manufacturers. These findings are in contrast with prior studies (Oliva and Kallenberg, 2003; Neely, 2009; Baines *et al.*, 2009a; Matthyssens and Vandenbempt, 2010). It may be that smaller firms provide more services in order to differentiate their offering in a market where large manufacturers have a strong position. In fact, in the elevator industry small manufacturers tend to operate in niche markets and are very specialised (Dachs *et al.*, 2012).

6. Discussion

6.1 External factors

We do not find any evidence that external factors, namely market, legal and environmental factors, have a direct impact on servitization intensity over time (H1.1 - H1.3 not supported). This finding contrasts with suggestions from prior conceptual studies (Turunen and Finne, 2014). The lack of impact of market factors (customer’s demand for services) may be related to the high level of servitization maturity of the elevator industry. Firms in this industry have been providing basic and advanced services since the 1980s and the servitization intensity in the industry has been steadily above 50% in the last 13 years. In this context, it is likely that customers do not seem to demand more services. This suggests that the impact of market factors may be contingent on the servitization maturity of the industry sector.

The absence of influence of legal factors on servitization intensity over time may be due to three reasons. First, as we discussed before, equipment maintenance is a legal requirement in several countries, and once introduced, this obligation remains over time. Thus, there will be no new source for a positive impact on service provision from the moment the legal obligation has been introduced. Second, other service legal requirements may have an effect which is limited in time. In the year when the legal imposition takes place, service revenues climb. However, in the following years, once the legal imposition is fulfilled, service revenues decline again, falling back to previous levels. This was the case, for instance, of the implementation of the EU Safety Norm for Existing Lifts – SNEL that was completed in several countries, meaning that the norm is unlikely to have any further positive impact on growth

other than in the short term after its implementation. Third, the introduction of a new legal requirement may lead to a reduction in the provision of existing services. For example, the legal obligation of modernising certain types of elevators may lead to a reduction in the provision of repair services and spare parts in the following years. This leads us to propose that services legal requirements that uniformly affect firms in a given industry sector, *per se*, may not lead manufacturing firms to increase service revenues over time.

With regards to the environmental factor, none of the firms considered in the sample mentioned it. This may result from the difficulty of firms in the elevator industry moving to product rental models in which the product ownerships rests with the manufacturer. This is because once the elevator is installed it becomes part of the building. Thus, it will be very difficult to disassemble the equipment in case a customer does not pay the regular fee for the use of the good. Thus, the manufacturer seems to be facing a very high risk that it is not able to incorporate into the existing business model.

6.2 Internal factors - Company goals

Our study addressed two categories of company goals: financial (one factor) and strategic (two factors). Regarding the financial factor, we found that the company goal of fostering to increase revenues had a positive impact on servitization intensity over time (H2.3 supported). This finding is illustrated by the following quote from one of the manufacturer's annual report:

> "In our business in the after-sales service market, we will continue to focus on the modernization business and strive to reinforce our revenue base by increasing the number of maintenance contracts." (Fujitec annual report, 2017)

From a longitudinal perspective, this finding is consistent with the notion that the service business is relatively unaffected by cyclical risks in the industry since services are less susceptible to the effects of an economic recession. A decline in business from fewer new installations may be virtually offset by growth in services (this can be seen in figures 2 and 3). For instance, maintenance contracts provide a solid foundation for the business through recurring revenues:

> "The fall of 3.6% in GDP was due to the general crisis in all sectors, especially in building construction which decreased by approximately 50%. In this framework, our strategy of giving priority to service functioned adequately. In fact, although new installations sales showed a drop of 30.3%, service sales grew by 2.5%, representing 75.5% of the business volume of the Group, or 5 points more than in 2008." (Zardoya annual report, 2009)
>
> "The top three companies, Otis, Schindler, and Kone, obtained around 50% of their revenue from service sectors whereas Hyundai got less than 20%. Last year, some large markets for new installations, such as China, stagnated; however, top players could overcome this difficulty with their service excellence which acted as a kind of buffer." (Hyundai annual report, 2017)

In addition, since the business model in the elevator industry is based on a life-cycle approach, the revenue streams from services are long-lasting, from the installation of the elevator

equipment, to on-going-maintenance and equipment modernisation, driven by a combination of ageing equipment and growing safety demands:

> "KONE sees that the lifecycle business model and the existing maintenance base of over 1.2 million units have a crucial role in value creation." (Kone annual report, 2017)

Finally, through services, the manufacturer may be able to help cushion increasing product price pressures, for example, by introducing services based on new technologies to create value for customers.

Interestingly, we did not find evidence that strategic factors – strategies based on locking-in customers and providing custom-made products – have a positive impact on servitization intensity over time (H2.1 and H2.2 not supported). The lack of impact of strategies based on locking-in customers may be explained by the fact servitization intensity has remained very high over time in the elevator industry; as a result, firms have already incorporated strategies based on locking-in customers into their business models. In the early years of the study, manufacturers indicated a clear orientation towards building strong relationships with their customers. As one manufacturer refers in 2005:

> "KONE strives to seek extensive customerships, including deliveries of new products with a long-term maintenance contract." (Kone annual report, 2005)

However, in the more recent years, this factor is not mentioned by the manufacturers.

Surprisingly, we found a negative relationship between strategies based on providing custom-made products and servitization intensity over time. The hypothesized positive impact was based on the notion that customers would likely require more support in the form of services when using this kind of products. Although this may be the case when one looks at the impacts at a given point in time (static analysis), looking at this issue from a dynamic perspective reveals contradictory forces at play. On the one hand, since custom-made products are more complex, it may be that customers are more open to the provision of full maintenance contracts (i.e. advanced services) than buyers of standard or mass-produced goods. Because these contracts result in a revenue payment that is constant over time, no significant increase in service revenues is generated throughout the years that follow (that is, the manufacturer will not be able to sell additional basic services). On the other hand, because custom-made products have higher selling prices, the revenues generated with the provision of these products may, over time, increase more than the revenues obtained through the selling of related services. This may lead to a negative impact on servitization intensity, computed as the ratio between service revenues and total revenues (products and services).

6.3 Internal factors - Capabilities

Our study addressed three capabilities: facilities in close proximity to the customers, service processes and ICT. The results regarding the positive impact that the existence of facilities in close proximity to the customer has on servitization intensity is consistent with the literature (H3.1 supported). Localised facilities seem to enable a strong relationship with the customer, leading to the provision of additional services over time. In the case of an elevator, a 24 hour/365 day availability must be ensured, for instance, to release people that might be stuck in an elevator car or to perform corrective actions. This implies that the service staff must be physically close to the equipment to ensure responsiveness. If the manufacturer provides performance-based services, the risk that the manufacturer faces is high and financial penalties may be incurred in case the equipment fails to perform as specified. Therefore, the response time will have to be short. For example, in hospitals or underground stations, the maintenance staff from the manufacturer will typically be located inside the customers' facilities:

> "Schindler aims to grow more rapidly than the global elevator market in the long term and therefore to ensure the success of the maintenance and modernization business. To achieve this goal, Schindler needs to continuously expand its service network in individual markets. This will enable the company to exploit the different growth cycles, to smooth out currency risks, to reduce response times in the field, and, at the same time, to increase the productivity of its service offering." (Schindler group review, 2016)

Our findings also confirm that the development of specific service processes over time is positively associated with increasing servitization intensity (H3.2 supported). For instance, to succeed in selling more services over time, the manufacturer should design processes to support the customers' business goals and to deliver through-life performance. The transition from products to services also requires a different sales approach, because the sales process is often more complex, takes longer and requires stronger customer empathy. As referred in the Schindler group review (2008):

> "To maintain customer loyalty, [Schindler] focused on offering high service quality with the support of its service leader concept, which was rolled out in all major European markets. This service model, which gives customers access to a team of dedicated service leaders who can offer comprehensive advice and answer any questions relating to their installations, has been very well received."

Our findings contrast with other studies concerning the impact of the use of ICT on servitization (H3.3 not supported). Our results show that the use of ICT is negatively associated with servitization intensity over time. Three reasons may explain this result. First, manufacturing firms may be using ICT to increase the efficiency of the service provision, reducing operating costs by decreasing the number of regular inspections and identifying an optimum replacement cycle of disposable parts. With sophisticated technology, engineers can, for example, remotely detect problems early and provide an accurate diagnosis, often resolving

problems within minutes. Despite this, customers may impose a reduction on the prices charged for the service provision, since the supplier is facing an operation cost reduction. Therefore, the manufacturing firm may have to transfer part of the gain to the customer, by reducing the service provision prices. Second, implementing technology may preclude the provision of other services, which may harm existing service revenues (and thus, servitization intensity). It may also be that customers do not pay at all for these additional services, and therefore the manufacturer is not capable of generating additional revenues (in line with Ryals and Rackham, 2012). For example, through remote monitoring, the number of call-outs will be reduced, thus decreasing the provision of paid repair services. Finally, the customers' heterogeneity may inhibit the broad use of ICT, as these partners may differ regarding their infrastructure, work procedures and IT experience levels and, thus, reject the adoption of ICT (in line with Kroh *et al.*, 2018).

7. Conclusions

This study is novel in two ways. First, to the best of our knowledge, it is the first longitudinal study to analyse the factors that impact servitization intensity, using qualitative and quantitative data from manufacturers from one single worldwide industry. Studying a single industry allows for the natural control of a number of contextual factors that may influence servitization intensity, as well as for a more granular insight into the factors that impact it. In addition, studying an industry over a long period of time mitigates the risk of uncontrollable factors that create noise in cross-industry studies. Second, the study discusses the dynamics of the impact of external and internal factors on servitization intensity over time. By integrating both types of factors into one single longitudinal model, we provide more robust empirical evidence of the factors that affect servitization intensity over time.

This study makes two major contributions to theory. First, it emphasises a view of servitization that is longitudinal and dynamic, contrasting with the cross-sectional approaches that dominate extant empirical research, arising from the difficulty in accessing data. The development of service offerings is inherently a dynamic process that requires a continuous adaptation to changing customer needs, technologies and general market trends. Specifically, with the benefit of panel data, our study confirms more firmly the expected positive longitudinal impacts on servitization intensity of the following factors: fostering to increase revenues, the development of facilities in close proximity to the customer and the development of service processes. That is, the expectations from the literature were confirmed in a longitudinal analysis of a highly servitized industry over a long period of time. However, our study suggests that other factors - the external context, strategies involving the provision of custom-made products and fostering the use of ICT - when analysed over time, may have an impact on

servitization intensity that is different from the one anticipated from the literature, which has tended to look at limited periods of time. We suggest that these differences may result from the way these factors play out dynamically over longer periods of time, as well as from the highly servitized nature of the elevator industry. Therefore, our study highlights the fact that the assessment of the factors that affect servitization intensity needs to consider dynamic aspects, as well as the degree of servitization maturity of an industry. Several industries exhibit high levels of servitization intensity, including elevators, aircrafts, HVAC-Systems (*heating, ventilation, and air conditioning)* and industrial equipment; it is expected that a growing number of industries become highly servitized in the near future. Overall, we strengthen theory validation in the servitization field by drawing on a longitudinal data set, a much-needed endeavour to complement case-based empirical studies.

Second, by including both external and internal factors this study allows us to understand the drivers of servitization intensity over time in a more comprehensive way. Contrary to expectations, the results of this research indicate that the external context factors (market, legal and environmental) do not appear to have an impact on servitization intensity over time. Rather, we find that servitization intensity over time is mainly driven by internal factors pertaining to direct managerial decision-making actions undertaken by the manufacturer.

Our study has important implications for practice, namely by offering guidance for the design of servitization strategies that may produce sustainable results over time. We suggest that manufacturers who wish to increase their servitization intensity over time in industries mature in servitization should: 1) maintain a strategic focus on revenue increase; 2) emphasize the development of key capabilities over time, namely, the development of service facilities in close proximity to the customer and service processes. Moreover, servitization should not be a reaction to the external context, but rather a deliberate management decision associated with the setting of suitable goals and development of appropriate capabilities.

Our research has limitations which open up opportunities for future research. First, although examining in-depth a single industry worldwide has a number of benefits, it limits the generalizability of the results. We believe that our results may hold in at least some other highly servitized industries with a large installed base of products, for example industrial machines, aircrafts or HVAC-Systems. Future research could study these industries, using the same methodology (content analysis and panel data models). Second, servitization intensity is measured by means of service revenues over total revenues of the firm. To get a deeper insight into servitization intensity, it would advisable to break down this metric across different types of services (e.g. basic and advanced services). This is faced with the challenge

that manufacturing firms typically do not report this information. Third, while annual reports are public and tend to inform stakeholders about the firms' strategies (Beattie *et al.*, 2008), they may not reveal all aspects of the strategies.

Appendix 1 – Coding Instrument

Pos.	Code	Category (Factor) Name	Score	Flags | Qualifications | Exclusions	Examples of qualifications
		Market factors			
1.1	STCD	**Customer's demand for more services**	= 1, if the category is present = 0, if the category is not present	**Flag:** Demand for more services. **Qualifications:** Firm reports that: a. customers are demanding a higher variety of services. b. customers demand their providers to offer service based contracts. c. customers are willing to buy the right to use the assets, rather than taking ownership of them. d. customers are increasingly outsourcing services to the manufacturer. **Exclusions:** Firm reports increase in service revenues without an explicit association with customer demand.	"Key competitive factors in the industry include [...] demand for better and more versatile services." (Kone Annual Report, 2005) "In the after-sales market, demand is strong for maintenance and repair services at the Service Division and for equipment updating services at the Modernization Division." (FujiTec Annual Report, 2009) "Demand continues to rise for Otis' comprehensive and priority Elite service program. " (Otis Annual Report, 2010) [...] demand for elevator and escalator renovation work is increasing in the aftermarket business, so that Fujitec will immediately and aggressively strengthen renovation-product merchandising." (FujiTec Annual Report, 2013) "Downtime is very costly, whatever the industry, and customers are therefore keen to reduce the operative risks by increasingly outsourcing servicing and maintenance to Alimak." (Alimak Annual Report, 2015)
		Legal factors			
1.2	LEGF	**Implementing services legal requirements**	= 1, if the category is present = 0, if the category is not present	**Flag:** Legal requirements related to services. **Qualifications:** Firm reports that: a. there is a legal obligation of providing certain services. b. new safety norms for services are introduced by governments. **Exclusions:** Firm reports legal aspects *only* about products or related to the company's manufacturing operations.	"The EU has introduced a new safety directive for existing elevator installations (SNEL). Once this directive is incorporated into local legislation in the individual member states, any elevators that do not fulfill these standards will have to be upgraded. This is leading to a rapid increase in the demand for elevator modernization solutions." (Schindler Activity Report, 2005) "New legislation requirements based on the European Safety Norms for Existing Lifts (SNEL) continued to create lot of demand for modernizations in Europe." (Kone Annual Report, 2006) "KONE operates in an industry with various local regulatory requirements in both the new equipment and service businesses." (Kone Annual Report, 2013) "In virtually all over the globe, equipment maintenance is also legally required." (Kone Corporate Responsibility Report, 2013) "There are laws and regulations in place regarding regular inspections and servicing, which often needs to be carried out by certified personnel, creating demand for after sales services." (Alimak Annual Report, 2015)

Pos.	Code	Category (Factor) Name	Score	Flags | Qualifications | Exclusions	Examples of Qualifications
		Environmental factors			
1.3	ENVF	**Pressures for the mitigation of environmental impact**	= 1, if the category is present = 0, if the category is not present	**Flag:** Mitigation of environmental impact. **Qualifications:** Firm reports that: a. customers revise their conception of ownership: customers do not want to have product ownership due to environmental concerns. This may lead manufacturers to deliver functionality rather than ownership. b. to minimize risks and costs if the ownership remains with the manufacturer, the manufacturer will tend to design products that are more efficient in their use phase. c. the manufacturer is following a "pay-by-the-hour" or similar concept / business model. **Exclusions:** Firm reports that there are pressures to encouraging the customer and manufacturer to follow actions that minimise the environmental impact of the product, e.g. to increase the energy efficiency of the product.	No evidence of this factor was found in the annual reports.
		Strategic factors			
2.1	STLI	**Strategies based on locking in customers**	= 1, if the category is present = 0, if the category is not present	**Flag:** Lock-in of customers through services. **Qualifications:** Firm emphasizes that: a. by earning the loyalty of its customers, a manufacturer can become its preferred supplier of services throughout the product life span. b. the manufacturing company considers selling the original equipment at, or close to, cost and seek to make its profits through the ongoing sale of associated spares, consumables and services. c. it considers selling long-term service contracts. **Exclusions:** Firm reports that it is using ICT to lock-in customers.	"KONE strives to seek extensive customerships, including deliveries of new products with a long-term maintenance contract." (Kone Annual Report, 2005) "KONE also introduced a Premier Partnership® program, which is a systematic way of packaging, promoting and delivering a customized offering to KONE's key customers. KONE Premier Partnership® is a collaborative crossbusiness approach that utilizes all opportunities for cross-selling, up-selling and additional sales. The new approach increases customer value by offering optimal management of the entire equipment and flexible and dedicated service, while also supporting customer relationships by bringing more communication and transparency to decision making. The new program supports the KONE Care for Life approach by reviewing maintenance contracts from the life cycle perspective." (Kone Annual Report, 2006) "The KONE business idea is to serve its customers by providing solutions throughout the entire lifecycle of a product, beginning from the installation of a new products until it is replaced with new equipment, including maintenance and modernizations. KONE seeks extensive customerships, including deliveries of new products with a long-term maintenance contracts." (Kone Annual Report, 2007) "To counter the loss of service units from an early stage, we employ marketing strategies aimed at retaining customers over the long term." (ThyssenKrupp Annual Report 2009)

Pos.	Code	Category (Factor) Name	Score	Flags | Qualifications | Exclusions	Examples of Qualifications
2.2	**TYPM**	**Strategies based on providing custom-made products**	= 1, if the category is present = 0, if the category is not present	**Flag:** Custom-made products. **Qualifications:** Firm reports that: a. it is providing tailor made products or customer made solutions. b. it is developing and selling high-rise solutions or panoramic elevators. **Exclusions:** Firm reports that it is providing *only* standard lines of products.	"Demand for KONE's advanced high-rise solutions increased strongly in growing high-rise hubs. This was particularly true for the double-decker (DD) elevators with advanced destination control systems (DCS) that were requested in several major projects, proving KONE's expertise in complex traffic calculations and people flow management." (Kone Annual Report, 2007) "Since 85% of the Corporation's products are custom made, [...]." (Savaria Management Report, 2010) "[...] the business area also delivers customized solutions." (ThyssenKrupp Annual Report, 2014) "In Korea, where we established a new research tower in 2014, we will devote efforts to R&D in addition to supplying our global bases mainly with custom-made models." (FujiTec Annual Report, 2015) [...] Fujitec continued to post favorable results supported by growth in sales of custom-made elevators and escalators for large-scale development projects in the Tokyo metropolitan area. (FujiTec Annual Report, 2015)
		Financial factors			
2.3	**FIIR**	**Fostering to increase revenues**	= 1, if the category is present = 0, if the category is not present	**Flag:** Increase revenues through services. **Qualifications:** Firm reports that it considers providing service as a way to increase overall revenues. **Exclusions:** Initiatives whose goal is not explicitly related to increase revenues, e.g. firm reports that it is acquiring other elevator manufacturing companies.	"Backed by sustained customer service, [...] management is confident that sales to its current network will grow." (Savaria Annual Report, 2005) "Services business as sustainable contributor both top and bottom line." (ThyssenKrupp Annual Report, 2006) "The Elevator segment is expanding its existing business, focusing in particular on Asia and Eastern Europe. To achieve this growth we intend to further intensify our service activities." (ThyssenKrup Annual Report, 2007) "Margin growth experienced at Otis from lower commodity prices and the continued shift toward higher margin contractual maintenance sales offset the adverse impacts of lower sales volume." Otis Annual Report, 2010) "In our business in the after-sales service market, we will continue to focus on the modernization business and strive to reinforce our revenue base by increasing the number of maintenance contracts." (FujiTec Annual Report, 2017)

Pos.	Code	Category (Factor) Name	Score	Flags | Qualifications | Exclusions	Examples of Qualifications
		Capabilities			
3.1	**FACI**	**The development of facilities in close proximity to the customer**	= 1, if the category is present = 0, if the category is not present	**Flag:** Service facilities in close proximity to the customer. **Qualifications:** The firm reports: a. adopting facilities that are located in close physically proximity to the customer's operations. b. increasing the density of the branches network. c. expanding the geographic coverage. **Exclusions:** The firm reports that it is expanding its production footprint.	"We are strengthening our global presence and expanding our service network in individual markets. This will enable Schindler to exploit different global growth cycles, to smooth out currency risks, to reduce response times thanks to our proximity to customers, and, at the same time, to increase the productivity of our service offering." (Schindler Activity Report, 2005) "An increasingly dense network of branches close to our customers safeguards our market presence." (ThyssenKrupp, Annual Report, 2006) "Schindler expanded the geographic coverage and density of its service portfolio in North America with the acquisition of Chicago-based Valley Elevator, Inc., thus laying the foundations for future growth in Northern Illinois." (Schindler Activity Report, 2008) "In a competitive market where customer needs are changing constantly, Zardoya makes every effort to be near to the customer when required and, in this respect, we have the most extensive service office network in the sector." (Zardoya Annual Report, 2014) "A tight-knit service network with competent employees at over 900 locations keeps us close to customers with our customized, intelligent, reliable and safe solutions and services for personal transportation." (ThyssenKrupp Annual Report, 2015)
3.2	**PROC**	**The development of service processes**	= 1, if the category is present = 0, if the category is not present	**Flag:** Launching service processes. **Qualifications:** The firm reports that: a. it is designing and introducing new/or innovative service processes. b. it is developing new standard methods for providing services. **Exclusions:** Enhancing the range of service offerings.	"KONE further improved the quality and productivity of its service business by commencing to implement new, uniform service methods both in maintenance and modernization operations." (Kone Annual Report, 2005) "In 2006, KONE introduced a new maintenance practice. The new preventive maintenance method not only improves end user safety, but also upgrades the maintenance service by ensuring that maintenance methods are similar in all market areas. The new approach was developed by reviewing and evaluating the best practices employed in KONE's existing maintenance operations. The renewed harmonized method, modular-based maintenance, is based on eight modules, which are performed systematically and in line with optimized maintenance planning." (Kone Annual Report, 2006) "In 2012, Schindler launched Customer Excellence – a program designed to deliver the solutions and services that customers expect globally. It defines the basic business processes needed to serve Schindler's customers effectively and describes Schindler's value proposition." (Schindler Corporate Sustainability Report, 2013) "Service sales also increased worldwide thanks to innovative service processes [...]. (ThyssenKrupp Annual Report, 2013) "In 2017, we created a Service Excellence team to set desired service goals and build proper processes." (Hyundai Integrated Sustainability Report, 2017)

Pos.	Code	Category (Factor) Name	Score	Flags | Qualifications | Exclusions	Examples of Qualifications
3.3	**TECF**	**Fostering the use of information and communication technologies (ICT)**	= 1, if the category is present = 0, if the category is not present	**Flag:** ICT related to services. **Qualifications:** Firm reports that: a. condition monitoring systems reduce maintenance costs. b. the use of ICT provides extensive insights for the further development of new service offerings. c. ICT enables important information to be analyzed in real time and issues to be anticipated and addressed before they lead to any downtime. d. with ICT service technicians rely on immediate access to repair history, maintenance routines, technical support data, trouble-shooting and repair routines as well as parts ordering to achieve field service excellence. **Exclusions:** ICT used for the development of products or manufacturing operations.	"Through remote monitoring, the condition and performance of the elevators or escalators is continuously monitored. The system automatically reports any abnormal operations and conditions to the Customer Care Center. Thus downtime can be prevented and maintenance productivity improved." (Kone Annual Report, 2005) "A new web-based maintenance service was launched in the U.S.A. And Australia. It provides both KONE and the customer with more extensive opportunities to obtain information on equipment functioning, service and repair measures, and billing compared to traditional maintenance contracts." (Kone Annual Report, 2005) "A customer extranet service, KONE eOptimum™, was introduced globally to provide real-time information relating to callout and equipment status, as well as reports related to performance, maintenance, repairs and invoicing. " (Kone Annual Report, 2006) "The digital toolbox supports Schindler technicians when servicing elevators and escalators. They can access information about the status of the installations at any time, promptly order replacement parts and even optimize their routes. They use the FieldLink app to plan and prepare their daily work schedule: The app prepares lists of jobs based on a real-time analysis of elevators and escalators. If, for example, an elevator stops working, a sensor relays this information to Schindler's back-end system, which then generates a recommendation that action should be taken. A repair job is then assigned to a service technician." (Schindler Group Review, 2015) MAX is the first big data solution for the preventive maintenance of elevators. ThyssenKrupp developed the system in teamwork with Microsoft. Sensors in the elevators send data to the cloud, where the remaining lifetime of key components and systems is calculated to determine where maintenance is required. Anything unusual is reported to service technicians so that problems can be eliminated before they occur. The aim is to reduce elevator downtimes by around 50 percent – and in so doing also reduce maintenance costs for customers. (ThyssenKrup Annual Report, 2017)

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3. Paper II

The impact of servitization intensity on the performance of product firms over time: an empirical investigation in the elevator industry

This paper was submitted to the Industrial Marketing Management journal (IMM).

Abstract

Purpose - The purpose of this paper is to provide insights into the complex relationship between service provision and the financial performance of product firms over time by: 1) considering relevant moderating factors of such relationship (resource slack, market share, advertising intensity and age of the firm); 2) drawing on longitudinal data, given that servitization is considered a long-term, often incremental process.

Design/methodology/approach – We examined the impact of servitization on firm financial performance in the elevator industry. This industry was one of the first to engage in servitization and is one of the highest servitized industries worldwide. Specifically, we studied all firms of this industry in one country (Portugal) based on longitudinal financial data (SABI database, 2006-2017). Studying a single industry in one country allows for the natural control of several contextual factors that may influence firm performance, and enables more granular insights on the factors that may affect it. We used panel data analysis with fixed effects to control for time-invariant, unobserved heterogeneity among firms.

Findings – Our findings show that a shift towards services is rapidly increasing, with servitization intensity (% of sales from services) rising from 49% in 2006 to 67% in 2017. They suggest that servitization intensity is positively associated with profitability (return on sales) over time. Resource slack and advertising intensity positively moderate the relationship between servitization intensity and profitability, over time.

Originality/value – This study answers calls for a better understanding of the complex relationship between servitization and firm performance, namely, by conducting longitudinal studies and examining factors that moderate such relationship. It does so by studying a highly servitized industry in a tightly controlled setting over a long period.

Keywords - Servitization, Performance, Elevator industry, Longitudinal study

Paper type - Research paper

1. Introduction

The decision to compete through servitization – offering a portfolio of integrated products and services rather than products alone (Neely, 2009; Baines and Lightfoot, 2014) - has been assumed to be beneficial for the performance of product firms (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Baines *et al.*, 2009a; Gebauer *et al.*, 2012). However, there is still limited large-scale empirical evidence on this supposition (Gebauer et al., 2012; Baines and Lightfoot, 2014; Eloranta and Turunen, 2015; Sousa and da Silveira, 2017). Said research is still in its early stages and scholars have called for an in-depth understanding of the financial performance outcomes of servitization (Ambroise *et al*., 2018, Eggert *et al.*, 2014a; Bigdeli *et al.,* 2017).

For that purpose, there is a strong need for longitudinal studies (Bigdeli *et al.*, 2017; Baines *et al.*, 2017). This is because servitization is often a long-term, incremental process (Gebauer *et al.*, 2012). Moreover, the extant evidence suggests a complex relationship between service provision and firm financial performance over time (Fang *et al.*, 2008; Gebauer *et al.*, 2012; Suarez *et al.*, 2013). The simple advice 'to add services' or to sell more services is not likely to always produce satisfactory performance outcomes for product firms (Mathieu, 2001a; Brax, 2005; Gebauer *et al.*, 2005; Eggert *et al.*, 2011; Ulaga *et al.*, 2011; Ryals and Rackham, 2012; Kohtamäki *et al.*, 2013; Coreynen *et al.*, 2017; Sousa and da Silveira, 2017), the so-called service paradox (Neely, 2009). It has been suggested that servitization may have a neutral or negative impact on performance at early stages of service offering, after which the impact may turn positive (Fang *et al.*, 2008; Suarez *et al.*, 2013). According to this perspective, there would be a convex, non-linear relationship between servitization intensity (share of revenues generated by services) and the financial performance of the product firm over time. Understanding this paradox requires longitudinal studies of servitization and firm performance over long periods of time. Moreover, since the impact of servitization on firm performance may be contingent on the type of industry (Fang *et al.*, 2008; Suarez *et al.*, 2013; Eggert *et al.*, 2014a; Kastalli and Van Looy, 2013; Visnjic *et al.*, 2016; Visnjic *et al.*, 2019) and the region of servitization maturity in which firms are operating (Wang *et al.*, 2018), it requires the empirical study of diverse industries with different levels of servitization intensity. Notwithstanding, prior research has rarely examined the impact of servitization in highly servitized industries. It has also been stressed that the factors that affect the impact of servitization on the performance of product firms over time are yet to be reliably established (Ulaga and Reinartz, 2011; Kohtamäki *et al.*, 2015; Benedettini *et al.*, 2017; Raddats *et al.*, 2019).

In order to address these gaps, this study investigates internal (firm-specific) factors that may moderate the impact of servitization intensity on the financial performance of product firms

over time, in a highly servitized industry. We do so by studying the elevator industry in a single country (Portugal) over a period of eleven years. Such setting enables the natural control of a number of external factors that may influence firm performance (Baines *et al.*, 2017). Thus, we are able to obtain more granular insights on the impact of internal factors which would be hardly obtainable from cross-industry data (Kastalli and Van Looy, 2013).

The elevator industry is especially interesting because it covers a broad spectrum of service offerings, from basic to advanced services (Mathieu, 2001a; Baines and Lightfoot, 2014; Sousa and da Silveira, 2017) and is highly servitized (in 2017, for instance, 67% of the total revenues in Portugal were generated through the provision of services). Two flagship elevator companies – Kone and Thyssenkrupp – are often considered worldwide exemplars of successful servitization, with over half of their total revenues coming from services provision (Jacob and Ulaga, 2008; Fischer *et al.*, 2010; Kohtamäki *et al.*, 2015).

We developed a panel data model to examine the impact of servitization intensity on firm profitability over time and relevant moderating factors (resource slack, market share, advertising intensity, and age of the firm). The model was tested with quantitative data of product elevator firms in the period 2006-2017, obtained from a financial database. Panel data models provide a greater ability to capture dynamic effects over time and to identify causal effects (Hsiao, 2007). In addition, they result in more accurate inferences of model parameters, due to larger sample size and the ability to control for the impact of omitted or missing variables that are correlated with the explanatory variables (Hsiao, 2003; Baltagi, 2005). Therefore, we are better able to identify and measure effects that are simply not detectable in pure cross-section or pure time-series data (Baltagi, 2005), by clearly isolating the main factors affecting firm financial performance over time.

Based on this model, we found that servitization intensity had a positive impact on the profitability of the product firm (return on sales) over time. However, we found no evidence of non-linear effects of servitization intensity on profitability. We also found that the impact of servitization intensity seems to be moderated by the advertising intensity and the resource slack of the product firm. By addressing an under-researched aspect of servitization, this study makes an important contribution to the theoretical foundation of the servitization literature.

The remainder of this paper is structured as follows: the next section reviews previous work and presents the underlying theoretical framework. Section 3 develops our hypotheses. Section 4 focuses on the empirical setting, methodology, sample selection, choice of variables, data collection and statistical procedures. The succeeding section presents the statistical models and formally tests the hypotheses. Section 6 discusses the results. The paper closes with a summary of the findings and a discussion of their implications for servitization theory and practice.

2. Theoretical Background

2.1 Financial performance measures employed in servitization research

For the sake of clarity, several concepts and definitions need to be established upfront. Performance measurement is defined as the process of quantifying the efficiency and effectiveness of the actions of a firm (Neely *et al.,* 1995). Thus, financial performance refers to the assessment of how well an organization executes on its most important financial parameters (Morgan, 2012).

Financial performance measures employed in servitization research can be grouped into objective and subjective measures. Objective measures refer to economic indicators related to profit, sales or market value (Srivastava *et al.*,1999). Subjective measures are indicators based on the managers' perceptions and satisfaction regarding servitization. The latter measures have been used in comparative studies (i.e. Eggert *et al.*, 2014b), namely when different accounting rules can lead to diverging practices in financial reporting, or when confidentiality can induce respondent managers to mask financial data on services. Table 1 outlines the identified financial performance measures used in prior studies, indicating the group they belong to, the statistical method used, whether a longitudinal study was adopted, and the corresponding main conclusions.

Table 1 shows that the most frequently used financial performance dimension is profitability. Sales performance (Kohtamäki *et al.*, 2013; Eggert *et al.*, 2014a), calculated as revenue growth is an important measure for smaller, entrepreneurial firms; still, it has been rarely used to assess firm performance (Gebauer *et al.*, 2012). Some other authors (Fang *et al.*, 2008; Visnjic *et al*., 2016) use Tobin's *q* to measure the impact of service strategies on firm shareholder value. The use of this measure is only possible in publicly-held product firms, since it is computed by means of the company´s market value (stock exchange value).

The next sections discuss the remainder of Table 1.

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Table 1 – Overview of the impact of services on product firm financial performance.

Type of Measure	Performance dimension	Measure	Study	Sample	Longitudinal study	Statistical Method used	Main Conclusions
Objective	Profitability	Operating margin	Homburg *et al.*, 2003	271 Strategic Business Units of manufacturing firms from three industrial sectors: electrical engineering industry, mechanical engineering industry and metalworking industry	No	Structural equation modeling technique	The direct service profitability is positively affected by the service orientation of corporate culture and the service orientation of human resource management. The overall profitability is strongly and positively influenced by the quality of customer relationships and moderately affected by the direct service profitability.
	Profitability	Operating margin	Neely, 2009	10,028 firms in 25 different countries with US SIC codes in the range 10-39 inclusive	No (only 2004)	Regression analysis	While the manufacturing firms that have servitized are larger than traditional manufacturing firms in terms of sales revenues, at the aggregate level they also generate lower profits as a % of sales. In smaller firms servitization appears to pay off while in larger firms it proves more problematic.
	Profitability	Operating margin	Gebauer *et al.*, 2010	Survey of German-speaking manufacturing companies (Germany and the German-speaking part of Switzerland) in January 2005. 302 responses from Strategic Business Units	No (only 2005)	Two-step approach to structural equation modeling. First step: confirmatory factor analysis and tests for the unidimensionality, reliability, and validity of the constructs. In the second step, research hypotheses are tested with path analysis and a moderating test	Service orientation in the corporate culture is positively associated with overall performance.
	Profitability	Operating margin	Suarez *et al.*, 2013	366 software fims of the prepackaged software products industry (SIC code 7372)	Yes (from 1990 to 2006)	System generalized method of moments (GMM) dynamic panel data method	Convex, non-linear relationship between servitization intensity and overall operating margin. Firms with a very high level of product sales are most profitable, and rising services are associated with declining profitability.
	Profitability	Operating margin	Kastalli and Van Looy, 2013	1 company (Atlas Copco) - 44 country subsidiaries	Yes (from 2001-2007)	Panel data analysis with fixed effects	Positive, yet non-linear relationship between servitization intensity and profitability: while initial levels of servitization result in a steep increase in profitability, a period of relative decline is observed before the positive relationship between servitization intensity and profitability re-emerges.
	Profitability	Operating margin	Visnjic *et al.*, 2016	Sample of 133 servitizing firms. Select listed companies with 100 employees or more, based in developed countries and with primary Standard Industrial Classification (SIC) codes between 10 and 39.	Yes (Financial data for the 1999–2009 period)	Panel data analysis with fixed effects	The interplay between service business model innovation and product innovation results in long-term performance benefits coupled with a degree of short-term profit gains but long-term knowledge loss and market performance decline.
	Profitability	Operating margin	Sousa and Da Silveira, 2017	931 valid responses from the sixt International Manufacturing Strategy Survey (IMSS-VI)	No (only 2013-2014)	Partial least squares structural equation modeling (PLS-SEM)	Basic services (BAS) do not impact financial performance, but support the offering of advanced services (ADS). Advanced services have a positive impact on profitability.

Table 1 – Overview of the impact of services on product firm financial performance - cont.

Type of Measure	Performance dimension	Measure	Study	Sample	Longitudinal study	Statistical Method used	Main Conclusions
Objective	Profitability	Operating margin growth	Eggert *et al.*, 2014a	558 German firms across 16 sectors: NACE sectors 10– 36, 50–52, 60–63 and excludes pure service companies	No (only 2005 and 2007)	Seemingly unrelated regression (SUR)	Positive impact of service innovations on profitability growth.
	Profitability	Return on assets (ROA)	Suarez *et al.*, 2013	366 software fims of the prepackaged software products industry (SIC code 7372)	Yes (from 1990 to 2006)	System generalized method of moments (GMM) dynamic panel data method	The regression for ROA fails to achieve significance for all of the predictors, including the service variables.
	Profitability	Return on Equity (ROE)	Suarez *et al.*, 2013	366 software fims of the prepackaged software products industry (SIC code 7372)	Yes (from 1990 to 2006)	System generalized method of moments (GMM) dynamic panel data method	ROE seems unaffected by a firm's service orientation, but it appears to be positively associated with firm size and the level of maturity in the firms' main product category.
	Sales performance	Amount of service sales	Kastalli and Van Looy, 2013	1 company (Atlas Copco) - 44 country subsidiaries	Yes (from 2001-2007)	Panel data analysis with fixed effects	Findings suggest that an integrated product-service business model – which creates opportunities for growth beyond the installed product base by relying on related services, coupled with managerial practices that reinforce complementarity through customer proximity – is important.
	Sales performance	Revenue growth	Kohtamäki *et al*., 2013	262 firms of the machine and equipment manufacturing industry (SIC 28) in Finland	No	Partial least squares (PLS) modeling	Non-linear effect of service offering on sales growth.
	Sales performance	Revenue growth	Eggert *et al.*, 2014a	558 German firms across 16 sectors: NACE sectors 10– 36, 50–52, 60–63 and excludes pure service companies	No (only 2005 and 2007)	Seemingly unrelated regression (SUR)	Positive impact of service innovations on revenue growth.
	Firm's value	Tobin's q = the ratio between market capitalization and debt, on the one hand, and the book value of total assets, on the other	Fang *et al.*, 2008	477 U.S.-based, publicly traded manufacturing firms with SIC codes of 28-39	Yes (from 1990 to 2005): 2748 observations	Two-way, fixed-effects panel model	The impact of a firm's transition to services on firm value remains relatively flat or slightly negative until the firm reaches a critical mass of service sales (20%-30%), after which point they have an increasingly positive effect. The effect of service sales on firm value depends on both firm and industry factors.

Table 1 – Overview of the impact of services on product firm financial performance – cont.

Type of Measure	Performance dimension	Measure	Study	Sample	Longitudinal study	Statistical Method used	Main Conclusions
Objective	Firm's value	Tobin's q = the ratio between market capitalization and debt, on the one hand, and the book value of total assets, on the other	Visnjic et al.,2016	Sample of 133 servitizing firms. Select listed companies with 100 employees or more, based in developed countries and with primary Standard Industrial Classification (SIC) codes between 10 and 39.	Yes (Financial data for the 1999–2009 period)	Panel data analysis with fixed effects	The interplay between service business model innovation and product innovation results in long-term performance benefits coupled with a degree of short-term profit gains but long-term knowledge loss and market performance decline.
	Service-related performance	Direct service profitability |financial outcome	Homburg *et al.* , 2003	271 SBUs of manufacturing firms from three industrial sectors: electrical engineering industry, mechanical engineering industry and metalworking industry	No	Structural equation modeling technique	The direct service profitability is positively affected by the service orientation of corporate culture and the service orientation of human resource management. The overall profitability is strongly and positively influenced by the quality of customer relationships and moderately affected by the direct service profitability.
Subjective	Profitability	Financial performance: a three-item factor measuring the role of the service business in the firm's financial protfolio	Oliva *et al.* , 2012	216 European manufacturers in the high-value durable equipment industry moving into the service business.	No (only 2003)	OLS Regression	The authors find evidence that the creation of a separate service organization, organized as a profit center, has a significant positive mediating effect between managerial commitment and the services' financial performance
	Profitability	Profit performance (Using scales. For the final measure, the importance and satisfaction scores were multiplied to determine a weighted average performance score.	Kohtamäki et al., 2015	115 Finnish machine- and equipment-manufacturing companies with 20 or more employees.	No (only 2010)	Structural equation modeling technique	The results confirm the mediating role of service orientation in the link between service offerings, sales performance, and profit performance.
	Sales performance	Revenue growth	Eggert *et al.* , 2014b	513 German firms from the mechanical engineering industry	Yes (three years - not indicated)	Latent growth curve modeling (LGCM)	Firms with a broader service portfolio display higher levels and percentage increases in revenues.
	Sales performance	Sales performance (Using scales. For the final measure, the importance and satisfaction scores were multiplied to determine a weighted average performance score.	Kohtamäki et al., 2015	115 Finnish machine- and equipment-manufacturing companies with 20 or more employees.	No (only 2010)	Structural equation modeling technique	The results confirm the mediating role of service orientation in the link between service offerings, sales performance, and profit performance.

2.2 Financial performance impacts of servitization in product firms

The extant literature (see Table 1) has yielded inconsistent and even conflicting results on the performance impacts of servitization. While several studies found a positive effect of servitization on firm financial performance (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003; Antioco *et al.*, 2008; Malleret, 2006; Baines *et al.*, 2009a; Eggert *et al.*, 2014b; Baines and Lightfoot, 2014; Kohtamäki *et al.,* 2015; Wang *et al.*, 2018), several others have raised questions about the impact of servitization on said performance (Fang *et al.*, 2008; Neely, 2009; Kastalli and Van Looy, 2013; Kohtamäki *et al.*, 2013; Suarez *et al.*, 2013; Eggert *et al.*, 2014b; Sousa and da Silveira, 2017; Visnjic *et al.*, 2019), thus raising the possibility of a servitization paradox (Gebauer *et al.*, 2005). The latter studies suggest that servitization may have a neutral or negative impact on performance at early stages of offering, after which the impact turns positive. The findings by Fang *et al*. (2008) and Kohtamäki *et al.* (2013) reveal a U-shaped relationship between servitization and firm value, whereas Kastalli and Van Looy (2013) find a S-shaped association between servitization and profit margin. Other studies show that servitization may increase the chance of bankruptcy because of additional exposure to the risks of resource shortage, loss of focus, complexity of coordination and investor uncertainty in potential future earnings (Benedettini *et al.*, 2015, 2017). Clearly, findings do not converge, which implies the need for further investigation of the servitization-financial performance relationship (Wang *et al.*, 2018).

2.3 Longitudinal studies on the financial performance impacts of servitization in product firms

Form Table 1 we can see that there are only a few longitudinal studies that analyse the effect of servitization on the financial performance of product firms in a dynamic panel data setting. Fang *et al.* (2008) used longitudinal data from US publicly traded product firms from a wide range of industries, gathered from secondary sources during the 1990-2005 period. They found that the impact of a firm's transition to services on firm value (Tobin's q) remains relatively flat or slightly negative until reaching a critical point of servitization intensity (20%–30%). After this point, service revenues seem to have an increasingly positive effect on firm's value, since the synergistic benefits of offering products and services, and the inherent benefits of services, become more dominant. This study also shows that the effect of service revenues on the firm's performance over time depends on both firm and industry factors. An analysis of the firm-specific moderators suggests that transition to services seems to be substantially more effective for firms that offer services related to their core product business. Therefore, managers should focus their service initiatives on closely related businesses as much as possible, so they can enhance synergistic spillover benefits. Generating firm value

from service transition strategies also seems to depend heavily on the characteristics of the firm's core product industry. Looking at industry-specific moderators over time, Fang *et al.* (2008) argue that adding services to a core product offering seems to be most effective among firms in slow-growth and turbulent industries. Product firms should avoid service initiatives if their core product markets grow quickly or are in stable industries. In stable (low turbulence) industries, adding services seem to have a negative effect on the firm's value, because product firms have minimal insider knowledge that they can arbitrage into spillover benefits; cannot offer substantial advantages by bundling products and services and achieve little advantage from the reduced volatility of service, compared with product sales.

By examining the role of services in the financial performance of 366 United States firms in the pre-packaged software products industry, from 1990 to 2006, Suarez *et al.* (2013) found that when servitization intensity is low, the additional provision of services tends to worsen operating margins. Nevertheless, there seems to be an inflection point - at about 56% servitization intensity - when this relationship reverses and additional services tend to improve overall margins. The authors claim that this pattern cannot be fully explained by industry maturity effects (external factors), but rather by an improvement of the service operations of the product firm (internal factors). According to this study, the role of services for product firms may increase not necessarily due to industry maturity, but to a conscious effort by firms to grow or improve the service business, once managers realize that services have become a large and strategically relevant part of the overall business.

Kastalli and Van Looy (2013) analysed the 44 national subsidiaries of a global product firm between 2001-2007. Their results reveal a positive non-linear relationship between servitization intensity and profitability. While low levels of servitization lead to a steep increase in profitability, the scaling up of service activities results in a temporary decrease in profitability. Only when a certain critical mass of service provision is reached does a positive relationship with profitability re-emerge. Furthermore, this study shows that products and services seem to act as revenue complements and generate a spiral of revenue growth between them, overcoming the inherent substitution of products by services (services seem to prolong the lifetime of existing products, thereby postponing product replacement). Customer proximity of service offerings also seems to reinforce the positive feedback from services to product sales. Finally, the authors argue that services should be viewed as a strategic complement to products; if services are approached merely as an add-on, the installed product base, which may well encourage firms to expand into independent services, will limit revenue growth. However, if services become unconnected to the products, complementary dynamics and

economies of scope in products will no longer act as sources of value creation, and specialized service providers may be a more efficient choice for the customer.

Visnjic *et al.* (2016) compiled a longitudinal data set from 133 listed product firms from different industries, with 100 employees or more, from 1999 to 2009. By focusing only on internal (firm-specific) factors over time, these authors provide a deeper analysis of the performance implications (measured by Tobin's q) of servitization and their interplay with product innovation. The authors argue that, when considering only the short-term impact on profitability, a product firm may be convinced of the need to focus on either servitization or product innovation. The results indicate that the interplay between service business model innovation and product innovation leads to long-term performance benefits, combined with a degree of short-term performance sacrifice. When isolated from product innovation, service business model innovation causes short-term profit gains, but long-term knowledge loss - thus market performance declines.

All the aforementioned studies have identified a nonlinear relationship between servitization and financial performance, in which a positive impact on performance only seems to (re)appear when a critical mass of services is achieved. We extend this research in two ways. First, we examine the complex relationship between servitization and financial performance in a highly servitized industry over a long period time. Second, we investigate the moderating role of internal (firm-specific) factors on this relationship over time (with the exception of Fang *et al.* (2008), moderators have not been addressed in longitudinal studies). In particular, based on the literature, we focus on resource slack, market share, advertising intensity and age of the firm. This tightly controlled setting and the use of a panel data model allows for a clear isolation of the main factors affecting firm financial performance over time.

2.4 Theoretical model

The theoretical model is depicted in Figure 1. We posit that the financial performance of the product firm (measured by profitability) is positively impacted by servitization intensity and that this relationship is non-linear (U-shaped). Based on the literature, we suggest that the relationship between servitization intensity and the product firm's performance is positively moderated by the following firm-specific and measurable factors obtainable from financial data: resource slack, firm's market share, advertising intensity and age of the firm. The corresponding hypotheses are developed next.

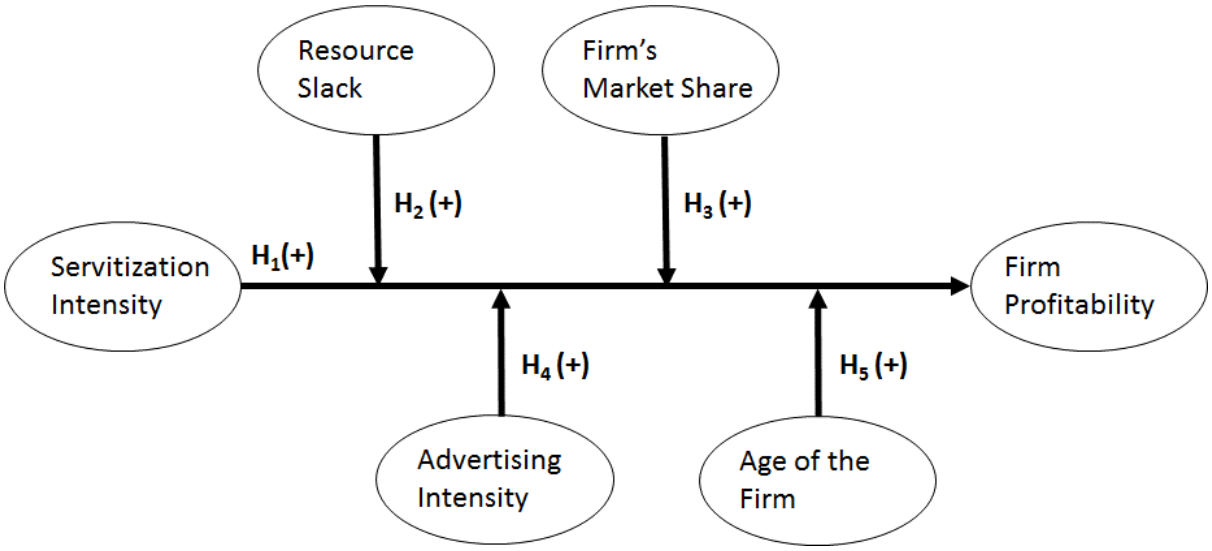

Figure 1 – Theoretical model.

3. Hypotheses

We analysed the impact of servitization intensity on firm profitability, as well as the factors that moderate (i.e. affect) this relationship over time. According to Wise and Baumgartner (1999) and Baines et *al.* (2009a) the product-service combinations seem to be less sensitive to price-based competition, thus tending to provide higher levels of profitability in comparison to offering the physical product alone (Johnstone *et al.* 2009; Oliva and Kallenberg, 2003). Consequently, product firms tend to offer services as a means to strengthen customer focus, increase overall profitability, and create revenue growth (Baines *et al.,* 2010). Kowalkowski *et al.* (2017) argue that services can become an important source of revenue and profits, a way to escape the product commoditization trap that product firms may face when reaching the maturity phase in the product lifecycle. For example, in the elevator industry, companies such as Otis and Kone enjoy maintenance service margins of 25–35% compared to a margin of approximately 10% for new equipment (The Economist, 2013). Furthermore, the provision of more services also seems to increase the efficiency of the product firm, by spreading some of the fixed costs related to service provision through repeated use of resources and capabilities (Eggert *et al.*, 2014a; Benedettini *et al.*, 2017). Therefore, the resource sharing and learning effects may lead to a reduction of the operating costs of the product firm, while providing more services (Benedettini *et al.*, 2017). These arguments led us to the following hypothesis:

> **Hypothesis 1a (H_{1a})**: Higher levels of servitization intensity are associated with higher firm profitability over time.

The relationship between servitization and performance seems to be non-linear (Fang *et al.*, 2008; Cusumano, 2008; Neely, 2009; Gebauer *et al.*, 2012; Baines and Lightfoot, 2014; Bigdeli *et al*., 2017; Baines *et al.*, 2017). In their empirical study about the software industry, Suarez *et al.* (2013) found that with rising service revenues, the operating margin seems to decline until a critical point (a specific inflection point when services reach 56% of revenues) when the offering of additional services start to have a positive marginal effect on firm's profits. Brax (2005), Gebauer *et al.* (2005) and Neely (2009) argue that there is a service paradox, meaning that revenues earned by the product company may increase, but profitability may decrease with higher servitization, at least in the initial stages of servitization.

This non-linear relationship between servitization and firm financial performance may be explained by at least two factors. First, although seen as more secure, the initial offering of services bundled with products is challenging, because services seem to be in conflict with the transaction orientation of the product firm (Brax, 2005). Shifting to services seems to demand different and possibly conflicting organizational elements, which can undermine motivation and productivity. This shift requires managers to allocate their limited resources from existing product opportunities to new service initiatives, even though they have little prior experience evaluating or managing service-based projects (Suarez *et al.*, 2013). When the product firm focuses on a specific set of activities and managers and employees gain more experience in those (Suarez *et al*., 2013), or more service-minded human resources join the organization it often gets better at doing them, reducing the product–service conflicts (Fang *et al.*, 2008). This suggests that accumulating levels of service over time will result in service learning effects, which are likely to further improve profit margins (Kastalli and Van Looy, 2013). Second, the servitized product companies appear unable to generate enough additional revenues or margins to cover the investment required to leverage servitization intensity, namely the need to build new capabilities (Gebauer, 2005; Neely, 2009; Martinez *et al.*, 2010; Sousa and da Silveira, 2017). Therefore, in an initial phase, investments and higher costs for developing and offering services often do not generate the expected returns (Lütjen *et al.*, 2017). As service sales increase to a meaningful level, organizational elements can be optimized for service offerings (e.g., separate business units), which seems to lead to an increase in performance (Fang et al., 2008), suggesting that economies of scale eventually compensate for investment costs (Kastalli and Van Looy, 2013). We thus, posit the following hypothesis:

> **Hypothesis 1b (H_{1b})**: The relationship between servitization intensity and firm profitability is non-linear (i.e. quadratic, with a convex U-shape) over time.

When delivering more services, the product firm seems to require additional assets, hence higher working capital (Neely, 2009; Baines *et al.,* 2010). Nevertheless, the offering of

additional services may divert financial and managerial resources from manufacturing and new product development, which are the traditional sources of competitive advantage for the organization (Oliva and Kallenberg, 2003). In order to succeed with servitization, the product firm may have to create a global service infrastructure that is capable of responding to the requirements of the geographically distributed installed base (Oliva and Kallenberg, 2003; Gebauer *et al*., 2005; Baines *et al.*, 2009b; Gebauer *et al.*, 2012). A product firm is likely to need new and alternative organizational principles, structures and processes (Baines *et al.,* 2009b), but also to develop new competences to better market, sell, deliver and profit from the services (Gebauer *et al.*, 2012). Consistent with the literature (cf. Bourgeois, 1981; Lee and Grewal, 2004; Benedettini *et al.*, 2017), resource slack is used to describe potentially serviceable resources that can be diverted or redeployed for the achievement of organizational goals. Slack resources consequently provide a cushion of actual and potential resources, enabling the organization's successful adaptation to internal pressures for policy changes, and encouraging changes in strategy (George, 2005). The availability of resource slack may enable firms to implement the service-specific resources required to offer services bundled with products, without affecting other goals or projects. In line with this reasoning, we advance the following hypothesis:

> **Hypothesis 2 (H_2)**: Resource slack positively moderates the effect of servitization intensity on firm profitability over time.

Since services are inherently intangible, customers are more likely to source services from a trusted provider, which implies that the competitive position of the provider is of critical importance (Benedettini, 2015; Kohtamäki et al., 2015). The firm's competitive position may be defined in terms of its market share. In line with Benedettini (2015), firms with greater market share may have greater visibility and therefore be better able to attract new customers and retain existing ones. Therefore, firms with higher market share should be able to leverage existing relationships better than competitors with lower market share, which should result in higher returns from their servitization strategy (Fang *et al.*, 2008). Hence, we propose:

> **Hypothesis 3 (H_3)**: The firm's market share positively moderates the effect of servitization intensity on firm profitability over time.

Product firms may use service elements to differentiate their product offerings, thus providing competitive opportunities (Vandermerwe and Rada, 1988; Brax, 2005; Baines *et al., 2009a*; Johnstone *et al.*, 2009) and increasing the performance of the product firm (Gebauer *et al.*, 2011). This is particularly accurate in industries where it is difficult to maintain competitive product differentiation due to commoditization (Kowalkowski *et al.*, 2017). Services may enhance the value of the good and act as a potential generator of additional demand for products, from both new and existing customers (Johnstone *et al.*, 2009). The addition of

services to products may increase the need of product firms to communicate the value of these new service-based propositions to their customers, in order to convince them of the benefits (Gebauer and Kowalkowski, 2012). Previous research has emphasized that services may need to be made more tangible (Kindström *et al.*, 2012). According to these authors, studies of service advertising have found that companies need to provide more information when delivering product-service combinations - comparing to only product-based offerings. Advertising is especially important to communicate the value proposition to the customer, leading to an increase in its perceived value, while providing instant awareness and lowering the buyer's risk of trial (Bagwell, 2005; Fier and Pooser, 2016). Advertising may lead product firms to be able to charge premium prices on services, based on the added value of the brand (Andras and Srinivasan, 2003). Advertising may also support the product firm's ability to differentiate its services and create entry barriers to other competitors (Fang *et al.*, 2008), by contributing to preserve customer loyalty through the entire lifecycle of the product. Thus, by having a higher perceived value and increasing its market differentiation, the product firm may increase the profit margins of the services it provides. We therefore propose:

> **Hypothesis 4 (H_4):** Advertising intensity positively moderates the effect of servitization intensity on firm profitability over time.

Product firms require some specific knowledge to provide services successfully. Therefore, many authors (Gebauer and Friedli, 2005; Neu and Brown, 2005; Gebauer and Kowalkowski, 2012) suggest that experience is a crucial variable influencing a firm's ability to servitize. The resource-based view of the firms considers them as heterogeneous bundles of idiosyncratic, hard-to-imitate resources and capabilities (e.g. Wernerfelt, 1984; Barney,1991). The impact on performance may be set by how well these resources and capabilities are aligned with the demands of the competitive environment (Amit and Schoemaker, 1993). Therefore, the longer a firm remains in the market, the greater its knowledge about market relationships. Consequently, this knowledge may be used to provide more services and attract new customers. On the one hand, firms may be facing the challenges of timescale. For advanced services, such as contracting for capability (e.g. aerospace sector and life management of buildings in the construction industry), the product firm tends to engage in multi-year partnerships. Managing and controlling long-term risk and exposure in these partnerships, as well as modelling and understanding their cost and profitability implications, are significant challenges for the product firm (Neely, 2009). On the other hand, transitioning from a product into a service provider constitutes a major managerial challenge. Services may require organizational principles, structures, processes and a new culture to the product firm. But for the required cultural change to take place, Gebauer *et al.* (2010) argue that managers have to be aware of the complex interactions between values and behaviors that form the service

orientation of the corporate culture. Managers must behave in a service-oriented way, in order to direct the service orientation from the management to the employee level. Without managers spending sufficient time and resources to put normative pressure on employees to understand the value of services and to overcome the complex interactions, service orientation will not be transferred to the employee level. In addition, the language used in a servitized product firm is particular and peculiar and has to be developed and adopted throughout the organization (Baines *et al.*, 2009b). Thus, accumulating levels of service over time seems to result in service learning effects (Kastalli and Van Looy, 2013). This is time consuming and consequently we rely on the age of the firm as a proxy of business experience. Thus, we put forward the following hypothesis:

> **Hypothesis 5 (H_5):** The age of the firm positively moderates the effect of servitization intensity on firm profitability over time.

4. Methodology

4.1 Empirical setting

The empirical context for the study is the elevator industry in Portugal. We chose this country as firms have there a legal obligation to report product and service revenues separately, thus enabling a reliable computation of the servitization intensity metric (see section 4.3). Studying a single industry in one country allows for the natural control of a number of contextual factors that may influence the firm's performance in line with Suarez *et al.* (2013).

The elevator industry includes firms that sell, produce, assemble and maintain elevators. It comprises two main business segments: new installations (products) and services. The new installations segment comprises the selling, production and assembly of new passenger and goods elevators in new or existing buildings. In the services segment, elevator firms provide basic and advanced services. Following the definition by Sousa and da Silveira (2017), basic services include spare parts provision, warranty, modular-based preventive maintenance contracts - which can be tailored according to customer requirements - repair, overhaul / modernization (upgrade of single components to ensure reliability and improve performance, or modernization of key systems such as control systems or door operator units, or major modernization of the complete elevator system), and condition monitoring. Advanced services include modular-based full maintenance contracts, which can be tailored according to customer requirements, and consultancy services e.g. energy efficiency improvement programs.

Being a long-lived equipment, elevators are technically complex and demand high safety requirements and consequent ongoing maintenance and inspection. Thus, elevator product companies may provide services and bundle them with products they sell, according to long-

term arrangements. The continuous usage of an elevator over time tends to increase fault-occurrence probability, which requires quick troubleshooting. Although elevators are designed, produced and installed according to accurate quality processes, they could lose not only their original functions, but also experience low performance and safety accidents without proper maintenance (Park and Yang, 2010).

The business model is based on a lifecycle approach. The average product lifecycle for elevators can be estimated within the range of 20 to 25 years. The elevator firm provides customers with solutions for the entire lifetime of their elevators and escalators, starting from the installation of new equipment. In the new equipment business, customers mainly include builders, general contractors and developers. Regular maintenance is required to keep equipment running adequately. As the equipment ages, larger repairs and replacements of parts are required in order to maintain optimal performance. Eventually, modernization via complete replacement becomes necessary. In the service business, customers consist of facility managers and building owners. The new equipment business is more cyclical in nature and fuels the growth of the maintenance business in the long run. Maintenance, on the other hand, brings stability to the business over economic cycles (because even in times of recession, maintenance is required to keep equipment running correctly) and in turn, the aging equipment in maintenance creates potential for modernization.

According to ELA – European Lift Association, the elevator industry's base of installed equipment in Portugal was approximately 152.600 elevators in 2017, increasing from 110.500 elevators in 2006. The elevator industry in Portugal was worth 288 Million Euros in 2017 - 95 Million Euros generated by new installations (products) and 193 Million Euros from services. Accordingly, around 67% of the global revenues in this industry are generated through services. While there are many companies operating (76 in 2017), this industry faces a very high concentration in terms of supply, and the market share of the first five companies represents 73%. Although total revenues fell, on average, more than 28% in 10 years, service revenues remained stable and contributed to a stable average operating profit margin of 15%, absorbing the decline in product revenues (see Figure 2).

Because of the critical aspect 'safety of end-users', there is a legal obligation for all elevators, installed and in use, to have regular maintenance: in Portugal, a monthly periodicity is defined by law. The owner of the elevator must sign a maintenance contract with a certified elevator company. All large product firms offer maintenance services to its installed base, but not only Original Equipment Manufacturers (OEM) are able to provide said service. There are several smaller companies providing maintenance to elevators produced or installed by other product elevator companies. The maintenance contract lasts for at least one year, and the average duration is three to five years. There are monthly, quarterly, half-year and yearly payment plans providing a stable source of revenue for the product elevator company. The Portuguese

law provides for two main types of maintenance contracts: (a) the simple maintenance contract, which comprises the preventive maintenance, the functional check and care of all safety devices, as well as the setting and adjustment work of the elevator (all other services, as repairs, spare parts and overhauls must be paid for on a separate bill); (b) the full maintenance contract, which involves the preventive maintenance and the corrective maintenance (that is, repairs and supply of spare parts). This service contract covers all costs related to the operation of an elevator system.

Therefore, the risks associated with the operation of the elevator ought to be covered by the service provider.

The importance of services (servitization intensity), measured by the share of service revenues to the total turnover of the product company, has been steadily increasing, from 49% in 2006 to 67% in 2017 (see Figure 3). The majority of the actual revenues for companies in the elevator industry are generated through services, not products, which demonstrates the strong prevalence of servitization for the firms in this industry.

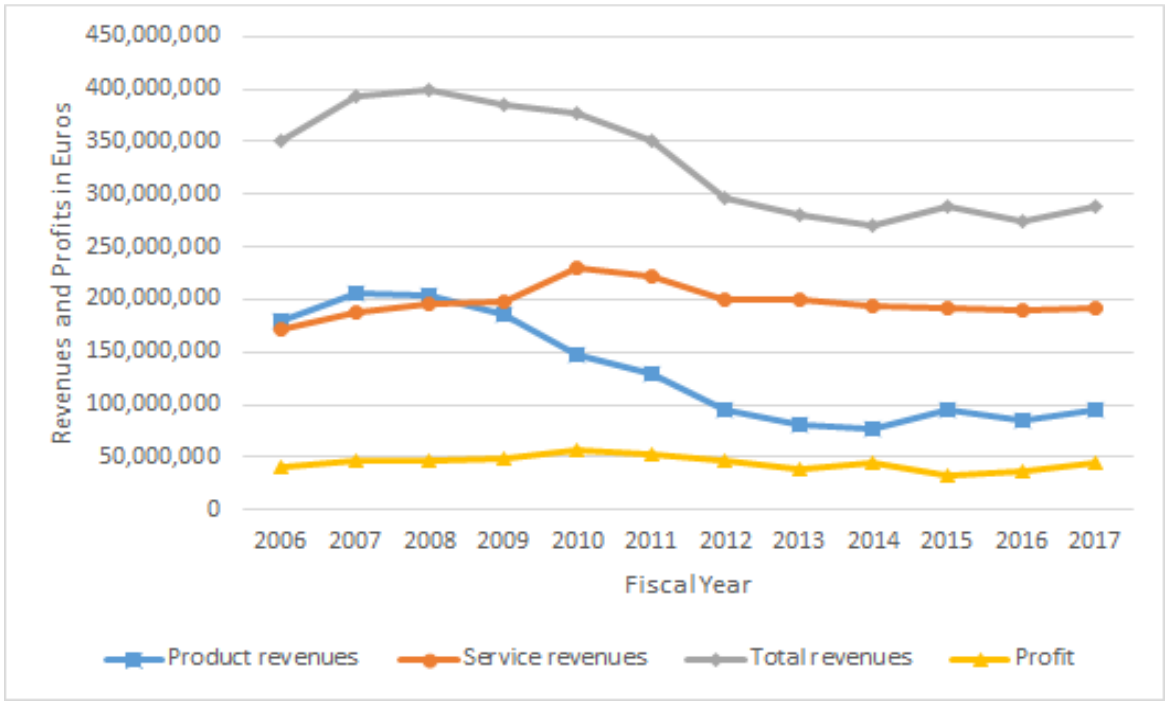

Figure 2 – Evolution of the product revenues, service revenues, total revenues and operating profit in the elevator industry in Portugal (2006-2017).

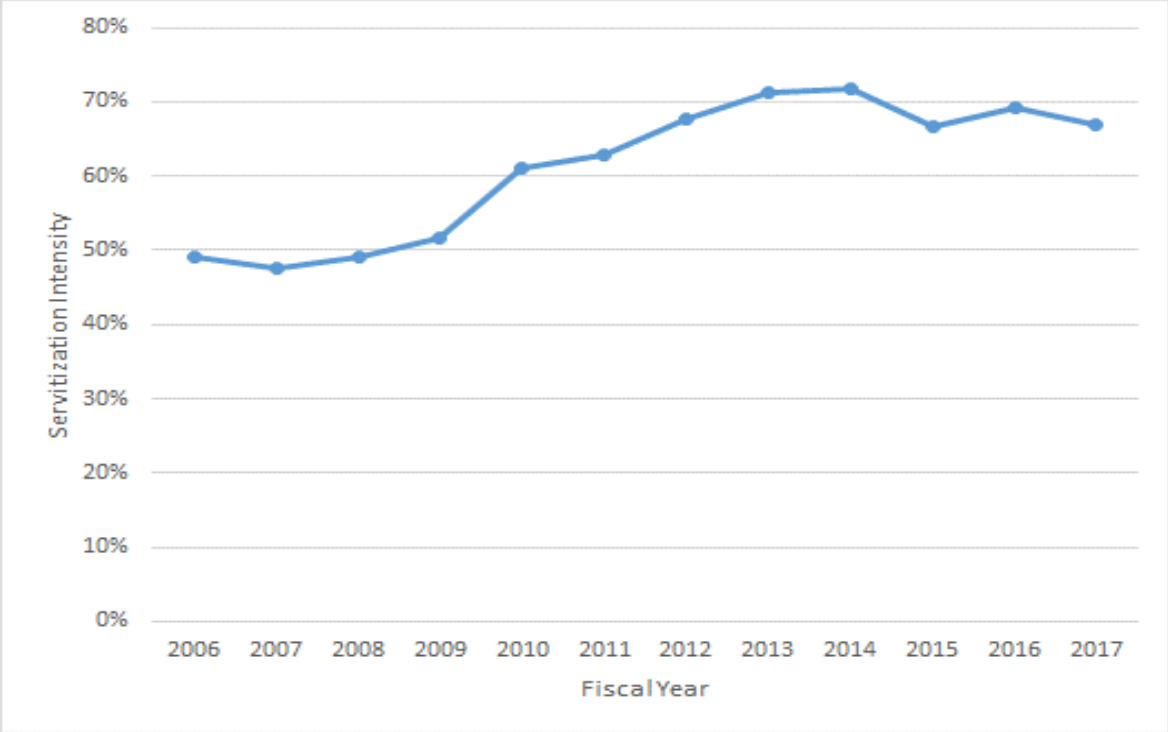

Figure 3 – Evolution of servitization intensity in the elevator industry in Portugal (2006-2017).

4.2 Data

The research is based on the analysis of secondary longitudinal financial data obtained from the database SABI – Bureau van Dijk. These data cover the period 2006-2017 for all the elevator companies that operate in Portugal. The first step was to identify the elevator companies operating in Portugal, regardless of their size (i.e. number of employees) and incorporation date. A list of 114 elevator companies was then crosschecked with the official authorized companies listed in the site of General Direction of Geology and Energy from the Portuguese Ministry of Economics, in order to guarantee that all elevator companies were considered. In order to perform services in the elevator industry, the company must have an authorization from this Ministry. In 2017, most of the companies (59%) from the sample were micro enterprises, 29% of the firms were small firms with 20 to 49 employees, and 7% had between 50 and 249 employees. Finally, only 5% of the firms registered more than 250 employees. Table 2 gives an overview of the sample over time. Figure 4 presents the number of active elevator firms per year in our data set.

Table 2 – Characterization of the sample over time.

Companies	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Nr. Companies	68	78	81	83	85	88	87	91	89	89	81	76
New Companies	4	5	4	8	3	4	7	3	1	1	2	0
Bankrupt	1	0	1	1	1	2	0	0	1	2	6	0
Acquired	1	0	2	0	2	1	1	2	4	0	1	4
Nr. Micro Enterprises	30	39	42	44	46	50	49	54	55	55	49	45
Nr. Small Enterprises	28	29	29	30	30	29	29	28	25	25	23	22
Nr. Medium Sized Enterprises	6	6	6	5	5	5	5	5	5	5	5	5
Nr. Large Enterprises	4	4	4	4	4	4	4	4	4	4	4	4
Nr. Product companies	6	3	3	1	2	3	5	3	3	3	2	1
Nr. Service companies	27	34	36	37	39	39	38	42	42	39	35	31
Nr. Servitized companies	35	41	42	45	44	46	44	46	44	47	44	44

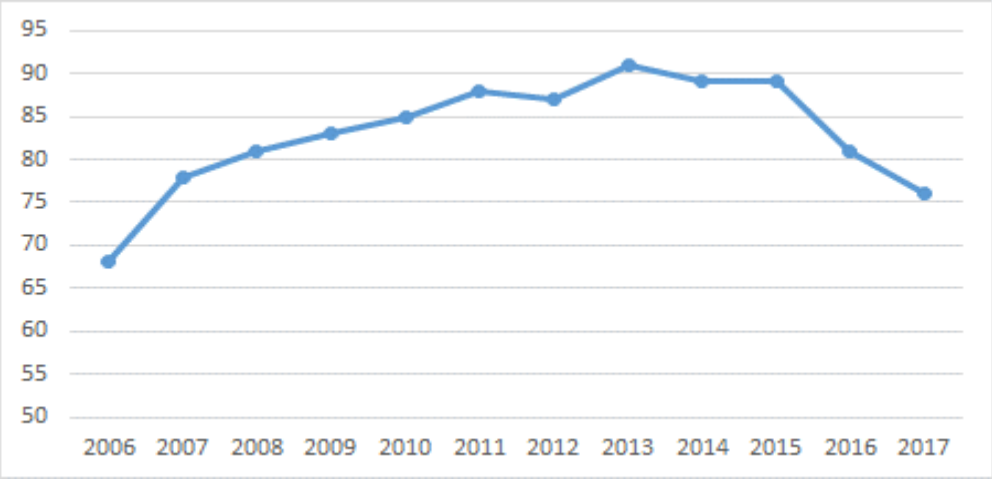

Figure 4 – Total number of firms in the elevator industry over time.

For the purpose of the present study, we only considered the servitized product companies, i.e. hybrid firms that report both product and service revenues, in at least one of the years considered. These amount to 44 firms, the remaining firms being either pure product or pure service firms.

4.3 Measurement

Servitization intensity is usually very difficult to measure, as access to reliable and insightful data is normally very onerous (Neely, 2009; Baines and Lightfoot, 2014). The reason for the relatively rare use of quantitative methods is likely to be the difficulty in collecting data on service provision. Because most product firms do not report services separately in their financial reports, secondary databases cannot usually be used to develop or test hypotheses regarding service provision.

Following the approval of the official chart of accounts (in 1989) in Portugal a separation between product revenues and service revenues has been imposed. This means that all companies operating in Portugal are obliged to report the revenues generated from products

and services separately. Therefore, it will be possible to compute the servitization intensity for all the elevator companies and to cross this information with other financial data on a company-based level over time. Even if this measure has been subject to some criticism (see for example Gebauer *et al.* (2005) for a detailed discussion on this matter), it has been by far the most widely used metric in empirical research (Fang *et al.*, 2008; Suarez *et al.*, 2013; Kastalli and Van Looy, 2013). Therefore, it will allow us to compare our results with other studies. Moreover, being an objective measure, this variable does not face the problem of managerial resistance regarding confidentiality about service revenue provision, which is a major issue when dealing with small and medium sized companies.

Profitability was assessed by the commonly used measure of operating margin (or return on sales), defined as the firm's operating profit divided by total sales of the firm (Suarez et al., 2013; Sousa and da Silveira, 2017). We use operating margin instead of net margins because the latter can be influenced by other financial factors, such as tax benefits, that do not correspond to service operations. Our measure of profitability is a good proxy for the overall firm performance, given the context of our study, also gathering universal acceptance among researchers. Other measures, such as return on assets (ROA) or return on equity (ROE), are not typically used within this industry.

In order to capture the nonlinear effect of servitization intensity on firm profitability, we computed the square value of servitization intensity (in line with Fang *et al.*, 2008; and Suarez *et al.*, 2013). The cushion of excess resources that a firm can use in a discretionary manner is measured through the resource slack, given by the ratio between working capital to total assets of the firm (Fang *et al.*, 2008; Benedettini *et al.,* 2017). The market share of each firm is computed by dividing the total revenues of the firm by the total revenues of the industry. Advertising intensity is measured as advertising expenditures divided by total revenues of the firm (Fang *et al.*, 2008; Kindström *et al.*, 2012). The age of the firm is measured as the number of years since incorporation.

We also included several time-varying control variables in our model. As the structure of European industry is mainly composed of small and medium sized companies, size seems to be an important characteristic of product firms to be analysed (Dachs *et al.*, 2012; Bigdeli *et al.*, 2017). We controlled for firm size, measured as the natural logarithmic transformation of the total revenues, to correct for non-normality (Suarez *et al.*, 2013). The growth rate in services, gauged by sales, is also included; therefore, we acknowledge that the impact of the servitization on the firm's performance may not be an exclusive result of the transitioning from product to service. The improved performance, because of inherently higher growth rates in service provision targeted by the firm (adapted from Fang *et al.*, 2008) should also be considered.

Previous literature has suggested that industry is an important control variable, which may influence the implementation of servitization and, consequently, the firm's performance (Fang *et al.*, 2008; Oliva *et al.*, 2012; Suarez *et al.*, 2013; Szász et al., 2017; Wang *et al.*, 2018; Visnjic *et al.*, 2019). Thus, we controlled for industry maturity, adapting the process proposed by Suarez *et al.* (2013). Based on the total number of active firms in each year, we calculated the maturity variable as follows:

$$\begin{cases} 100 \times \dfrac{1}{\text{number of active firms in each year}}, \text{for } t > \text{peak year} \\ -100 \times \dfrac{1}{\text{number of active firms in each year}}, \text{for } t \leq \text{peak year} \end{cases}$$

In consequence, industry maturity takes a positive and increasing value after the peak year, and negative and decreasing values as we move further away from said peak year. The peak year occurs in 2013 (see Figure 4). We also controlled for industry competition: computing the Herfindhal index, by squaring each firm's market share and take the sum of all firms. This sum is subtracted from 1, for each year, in line with Fang *et al*. (2008). We also controlled for the total installed base of elevators in Portugal, thanks to the global installed base numbers for each period, provided by the European Lift Association (ELA). The installed base figures of each company cannot be accessed, since the elevator companies operating in Portugal are not required to communicate these to the official authorities. Finally, to control for changes in economic growth over the period evaluated, we included gross domestic product (GDP) growth, according to data from the Portuguese National Authority of Statistics (INE – Instituto Nacional de Estatística), in line with Vanstraelen *et al.* (2003). The variable Year is used to capture the effect of time. A description of the variables used in the models is provided in Table 3.

Table 3 – List of variables used in the models.

Variable	Description
Operating margin $_{i,t}$	The dependent variable in Model I and Model II. Is the firm *i*'s operating margin in year *t*. The operating margin is calculated as the firm's operating profit divided by total sales of the firm.
Servitization intensity $_{i,t}$	The servitization intensity of firm *i* in year *t*. Is computed as the share of services in % of total revenues of the firm.
Servitization intensity^2 $_{i,t}$	The square of Servitization Intensity$_{i,t}$. Is used to capture the nonlinear effect, in line with Neely (2009), Suarez et al. (2013), and Kastalli and Van Looy (2013).
Resource slack $_{i,t}$	The cushion of excess resources that the firm *i* can use in a discretionary manner in year *t* (Fang *et al.*, 2008), and is calculated as the ratio between working capital to total assets, with working capital indicating the firm's current assets less its current liabilities.
Market share $_{i,t}$	The firm's *i* market share in year *t*. Is computed as the share of total revenues of the firm in % of total revenues of the industry.
Advertising intensity $_{i,t}$	The advertising intensity of firm *i* in year *t*, computed as advertising expenditures divided by total sales of the firm.
Age of the firm $_{i,t}$	The age of the firm *i* in year *t*, measured as number os years since incorporation.
Size of the firm $_{i,t}$	Control variable | The size of firm *i* in year *t*. Is obtained by the natural logarithmic transformation of the total revenues of the firm *i* in year *t*.
Service growth $_{i,t}$	Control variable | The service revenues growth of firm *i* in year *t*.
Installed base $_{t}$	Control variable | The natural logaritmic transformation of the installed base of elevators in Portugal in the year *t*, according to ELA - European Lift Association.
Industry maturity $_{t}$	Control variable | The maturity level of the industry at any given year *t* (in line with Suarez *et al.* (2013). Takes negative and decreasing values for periods before the onset of maturity and positive and increasing values for points after the onset of maturity (for a full definition see 4.3)
Industry competition $_{t}$	Control variable | Is computed using the Herfindahl index, by squaring each firm's market share and take the sum over all firms. This sum is substracted from 1, for each year t (in line with Fang *et al,* 2008).
GDP growth $_{t}$	Control variable | Is the gross domestic product growth in the year *t*, according to data from INE.
Year $_{t}$	Used to capture the expected yearly effects.

4.4 Panel data with fixed effects model

We employed a panel data model with the operating margin (firm profitability) as a dependent variable. Since longitudinal data or panel data are repeated measurements at different points in time on the same firm, regressions can then capture the variation over both firms and time (Cameron and Trivedi, 2009). This requires special attention to several estimation procedure issues. First, some regressors may be time invariant, others may be firm invariant, and some may vary over time and firms. Secondly, serial correlation of the dependent variable may bias parameter estimates. Thirdly, the idiosyncratic error term ε_{it} is assumed uncorrelated with the explanatory variables of all past, current and future periods of the same firm. Finally, it is crucial to define whether a fixed-effects or a random-effects treatment of unobserved heterogeneity is better suited. In the former, the firm-specific effect is could correlate with the explanatory variables; in the latter, it is uncorrelated with the explanatory variables.

Concerning our data, the Hausman specification test (Cameron and Trivedi, 2009) was quite significant, indicating that the random-effects treatment is not appropriate. The panel data is strongly balanced, meaning that almost all firms have data for all the years considered. The

expected yearly effect, which affects all firms in the same way, is countered by introducing a year variable.

In order to test our hypotheses, we estimated two models. Model 1 tests direct effects (linear and quadratic) of servitization intensity on the operating margin of firms *i* in period *t* (H1a, H1b), as follows:

$$\text{Operating margin}_{i,t} =$$
$$= \beta_0 + \beta_1 \text{Servitization intensity}_{i,t} + \beta_2 \text{Servitization intensity}_{i,t}^2 + \beta_3 \text{Resource slack}_{i,t} +$$
$$+ \beta_4 \text{Market share}_{i,t} + \beta_5 \text{Advertising intensity}_{i,t} + \beta_6 \text{Size of the firm}_{i,t} + \beta_7 \text{Service growth}_{i,t} +$$
$$+ \beta_8 \text{Installed base}_t + \beta_9 \text{Industry maturity}_t + \beta_{10} \text{Industry competition}_t + \beta_{11} \text{GDP growth}_t +$$
$$+ \theta_j \text{Year}_t + \varepsilon_{it},$$

where β_j represents the coefficient of each regressor in the model, θ_j the coefficient of each year, and ε_{it} is the idiosyncratic error term.

Model 2 tests direct linear effects of servitization intensity on the profitability of firms *i* in period *t* and the moderating effects, as follows:

$$\text{Operating Margin}_{i,t} =$$
$$= \beta_0 + \beta_1 \text{Servitization Intensity}_{i,t} +$$
$$+ \beta_2 \text{ Servitization intensity}_{i,t} \text{ Resource slack}_{i,t} +$$
$$+ \beta_3 \text{Servitization intensity}_{i,t} * \text{Market share}_{i,t} +$$
$$+ \beta_4 \text{Servitization intensity}_{i,t} * \text{Advertising intensity}_{i,t} +$$
$$+ \beta_5 \text{Servitization intensity}_{i,t} * \text{Age of the firm}_{i,t} +$$
$$+ \beta_6 \text{Resource Slack}_{i,t} + \beta_7 \text{Market share}_{i,t} + \beta_8 \text{Advertising intensity}_{i,t} + \beta_9 \text{Size of the firm}_{i,t} +$$
$$+ \beta_{10} \text{Service growth}_{i,t} + \beta_{11} \text{Installed base}_t + \beta_{12} \text{Industry maturity}_t + \beta_{13} \text{Industry competition}_t +$$
$$+ \beta_{14} \text{GDP growth}_t + \theta_j \text{Year}_t + \varepsilon_{it},$$

where β_j, θ_j and ε_{it} have the same meaning as in Model 1.

5. Analysis and Results

To test the research hypotheses, we estimated the panel data models with fixed effects using the STATA 13 Software program. Table 4 summarizes the descriptive statistics (SD stands for standard deviation) for all measures, pooled across firms and years. In Table 5, we present the results for models 1 and 2. The overall fit measures suggest that the hypothesized models provide a good fit for the data.

Table 4 – Descriptive statistics and correlation matrix.

Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Operating margin	0.0814	0.1314	-0.4697	0.5031	1.000															
2. Servitization intensity	0.5332	0.2992	0.0000	1.0000	0.462	1.000														
3. Servitization intensity^2	0.3736	0.3036	0.0000	1.0000	0.456	0.966	1.000													
4. SI x Resource slack	0.2012	0.2172	-0.5165	0.7572	0.585	0.588	0.565	1.000												
5. SI x Market share	0.0158	0.0375	0.0000	0.1822	0.303	0.259	0.239	0.226	1.000											
6. SI x Advertising intensity	0.0018	0.0032	0.0000	0.0376	-0.026	0.111	0.065	0.035	-0.051	1.000										
7. SI x Age of the firm	11.8541	12.8959	0.0000	80.5707	0.473	0.571	0.570	0.442	0.514	0.032	1.000									
8. Resource slack	0.3312	0.2928	-0.5165	0.9987	0.450	0.281	0.244	0.837	0.175	0.048	0.279	1.000								
9. Market share	0.0256	0.0526	0.0000	0.2345	0.232	0.137	0.111	0.175	0.944	-0.030	0.435	0.216	1.000							
10. Advertising intensity	0.0042	0.0118	0.0000	0.1802	-0.129	-0.138	-0.148	-0.086	-0.060	0.801	-0.081	0.002	0.020	1.000						
11. Size of the firm	14.3235	1.7982	9.5899	18.2178	0.267	0.033	0.008	0.179	0.696	-0.075	0.495	0.275	0.779	-0.022	1.000					
12. Service growth	1.4031	19.1170	-1.0000	379.0000	-0.023	-0.096	-0.072	-0.069	-0.029	-0.029	-0.059	-0.082	-0.018	-0.020	0.013	1.000				
13. Installed base	11.8923	0.0434	11.7753	11.9356	0.112	0.298	0.300	0.265	0.053	0.079	0.228	0.218	-0.001	0.001	-0.078	0.012	1.000			
14. Industry maturity	1.2093	2.3049	-2.6316	2.9412	0.097	0.292	0.294	0.271	0.053	0.082	0.216	0.233	-0.005	-0.012	-0.095	0.013	0.843	1.000		
15. Industry competition	0.8748	0.0031	0.8695	0.8797	-0.052	-0.164	-0.158	-0.125	-0.028	-0.043	-0.092	-0.131	0.011	0.016	0.075	0.069	-0.533	-0.451	1.000	
16. GDP growth	0.0550	2.1673	-4.0300	2.7000	0.081	0.030	0.058	0.031	0.004	-0.047	0.051	0.005	0.008	-0.049	0.015	0.075	-0.108	0.083	0.521	1.000

Table 5 – Results of panel data analysis.

Variables	Hypotheses	Model I Operating margin Panel data with fixed effects		Model II Operating margin Panel data with fixed effects	
Main effects					
Servitization intensity	H_{1a}	0.1842	(0.0895) *	0.0880	(0.0415) *
Servitization intensity^2	H_{1b}	-0.0517	(0.0800)		
Moderating effects					
Servitization intensity x Resource slack	H_2			0.1065	(0.0636) †
Servitization intensity x Market share	H_3			0.043	(0.9685)
Servitization intensity x Advertising intensity	H_4			6.3351	(3.0136) *
Servitization intensity x Age of the firm	H_5			0.0002	(0.0018)
Control variables					
Resource slack		0.0826	(0.0276) **	0.0183	(0.0459)
Market share		-1.3829	(0.4386) **	-1.1995	(0.7850)
Advertising intensity		0.2045	(0.4078)	-1.0866	(0.7604)
Size of the firm		0.0562	(0.0148) ***	0.0558	(0.0142) ***
Service growth		-0.0001	(0.0002)	-0.0001	(0.0002)
Installed base		0.1370	(0.3102)	0.1530	(0.3074)
Industry maturity		-0.0037	(0.0036)	-0.0040	(0.0037)
Industry competition		-4.4322	(1.9266) *	-4.4589	(1.9139) *
GDP growth		0.0070	(0.0030) *	0.0070	(0.0030) *
Year		-0.0004	(0.0039)	-0.0011	(0.0040)
Intercept		2.3652	(5.7614)	3.5864	(6.2854)
F-test (model)		6.36 ***		5.61 ***	
Degrees of freedom		347		344	
R2		0.68		0.69	
R2 adjusted		0.63		0.63	
Number of observations		403		403	
Number of groups		44		44	

Note: Standard errors are in parenthesis, except where indicated.
†Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level.

Consistent with Model 1, there seems to be a significant, positive effect of servitization intensity on the performance of the firm (b = 0.1842, $p < 0.05$); but no significant quadratic effect. Thus, H_{1a} is supported, but not H_{1b}.

From model 2, we find support for positive moderating effects of resource slack (H_2; b = 0.1065, $p < 0.10$) and advertising intensity (H_4; b = 6.3351, $p < 0.05$). We do not find support for market share (H_3) and firm age (H_5).

Table 6 presents a summary of the hypotheses tests.

Table 6 – Summary of the study's hypotheses tests.

Hypotheses		Supported	
		Model I	Model II
H_{1a}	Higher levels of servitization intensity are associated with higher firm profitability	Yes	Yes
H_{1b}	The relationship between servitization intensity and the firm profitability is non-linear	No	---
H_2	Resource slack positively moderates the effect of servitization intensity on firm profitability	---	Yes
H_3	The firm's market share positively moderates the effect of servitization intensity on firm profitability	---	No
H_4	Advertising intensity positively moderates the effect of servitization intensity on firm profitability	---	Yes
H_5	The age of the firm positively moderates the effect of servitization intensity on firm profitability	---	No

6. Discussion

Our findings confirm a positive linear effect of servitization intensity on firm profitability over time, using large-scale objective financial data of one single industry. However, we find no support for a non-linear (quadratic) relationship between servitization intensity and the firm's performance over time. As discussed before, the elevator industry is highly servitized, with 67% of the total revenues in 2017 generated through the provision of services. Hence, on average and over time, we suggest that the product firms in this industry may be operating after the specific inflection point referred by Suarez *et al.* (2013). These authors argue that after a servitization intensity of 56%, the offering of additional services begin to have a positive marginal impact on the firm's financial performance.

In our longitudinal study, we reliably examine relevant firm-specific factors that moderate the impact of servitization on financial performance. Our findings show that resource slack and advertising intensity are important positive moderating factors of the impact of servitization intensity on profitability. Regarding slack resources, continuous slack can support required investments in service specific assets and capabilities, without increasing the firm's financial exposure, or affecting other projects and goals. Slack resources seem to allow the product firm to adapt successfully to the changes that it undergoes while servitizing. This result is consistent with findings by Fang *et al.* (2008) and Benedettini *et al.* (2017). Thus, we agree with Benedettini *et al.* (2017), that product firms should absorb excess resources during periods of growth to be able to overcome the investment hurdles over time, while servitizing.

Our study further suggest that advertising intensity may be an important moderating factor when product firms tend to servitize, because services are inherently intangible and,

consequently, customers often struggle to understand and to compare service offerings from different providers. Since customers are more likely to source services from a trusted provider we suggest that higher investment in advertising may boost the firm's reputation and ultimately the customers' perceived value. This seems to contribute to an increase in the profit margins of the services provided. Our results are consistent with the argument that a greater reputation may positively moderate the impact of servitization intensity on financial performance, because the product firm may create differentiation and barriers to entry (Fang *et al.*, 2008). We found no support for the moderating role of market share and age of the firm. We would expect that a product firm with a larger market share and with longer market activity would be better positioned to extract profits from its service offerings than lower-share and younger competitors. However, our findings suggest that smaller and younger product firms may be equally well positioned to do so.

7. Conclusion

Considerable research has been dedicated to the benefits of integrated product and service offerings. But only a limited number of empirical studies have considered the relationship between service provision and the firm's performance over time. This study is one of the few to provide a theoretical articulation and to empirically test an integrated longitudinal model of moderating effects on performance outcomes of servitization strategies. The moderator analysis offers a finer-grained view on the servitization intensity-performance link, enabling us to identify firm-specific factors that foster (or hamper) the impact of servitization intensity on firm performance. By focusing on the elevator industry in one country, we reduce the risk of uncontrollable factors that create noise in cross-industry studies (in line with Eggert *et al.*, 2014b). Also new is the dynamic approach to the debate on servitization intensity determinants on performance. By examining the impacts of different factors on firm performance, we contribute to a more holistic understanding of the role of services to product companies' financial results, responding to the call of Bigdeli *et al.* (2017) for the use of a more comprehensive perspective on business performance in this research field.

Our study makes several important contributions to theory, by providing new insights into the nature of the relationship between servitization intensity and the profitability of the product firm. First, it suggests that product firms in an industry where servitization intensity is very high can operate past the inflection point without facing a service paradox. This means that firm profitability increases consistently with the provision of additional services and that this positive effect remains even at very high levels of servitization intensity over extended periods. This insight contributes to the literature addressing the longitudinal performance impacts of servitization, including that on the servitization paradox (Coreynen *et al.*, 2017; Sousa and da

Silveira, 2017; Ambroise *et al.*, 2018). Second, we found that resource slack and advertising intensity positively moderate the relationship between servitization intensity and financial performance of product firms over time. In contrast, we found no evidence of moderating effects of firm age and market share. These insights contribute to the emerging literature on servitization contingencies (Benedettini *et al.*, 2017; Bohm *et al.*, 2017; Kohtamäki and Partanen, 2016; Valtakoski and Wittel, 2018) by increasing our understanding of how firm-specific factors may enhance the impact of servitization intensity on firm financial performance over time.

Our findings also have important managerial implications, namely, by offering guidance for the deployment of servitization strategies. Product firms in highly servitized industries should seek increasing service provision since it seems to contribute directly to a higher financial performance over time. In addition, they should be able to build up a resource slack over the years, i.e. a cushion of actual and potential resources, in order to help the firm adapt to new service strategies over time. While the market-based asset of advertising is often among the first areas to face budget cuts during times of competitive and economic stress, our results suggest that product firms should invest continuously in advertising, since it enhances the positive impact of servitization intensity on financial performance over time.

We finish by referring some limitations of this study that open up opportunities for future research. To begin with, we examined a single industry in one country. Although this provides a tightly controlled setting, it reduces the generalizability of the findings. Future research would benefit from international data collection and cross-country/cross-industry comparisons. Secondly, we were not able to take into account the type of services that were being provided by each elevator firm. In this sense, it would be interesting to analyze how the provision of different types of services affects the profitability of product firms over time. Thirdly, we assessed the impact of servitization on the product firm's performance through financial indicators. Other non-financial performance measures should also be used to assess the impact of servitization intensity, such as those proposed by Kaplan and Norton (2007) in the balanced scorecard. Finally, it would be important to understand how other contextual factors may moderate the impact of servitization intensity on the firm's performance (Voss et al., 2016; Sousa and da Silveira, 2017), by collecting additional data from companies' websites or financial reports.

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4. Paper III

How do external and internal factors promote or hinder servitization over time? An in-depth case-study in the elevator industry.

A smaller version of this paper won the “Best paper Award for the category Case Study” at the Spring Servitization Conference 2018 which took place in Denmark at the Copenhagen Business School. This paper went through a double-blind review process and was originally published in the conference proceedings of the Spring Servitization Conference 14-16 May 2018, Copenhagen, Denmark. This paper was also presented in the Spring Servitization Conference 14-16 May 2018, Copenhagen, Denmark.

This paper is to be submitted to the International Journal of Production Economics (IJPE).

Abstract

Purpose: Servitization of manufacturing is a long-term, often incremental process of transformation, influenced by internal and external factors. The purpose of this research is to provide insights into how said factors explain the servitization journey of a manufacturing firm over time.

Design/Methodology/Approach: The research is based on an in-depth case study of the implementation of servitization in an elevator manufacturer, over a period of 30 years. The case study drew on multiple sources of evidence, including semi-structured interviews with senior managers, memos of workshops with the company´s key decision makers, company’s internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company, and participant observation at the company’s premises during the research period.

Findings: Our findings revealed that a manufacturer’s servitization journey may progress through three different servitization implementation periods: “the product-oriented period”, “the service-led period”, and finally “the advanced services period” by the interplay between external and internal factors, service offerings and bundles of servitization practices. External factors seem to be the main trigger for initiating the transition to the next servitization implementation period, followed by the corresponding adaptation of the internal factors, service offerings and servitization practices. Furthermore, the data suggest that applying bundles of servitization practices over time seems to contribute substantially to servitization intensity. Finally, the service offering seems to focus on the provision of basic services during the initial periods, followed by the gradual development of advanced services. The manufacturer provides basic services followed by advanced services first to the installed base, and only then to the captured base. In all three periods the servitized manufacturer continuously supplies products to enhance the installed base.

Originality/Value: This study addresses the shortcomings on longitudinal research on servitization. It also advances the literature by providing insights into the dynamics of how internal and external factors influence servitization intensity over time. Our findings suggest that a manufacturing firm's service offerings per se do not completely describe its servitization journey. A multidimensional approach considering bundles of servitization practices and internal and external factors, must be examined to capture the servitization transition periods.

KEYWORDS: Servitization; Elevator Industry; Case Study; Longitudinal Study.

1. Introduction

Nowadays an increasing number of manufacturing companies is competing through a portfolio of integrated products and services (Baines and Lightfoot, 2014; Sousa and da Silveira, 2017). This is a service-led competitive strategy and the process through which it is achieved is commonly referred to as servitization. Integrated product-service offerings can be distinctive, long-lived, and easier to defend from competition of lower-cost economies (Wise and Baumgartner, 1999; Tukker, 2004; Neely, 2009; Lay *et al.*, 2010; Gebauer *et al.*, 2012), being a conscious and explicit strategy for market differentiation (Baines *et al.*, 2009a; Lightfoot *et al.*, 2013; Ryals and Rackham, 2012; Smith *et al.*, 2014).

Much research has been dedicated to the design and benefits of integrated product service offerings from a manufacturer's internal perspective (Oliva and Kallenberg, 2003; Gebauer *et al.*, 2010; Baines *et al.*, 2017). More recently, some authors suggest that the organizational environment may also affect servitization of the manufacturing firm (Turunen and Finne, 2014; Baines *et al.*, 2017; Bigdeli *et al.*, 2017, Visnjic *et al.*, 2019). Finne *et al.* (2013) and Baines *et al.* (2019) draw attention to the need to study how external and internal factors influence not only servitization itself, but mainly the transition process across the servitization journey.

Specifically, knowledge about the interplay between external factors, internal factors, service offerings and servitization practices (what manufacturing firms usually do to manage servitization) is still lacking (Baines and Shi, 2015; Brax and Visintin, 2017; Baines *et al.*, 2017). External factors refer to exogenous organizational environment circumstances impacting the manufacturing firm, while internal factors relate to managerial decision-making inside the firm. In addition, there is a paucity of verified frameworks for explaining the servitization journey (Martinez *et al.*, 2010; Ng *et al.*, 2013; Kindström and Kowalkowski, 2015; Martinez *et al.*, 2017). Thus, further in-depth research is required to better understand servitization transition beyond service offerings (Lütjen *et al.*, 2017), explaining the details of individual manufacturers' step-by-step servitization journeys

(Vendrell-Herrero *et al.*, 2014; Martinez *et al.*, 2017). Given that servitization is considered a long-term, often incremental process, there is also a strong need for more studies on the implementation process of servitization over time (Malleret, 2006; Gebauer *et al.*, 2012; Baines *et al.*, 2017; Bigdeli *et al.*, 2017; Baines *et al.*, 2019).

In order to address these gaps, this study provides insights into which factors may promote or hinder servitization in manufacturing firms and how they play out over time. More specifically, we conduct an in-depth case study of a manufacturer in the elevator industry from an European country. The elevator industry was chosen because this industry was one of the first to initiate servitization and is highly servitized today, covering a broad spectrum of service offerings, from basic to advanced services. Elevators are long-lived, technically complex equipment that demand high safety requirements and consequent ongoing maintenance and inspection. Thus, it allows for the examination of long-term dynamics of servitization over time.

Our study explains in detail the actual servitization journey undertaken by a manufacturing firm over 30 years, comprising three distinct implementation periods. The study's key contribution is providing in-depth insights into the process and periods of organizational transformation towards servitization, along with addressing the limited attention given to external and internal factors.

First, our findings suggest that a manufacturing firm's service offerings per se do not completely describe its servitization journey. Rather, each period is characterized by multiple elements, including the service offerings, servitization practices, and internal and external factors (and how they interplay).

Secondly, external factors seem to be the main trigger for transitioning to the next period in the servitization journey, followed by the corresponding adaptation and interplay of the internal factors, service offerings and servitization practices.

Third, during the manufacturer's servitization journey there seems to be a coexistence between basic and advanced services over time, consolidating the provision of basic services first, followed by the development of advanced services. The servitized manufacturer provides basic services followed by advanced services first to the installed base, and only then to the captured base (equipment installed by other manufacturers). During the servitization journey the servitized manufacturer continuously supplies products to enhance the installed base.

Finally, the introduction of bundles of servitization practices in each of the servitization implementation periods contributes substantially to the servitization intensity of the manufacturer over time.

2. Theoretical Background

2.1 Conceptual Framework

The manufacturers' service offering does not thoroughly describe its servitization transition stages or periods (Lütjen *et al.*, 2017). Therefore, a multidimensional approach, which also considers servitization practices as well as internal and external factors over time, is relevant. Figure 1 presents the conceptual framework that underlies the research. This framework introduces the main aspects to be studied – the key factors, constructs or variables – and the presumed relationships between them, over time.

We define servitization intensity of the manufacturing firm as the share of revenues generated by services (in line with Gebauer *et al.,* 2005; Fang *et al.*, 2008; Suarez *et al.*, 2013).

In the next sections we will discuss each of the elements presented in Figure 1.

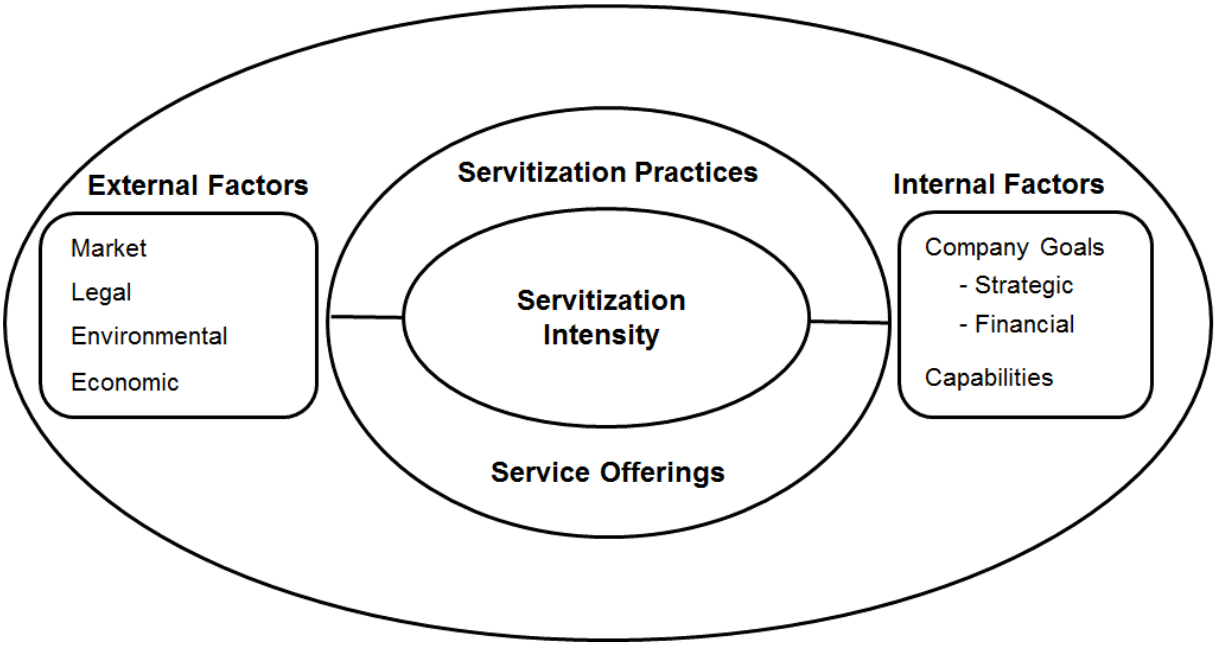


Figure 1 – Conceptual framework

2.2 External and Internal Drivers of Servitization

Servitization seems to be driven from both the outside and within the company (Turunen and Finne, 2014; Baines *et al.*, 2017; Bigdeli *et al.*, 2017; Baines *et al.*, 2019). Table 1 summarizes the literature on external and internal drivers of servitization. External factors correspond to exogenous organizational environment circumstances impacting the manufacturing firm (Sousa

and Voss, 2008; Baines *et al.*, 2017), and include market, legal, environmental and economic factors. Internal factors correspond to direct managerial decision-making inside the firm (Bigdeli *et al.*, 2018; Kroh *et al.*, 2018). These include i) company goals: voluntary decisions concerning the provision of services that the manufacturing firm can take on its own (strategic and financial factors) and ii) Capabilities: the firm's capacity to deploy combinations of resources to achieve a desired goal (Amit and Schoemaker, 1993), namely the development of service facilities in close proximity to the customer, services organizational structure, service culture and human resources with service skills, as well as the use of information and communication technologies (ICT).

Table 1 – External and internal drivers of servitization.

Categories		Factors	Studies	Characterization
External		**Market**	Vandermerwe and Rada, 1988; Oliva and Kallenberg, 2003; Brax, 2005; Baines *et al.* , 2009a; Johnstone *et a.* , 2009; Neely, 2012; Ryals and Rackham, 2012; Neely, 2013; Suarez *et al.* , 2013; Durugbo and Riedel, 2013; Kohtamäki *et al.* , 2013; Benedettini *et al.* , 2016; Benedettini *et al.* , 2017; Martinez *et al.* , 2017; Visnjic *et al.* , 2019; Baines *et al.* , 2019	Market factors are associated with customers and competitors. a. The provision of services to satisfy demand for more services from existing customers, improving customer satisfaction and strengthening customer confidence and supplier credibility. b. Competitors may promote the provision of additional services and existing services not only to the installed base but also to the captured base - equipment installed by other manufacturers. Competitors may also lead to a reduction on service prices leading the customer to switch the provider.
		Legal	Turunen and Finne, 2014; Bigdeli *et al.* , 2017; Franco *et al.* , 2016, 2017, 2018; Sousa and da Silveira, 2019; Baines *et al.* , 2019	Through legislation governments can impose the provision of certain types of service in some industries. For instance, in the aerospace and elevator industries, this factor seems to contribute to servitization.
		Environmental	Baines *et al* ., 2009a; Neely, 2012; Bocken *et al.* , 2014; Porter and Heppelmann, 2014; Doni *et al.* , 2019; Baines *et al.* , 2019	Environmental factors are associated with business models in which customers share access to assets, rather than physically owning them, thereby reducing the environmental impact of production.
		Economic	Neely, 2009; Smith, 2013; Kaczor and Kryvinska, 2013; Eggert *et al.* , 2014; Benedettini *et al.* , 2015; Martinez *et al.* , 2017; Baines *et al.* , 2019	Economic factors have a significant impact on how an organisation does business and also how profitable it is. These factors include e.g. economic growth, taxes, interest rates, exchange rates, inflation, disposable income of consumers and businesses and demand/supply of goods and services. Implementing a service strategy may expose the manufacturer to a wider array of economic factors, for example economic downturn .
Internal	**Company Goals**	**Strategic**	Vandermerwe and Rada, 1988; Wise and Baumgartner, 1999; Mathieu, 2001a; Brax, 2005; Saccani et al., 2007; Antioco *et al.* , 2008; Neely, 2009; Baines *et al.* , 2009a; Baines *et al.* , 2009b; Lightfoot *et al.* , 2011; Ryals and Rackham, 2012; Smith *et al.* ,2014; Benedettini et al., 2016; Coreynen *et al.* , 2017; Sousa and da Silveira, 2019; Doni *et al.* , 2019; Baines *et al.* , 2019	Strategic factors are largely related to the achievement of competitive advantage. Services may be used to differentiate the offering from competitors' and to create growth opportunities in mature markets.
		Financial	Wise and Baumgartner, 1999; Brax, 2005; Gebauer *et al.* , 2005; Mallaret, 2006; Gebauer *et al.* , 2006; Gebauer and Fleisch, 2007; Baines *et al.* , 2009a; Johnstone *et al.* , 2009; Gebauer *et al.* , 2010; Kastalli and van Looy, 2013; Eggert *et al.* , 2014; Benedettini *et al.* , 2016; Sousa na da Silveira, 2017; Kowalkowski et al., 2017; Baines *et al.* , 2019	Financial factors are associated with the positive impact on revenues and/or on margins that manufacturers may achieve while providing (more) services. Many studies refer that services seem to yield a higher sales margin than products. Services also seem to better balance the effects of economic cycles, through more stable revenues.
	Capabilities	**Capabilities**	Amit and Schoemaker, 1993; Mathieu, 2001b; Baines *et al.* , 2009b; Kindström, 2010; Ulaga and Reinartz, 2011; Storbacka, 2011; Gebauer et al., 2013; Paiola et al., 2013; Baines and Lightfoot, 2014; Bocken *et al.* , 2014; Kanninen et al., 2017; Sousa and da Silveira, 2017; Coreynen *et a.* , 2017; Jaakkola *et al.* , 2017; Grubic, 2018; Kroh *et al.* , 2018; Bigdeli *et al.* , 2018; Baines *et al.* , 2019	Capabilities refer to a firm's capacity to deploy combinations of resources to achieve a desired goal.

2.3 Servitization Practices

Practices can be defined as “what people or organizations are doing as part of everyday individual or organizational life” (Grönroos and Helle, 2010, p. 586). In a business context, practices can relate to operational, administrative, financial, marketing and other processes, and are both mental and physical activities (Grönroos, 2011).

We define servitization practices as what manufacturing companies usually do to manage servitization. A manufacturing firm would employ a particular practice assuming that it is an effective way of contributing to the servitization process.

Table 2 identifies and characterizes practices that are commonly associated with servitization in the literature.

Table 2 – Servitization practices.

Servitization practice	Studies	Characterization
Sales organization management	Stremersch *et al.* (2001) Ulaga and Reinartz (2011) Ryals and Rackham (2012) Smith *et al. (2014)* Ulaga and Loveland (2014)	By adding the service element to the product, the sale may become more complex, taking it longer to explain to customers, longer to negotiate and therefore longer to sell. Servitized companies will have to broaden their marketing and sales approach in an horizontal as well as a vertical way.
Supply chain management	Johnson and Mena (2008)	The servitized supply chain delivers a range of options, from spare parts to services such as maintenance. This is an evolution of the supply chain away from the delivery of the physical towards the co-ordination and delivery of the physical (e.g. spare) and the non-physical (service).
Service Design and Development	Alonso-Rasgado *et al.* (2004) Malleret (2006) Payne *et al.* (2007) Kindström and Kowalkowski (2009) Grönroos and Helle (2010) Grönroos (2011) Durugbo (2014)	When a service offering is designed, the service provider must be careful to offer services that create value for its customers. Co-design offers an important avenue for realising multidisciplinary and timely service designs.
Service delivery	Corrêa *et al.* (2007) Kindström and Kowalkowski (2009) Erkoyuncu *et al.* (2010) Ng and Nudurupati (2010) Smith *et al.* (2014) Baines and Lightfoot (2014)	The mental and physical activity of providing a service to the customer. The service delivery system constitutes the integration across the different actors for a given type of service. The service delivery is people intensive and it defines the interaction between the service provider and the customer (co-production).
Service pricing	Boyt and Harvey (1997) Oliva and Kallenberg (2003) Malleret (2006) Lusch *et al.* (2007) Gebauer *et al.* (2008) Nordin and Kowalkowski (2010) Toossi *et al.* (2013) Kindström and Kowalkowski (2014) Brax and Visintin (2017)	Pricing practices are needed to determine how to charge for new services and possibly change the revenue model of existing services, such as moving from free to fee. The firm must be able to manage traditional pricing schemes and revenue mechanisms in parallel with new methods and models. In the case of traditional, input-based revenue mechanisms, the firm gets paid per service hour and units sold. The services are sold as deeds, without any direct link to or feedback from the customer's value creation process. Output-based revenue mechanisms instead rely on either fixed (e.g., availability, usage) or dynamic (e.g., performance, results, gain sharing) prices. If a customer signs a fixed price agreement, the supplier receives the same amount every month, regardless of the number of service hours, components, or spares needed.
Risk Management	Oliva and Kallenberg (2003) Johnson and Mena (2008) Nordin *et al.* (2011) Benedettini *et al.* (2015)	Adding services to traditional goods introduces new risks for firms and managers have to seek means of mitigating these risks to ensure successful introduction of services. Requires a new set of skills and information gathering mechanisms to determine and manage risk.
Service rewarding	Homburg *et al.* (2003) Neu and Brown (2005) Neu and Brown (2008) Gebauer *et al.* (2010) Hill and Cuthbertson (2011) Oliveira and Roth (2012) Paiola *et al.* (2012) Biege *et al.* (2012)	The extent to which a company has a reward system in place to reward employees on the basis of their performance is critical because of its effect on employee satisfaction. The literature on service suggests that employees who are rewarded for service-oriented values and behaviors will arguably be more likely to provide services that fulfill customer needs. Reward and compensation schemes that need to be adjusted so as to encourage the development and successful selling of solutions rather than the maintenance of the product-centric sales of the past.
Perfomance measurement	Ng *et al.* (2011) Baines and Lightfoot (2014) Jääskeläinen *et al.* (2014)	To deliver services, manufacturers adopt performance measures that reflect outcomes aligned to individual customers, and these are then cascaded into various forms throughout the service delivery system, and complemented by a set of more measures that demonstrate value to the customer.
Service metrics and standards management	Wise and Baumgartner (1999) Ng *et al.* (2011) Baines *et al.* (2011a) Oliveira and Roth (2012)	The metrics and standards dimension refers to the metrics captured by the measurement system on customers and services, and the establishment of service standards. Such metrics and standards have been identified as key factors for the success of service companies. The measurement system can be an essential link between a company's strategy, operations, and value creation. Measurement systems are also a requirement for companies that want to conduct benchmarks against competitors.

2.4 Service Offerings

Servitization strategies are defined to a great extent by the types of services provided by the manufacturer (Eggert *et al.*, 2014). In line with several authors (Mathieu, 2001a; Gebauer *et al.*, 2005; Sousa and Da Silveira, 2017) we adopt hereafter the distinction between basic and advanced services.

Basic services aim to install and maintain basic product functionality. This category of services covers the bundling of some extra services to the sale of goods, and the manufacturer may offer services that are needed during the use phase of the good (Tukker, 2004; Baines *et al.*, 2013). Examples are the provision of spare parts, maintenance and repairs.

Advanced services relate to working closely with customers to co-create value that goes beyond basic product operation, involving the adaptation of the product use to the customer's unique needs and usage situation (Sousa and Da Silveira, 2017). Advanced services include customer support agreement, risk and revenue sharing contract, revenue-through-use contract or rental agreement (Baines *et al.*, 2013). The risk that the manufacturer faces is high, and financial penalties may be incurred if equipment fails to perform as specified. The revenue payment may be linear, due to a pay-through-use with period adjustments in rate.

Prior studies suggest that manufacturers introduce and consolidate the basic services first, followed by the development of advanced services. There seems to be a sequential transition path from basic to advanced services (Oliva and Kallenberg, 2003; Gebauer *et al.*, 2005; Martinez *et al.*, 2010; Eggert *et al.*, 2014; Kowalkowski *et al.*, 2015). More recently, Visnjic *et al.* (2019), using the competence-based view of industry evolution, theorize that manufacturers provide basic services in early stages of the product life cycle and advanced services in the late stages of the product industry life cycle. However, Sousa and Da Silveira (2017), found out that there seems to be a balanced adoption of basic and advanced services, using the basic services as a platform for providing advanced services, rather than providing basic services first to a high extent, then followed by advanced services.

2.5 Servitization implementation journey

The literature presents several different servitization implementation paths that manufacturing firms may follow over time. The shift from a manufacturer to a company with a service-dominant offering is commonly interpreted as an incremental change, rather than a radical one, suggesting that manufacturers proceed gradually through a number of well-ordered evolutionary stages. However, several authors argue that the reality is far more complex (Brax, 2005; Johnstone *et al.*,

2009), with the servitization process following a continuous change that is either emergent and intuitive in nature (Martinez *et al.*, 2017) or unstructured and iterative, with multiple crises or tipping points (Baines *et al.*, 2019).

Table 3 summarizes the literature on servitization paths, following the study by Baines *et al.* (2019). It draws on organizational change theory to summarize and group these servitization journeys. According to these authors, the general literature on organizational change is dominated by two main approaches: i) the punctuated equilibrium model, and ii) the continuous change model. The punctuated equilibrium model is characterized by long periods of small, incremental change that are interrupted by brief periods of discontinuous, and radical change (Tushman and Anderson, 1986; Gersick, 1994; Martinez et al., 2017; Baines *et al.*, 2019). The continuous change model, alternatively suggests that change is not episodic but endemic to the way in which organizations operate, with the ability to engage in rapid and relentless continuous change (Langley et al., 2013; Martinez et al., 2017). Firms continually monitor, recognize and respond to external and internal factors in small steps as an ongoing process (Baines *et al.,* 2019).

As we described previously, we aim to better understand (in a holistic way) how external and internal factors promote or hinder servitization over time.

Table 3 – Servitization paths

Servitization Journey	Change management theory	Studies	Main contributions
Servitization is viewed as a transition characterized as a linear and gradual move along a product-service continuum from less to more advanced services. Transition is assessed by a direct relationship between service offerings and the extent of servitization.	**Punctuated Equilibrium Model:** is characterized by an incremental continuum of service development. Long periods of small, incremental change are interrupted by brief periods of discontinuous, radical change (Tushman and Anderson, 1986; Martinez *et al.*, 2017; Baines *et al.*, 2019).	Oliva and Kallenberg, 2003	The authors structured their thinking along a continuum from pure-product to pure-service providers, and thought of manufacturing firms moving along that axis as they incorporated more product-related services. Their analysis suggests that the transition occurs in four stages: "consolidating product-related services", "entering the installed-base service market", "expanding to relationship-base services or process-centered services", and "taking over the end-user's operation". During each stage, the firm focuses on a set of issues and addresses them through the development of new capabilities. Transitioning from a product manufacturer into a service provider constitutes a major managerial challenge. Services require organizational principles, structures and processes new to the product manufacturer. Not only are new capabilities, metrics and incentives needed, but also the emphasis of the business model changes from transaction- to relationship-based.
		Tukker, 2004	Using a product-service continuum that leads from 'pure product' to 'pure service', the author proposes three main categories and eight sub-categories of Product-Service Systems (PSS). The first category 'Product-oriented services' covers the bundling of some extra services to the sale of products. In the second category 'Use-oriented services' the ownership of the product is retained by the service provider who sells the function of the product to the customer. In the third category 'Result-oriented services' the service provider sells results rather than functions.
		Martinez *et al.*, 2010	Servitization is defined as the journey or transformation process whereby an organisation enables its product-service offerings. An organisation's journey towards higher levels of servitization (e.g. relationship-based transactions, asset utilization, total service integration offering and high levels of production customisation), is inhibited by a variety of internal and external challenges.This research indicates that these internal and external challenges are embedded into the five categories, i.e. embedded product-service culture, delivery of integrated offering, internal processes and capabilities, strategic alignment and supplier relationships. These authors propose a five pillar model, where the five categories: "embedded product-service culture", "delivery of integrated offering", "internal processes and capabilities", "strategic alignment", and "supplier relationships", form a supporting foundation that enables the challenges of the servitization process to be met.
		Zeithaml *et al.*, 2014	These authors propose a continuum, called the 'Service Infusion Continuum' to categorize the services that can be added by a manufacturing firm, that evolve from basic entitlements to complex services and solutions. On one side of the continuum all services that are traditionally provided by manufacturers to support their products are presented (services supporting products). Moving to the other side of the continuum, the manufacturer increases the offering of services that support the customer's business (services supporting customers).

Table 3 – Servitization paths (cont.)

Servitization Journey	Change management theory	Studies	Main contributions
Rather than following an incremental transition process across the product-service continuum, the challenge of servitization for firms is to balance the co-existence of different roles of the service-related business models on a continuous basis. Uses the service offerings category as a proxy for the extent of servitization.	**Continuous Change Model:** change is not episodic but endemic to the way in which organizations operate, with the ability to engage in rapid and relentless continuous change (Langley *et al.* , 2013; Martinez *et al.*, 2017; Baines *et al.* , 2019).	Martinez *et al.* , 2017	Servitization follows a continuous change rather than a punctuated equilibrium. Servitization is not occasional but endemic in the way in which firms typically operate. This continuous change is neither logical nor structured but much more emergent and intuitive. These authors present three actual service journeys and the associated seven stages of the service strategy model that firms need to consider in order to increase the success of their servitization strategy. The seven stages of the service strategy are the critical element for the transition to services, are interdependent and need to operate concurrently. The seven stages are: "assess market and internal readiness", "creating the strategic and cultural context", "service processes", "structure and governance", "engagement and trust", "resources" and "optimize and communicate best practices".
		Lütjen *et al.* , 2017	Presents a three-stage service transition classification. "Service initiation": firms are still product-centric ones focussed on selling commodity products. "Service anchoring": increasing service budget and often have separate service departments. "Service extension": launch service types that are substantially more advanced than basic services. This study also describes stage-specific barriers that prevent firms from transitioning further. Internal as well as external resources and capabilities, and the innovativeness and offering types of services are needed to reconfigure an organisational architecture and to develop new service offerings. A firm's service offerings do not exhaustively describe its service transition stages. Developing highly innovative services also requires collaboration with customers and solutions providers as well as efficient knowledge-sharing.
		Baines *et al.* , 2019	Servitization is a unidirectional and linear shift from products to product-service offerings. These authors develop a theoretcial model which explains how manufacturers progress through transformation processes when they servitize to compete through advanced services. The process of organisational change through servitization can be explained as four macro-stages: Exploration, Engagement, Expansion and Exploitation. The progression between and within these macro-stages is significantly influenced by contextual factors. This change process is complex and loosely structured. While progression from one macro-stage to the next does appear as structured and predominantly unidirectional, within each stage are activities which are characteristically organic, unstructured and iterative, and so the whole process can be characterised as a business growth model with multiple crises or tipping points. These tipping points are significant since, under certain conditions the servitization journey may stall or even fail entirely. Progress from one macro-level to the next is punctuated by tipping points, which are only overcome once the activities of the preceding stage demonstrate sufficient value that the organisation consents to progression to the following stage.

3. Research method

The research is based on an in-depth retrospective case study of one elevator manufacturing firm from a European country (henceforth referred to as Up-Down Elevators). Case study research is considered one of the most powerful research methods in operations management (Voss *et al.*, 2002), namely for examining how and why questions, as well as longitudinal issues (Yin, 1994; Voss *et al.*, 2002; Barratt *et al.*, 2011). It is also suitable for developing new theory (Eisenhardt, 1989; McCutcheon and Meredith, 1993; Yin, 1994; Voss *et al.*, 2002).

A single case was chosen, because it provided an unusually insightful and great opportunity for research access, which may lead to deeper insights that are otherwise unobtainable via quantitative studies (Yin, 1994). Hence, single-case research typically exploits opportunities on a significant phenomenon under rare or extreme circumstances (Eisenhardt and Graebner, 2007), and enables the researcher to capture the context within which the phenomena under study occur, in much more detail (Dyer and Wilkins, 1991). Up-Down Elevators (see section 4 for a detailed description of the firm) was selected because of: i) in-depth access to the company (people and archival documents); ii) access to relevant information over 30 years (from 1989 until 2018); iii) the firm not only produces goods (elevators), but has also been providing a diverse set of basic and advanced services to the installed base over several years.

Access to in-depth fieldwork is not easily granted to researchers outside firms, due to confidentiality concerns and the heavy time commitment that is usually required from firm employees. To overcome this obstacle and obtain unique insights, we collected rich qualitative data through participant observation (Iacono *et al.*, 2009) carried out by the lead author, who is also a manager in Up-Down Elevators. The literature recognizes “the knowledge-yielding character of inquiry from the inside, and legitimises the contribution of industry practitioners to management research” (Iacono *et al.* 2009, p.44). According to Yin (1994), participant observation provides an opportunity to gain access to events and groups that otherwise would be inaccessible to the researcher. Through participant observation the researcher may also observe reality from the perspective of someone “inside” the case study rather than external to it (Yin, 1994). Despite its advantages, this data collection technique may lead to some potential biases: the influence of the researcher over participants’ behaviours, the impact of the researcher’s own beliefs (Iacono *et al.*, 2009), and the potential lack of objectivity e.g. following a commonly known phenomenon and become a supporter of the group or organization being studied (Yin, 1994). Finally, the researcher may “not have sufficient time to take notes or to raise questions about events from different perspectives, as good observer might” (Yin, 1994, page 89). To mitigate these potential

problems, two researchers carried out interviews, with one researcher in charge of presenting the interview questions, while the other recorded notes and observations (in line with Eisenhardt, 1989). Therefore, the “interviewer has the perspective of personal interaction with the informant, while the note taker retains a different, more distant view” (Eisenhardt, 1989, p. 538).
A retrospective approach is employed to understand how external and internal factors promote or hinder servitization over time (Pettigrew, 1990; Yin, 1994; Voss *et al.*, 2002). We collected data on the evolution of these relationships, which also enabled us to gain a deeper understanding of the development of the servitization process journey.

In order to enhance reliability and validity, we developed a research protocol (see Appendix 1), using the conceptual framework (Figure 1) as a lens for analysis. This protocol contains the procedures and general rules that were followed during data collection and indicates from whom or where different sets of information were obtained. The core of the protocol is the set of questions to be used in interviews. It outlines the topic areas to be covered during an interview, states the questions to be asked and indicates the specific data required. This ensured that all areas of enquiry were covered. We also encouraged the respondents to talk about novel concepts during the interview.

We interviewed numerous and highly knowledgeable respondents who viewed the focal phenomena from diverse perspectives. These informants included organizational actors from different hierarchical levels, functional areas, groups and geographies (Eisenhardt and Graebner, 2007). Each interview lasted 60-120 minutes and they were conducted over a period of two months. A total of 15 semi-structured face to face interviews were carried out with two Co-CEOs, two senior service managers, two senior new installation managers, seven service managers and two new installations managers. These interviews were conducted individually and in the native language of the interviewee, in order to maximize the respondent’s ability to express his/her thoughts, feelings and opinions (Vanpoucke *et al.*, 2014). At least two researchers were present at each interview, and the answers were collected via audio recording and written notes. All respondents had worked for the firm for more than 10 years, indicating their ability to describe developments over time. By the end of each interview the researcher filled out the table – relevant factors identified by interviewees (see Figure 1 from the research protocol in Appendix 1), indicating whether they have promoted or hindered servitization and their relevance (classified as weak, moderate or strong). Throughout the study, and following each interview, a thematically arranged outline describing the covered issues was written.

Detailed write-ups were prepared (including the tables aforementioned) and sent to the interviewees to validate the data and maintain participant engagement during the research process. At this stage, we also re-examined the available documents to check whether the information from the interviews was supported by the documents. When discrepancies between these data sources or between respondents were observed, we asked for additional information.

Therefore, triangulation (Jick, 1979) was carried out to verify responses, including supplementary data, such as memos of workshops with the company´s key decision makers, the company's internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company, publicly available information and site visits and participant observation by the author on the company's premises during the research period. Data collection was carried out until theoretical saturation was reached i.e. when no new information emerged (McCutcheon and Meredith, 1993; Yin, 2003).

A case study database with all available interview transcripts, case study write-ups, and other documents was put together in order to increase reliability (in line with Kowalkowski *et al.*, 2013). This case study database was then used for subsequent data analysis.

4. Empirical Setting

4.1 The Elevator Industry

The elevator industry comprises two main business segments: new installations and services. The first includes the selling, production and assembly of new passenger and goods elevators in new or existing buildings, while the latter focuses on basic and advanced services provided by elevator firms. The business model is based on a life-cycle approach. The average elevator lifecycle ranges between 20 and 25 years, and the elevator firm offers solutions for the entire lifetime of their elevators. Regarding new equipment installation, customers are mainly builders, general contractors and developers. The use of the equipment triggers the service business, targeting customers such as facility managers and building owners. Regular maintenance is required to keep equipment running smoothly. As the equipment ages, larger repairs and replacements of parts are required to maintain its optimal performance. Eventually, full replacement becomes necessary to ensure modernization. The new equipment business is more cyclical in nature and fuels the growth of the service business in the long term. Services, on the other hand, bring stability to the business over economic cycles (because even in times of

recession, maintenance is required to keep equipment running smoothly) and in turn, the end of the useful life time of the equipment creates potential for modernization.

4.2 Up-Down Elevators

Up-Down Elevators is part of a group with more than 1700 employees operating in Europe. With 440 employees, exclusive engineering and R&D departments, two factories and six geographically distributed branches in one European country, Up-Down Elevators designs, sells, produces, assembles and services all kinds of elevators. It provides a range of services to B2B customers, such as basic and advanced services.

The basic services include spare parts provision, warranty, modular-based preventive maintenance contracts, which can be tailored according to customer requirements, repair, overhaul / modernization (upgrade of single components to ensure reliability and improve performance, or modernization of key systems such as control systems or door operator units, or full modernization of the complete elevator system), and condition monitoring.

The advanced services are made up of modular-based full maintenance contracts, which can be customized to customer requirements and consultancy services, such as energy efficiency optimization studies.

Up-Down Elevators produces standard and custom-made elevators; at the time of the study, the firm was servicing more than 12,000 pieces of equipment from different OEMs. A separate organization for the service business with its own service managers, engineers and technical staff, was introduced in 1998. Each branch was created to sell and install the new elevators, but also to maintain them, in close proximity to the customer. Therefore, it is divided into new installations and service structure, with different teams assigned.

Strategically, Up-Down Elevators is further developing the installed base in order to sell more services. There is a very large installed base (increasing every year), and providing maintenance and support service through the entire product's life cycle, particularly concerning the installed base, represents a significant source of revenue.

The service margins have clearly been higher than product margins over time. Although service contracts may only generate smaller revenues, they are typically regular and more resistant to economic cycles than new installations. Thus, by including more services in the overall portfolio, Up-Down Elevators tended to balance the effects of economic cycles with different cash-flows, reducing their vulnerability and volatility. For instance, looking at the last 10 years, product revenues fell 50%, while service revenues increased 20%. Over the last twenty-five years,

servitization intensity (service sales divided by total sales) doubled, from 36% in 1994 to 72% in 2018.

5. Data Analysis

We followed the standard guidelines for qualitative data analysis, comprising three phases: data reduction, data display, and conclusion drawing (Miles and Huberman, 1994).

Data reduction consisted in “selecting, focusing, simplifying, abstracting, and transforming the data” (Miles and Huberman, 1994 p. 10). Prior to fieldwork, we created a provisional “start list” of codes related to external and internal factors, and to servitization practices, based on the literature review and our conceptual framework (see Appendix 2). This step consisted of coding interview write-ups, company documentation (internal documents and presentations, data on delivered goods and services, brochures about the historical development of the company), and field notes, in order to reduce and map data into conceptual categories (Miles and Huberman, 1994; Voss *et al.*, 2002). We coded the data according to this “start list” of codes, while simultaneously allowing for new codes and relationships to emerge inductively from the data. These standard coding procedures helped identifying the key constructs in the study and associated relationships.

In phase two, we produced a set of tabular displays to provide the depth of understanding that is needed for case analysis. A display is a visual format that presents information systematically so that the user can draw valid conclusions (Voss *et al.*, 2002). Since we aimed to study servitization over time, a graphical timeline of the sequence of events was also drawn.

Figure 2 summarizes the evolution of service provision, servitization practices and servitization intensity for the period 1992-2018. Service provision (basic and advanced) and implementation of servitization practices were scored in 0-2 ordinal levels. For services the levels were: 0, if not provided; 1, if moderately provided and 2, if strongly provided. For servitization practices, the levels were: 0, if not implemented; 1, if moderately implemented and 2, if strongly implemented. For an explanation of how these variables (service offerings and servitization practices) were classified, see Appendix 3. Figure 2 uses a shadow scale to highlight these levels: white for not provided or not implemented; light grey for moderate; and dark grey for strong. Furthermore, to be able to simultaneously analyze the yearly scores for basic services, advanced services and practices, their average were calculated.

We drew on the variables listed under “service offerings”, “servitization practices” and “servitization intensity” in Figure 2, in order to conduct a hierarchical cluster analysis to identify discrete servitization implementation periods (clusters of variables). To identify the ideal number

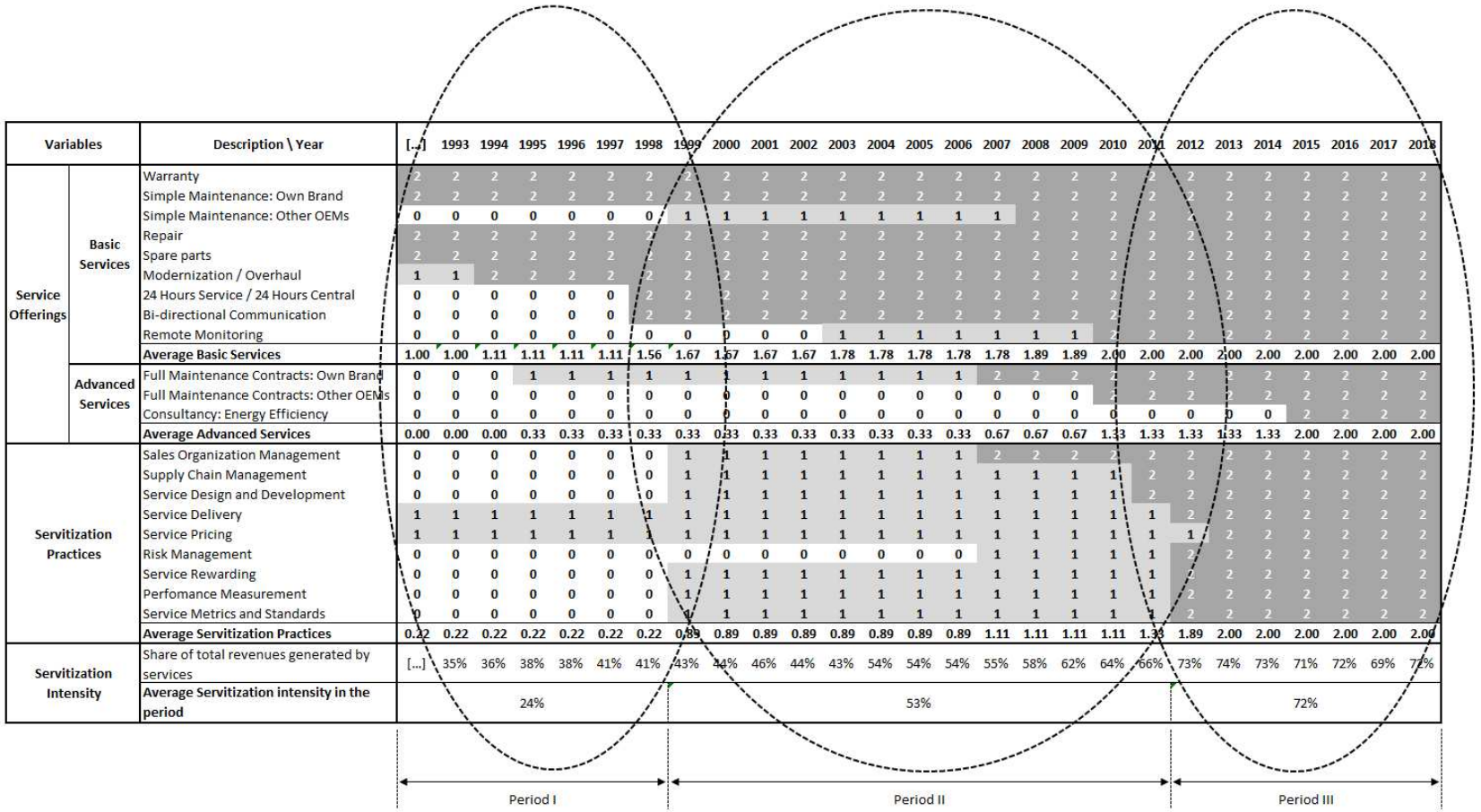
of clusters, we used the approach suggested by Mardia *et al.* (1979) and we looked for managerial interpretability of the clusters and for a distinct increase in the tightness of the clusters as measured by the R^2 and the pseudo-F statistic. This analysis led us to adopt the three clusters solution. Appendix 4 presents the results of the cluster analysis and the statistical details. We performed the analysis with the complete data set (n=30) using the STATA 13 software. Due to the small size of the sample and the exploratory nature of our approach, the statistical results serve as supporting evidence for the interpretation of the data. Figure 2 reveals these three distinct servitization periods: I- before 1999; II- from *circa* 1999 to 2011; III - from *circa* 2012 until 2018.

Table 4 summarizes the three periods comprehending service offerings, servitization practices and servitization intensity. We call period I "the product-oriented period", period II "the service-led period" and period III "the advanced services period".

Table 4 – Summary characterization of the servitization implementation periods.

Period	Service Offerings	Servitization Practices	Servitization Intensity (SI) (average for the period)
The product-oriented period	Mostly basic services are provided	Only a few practices are implemented and in a moderate way	SI ≤ 25%
The service-led period	Basic services and some advanced services are provided	Widespread use of practices, in a moderate way	SI ≥ 50%
The advanced services period	Basic services and advanced services are provided	Widespread and strong use of practices	SI ≥ 70%

Using these three periods, and in order to assess the relationship (nature and strength) between the external and internal factors, service offerings, servitization practices and servitization intensity, all the respondents were asked to classify these relationships as weak, moderate and strong. A convergence in the responses was attained (see Appendix 5). For the study, we only consider the factors and the servitization practices that have a cut-off level of convergence of over 80%.



Variables		Description \ Year	[...]	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Service Offerings	Basic Services	Warranty	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Simple Maintenance: Own Brand	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Simple Maintenance: Other OEMs	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
		Repair	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Spare parts	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Modernization / Overhaul	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		24 Hours Service / 24 Hours Central	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Bi-directional Communication	0	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
		Remote Monitoring	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
		Average Basic Services	1.00	1.00	1.11	1.11	1.11	1.11	1.56	1.67	1.67	1.67	1.67	1.78	1.78	1.78	1.78	1.78	1.89	1.89	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Advanced Services	Full Maintenance Contracts: Own Brand	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
		Full Maintenance Contracts: Other OEMs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	2	2	2	2	2
		Consultancy: Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2
		Average Advanced Services	0.00	0.00	0.00	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.67	0.67	0.67	1.33	1.33	1.33	1.33	1.33	2.00	2.00	2.00	2.00
Servitization Practices		Sales Organization Management	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
		Supply Chain Management	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
		Service Design and Development	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
		Service Delivery	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
		Service Pricing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
		Risk Management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2
		Service Rewarding	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
		Perfomance Measurement	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
		Service Metrics and Standards	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
		Average Servitization Practices	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	1.11	1.11	1.11	1.11	1.33	1.89	2.00	2.00	2.00	2.00	2.00	2.00
Servitization Intensity		Share of total revenues generated by services	[...]	35%	36%	38%	38%	41%	41%	43%	44%	46%	44%	43%	54%	54%	54%	55%	58%	62%	64%	66%	73%	74%	73%	71%	72%	69%	72%
		Average Servitization intensity in the period				24%								53%									72%						

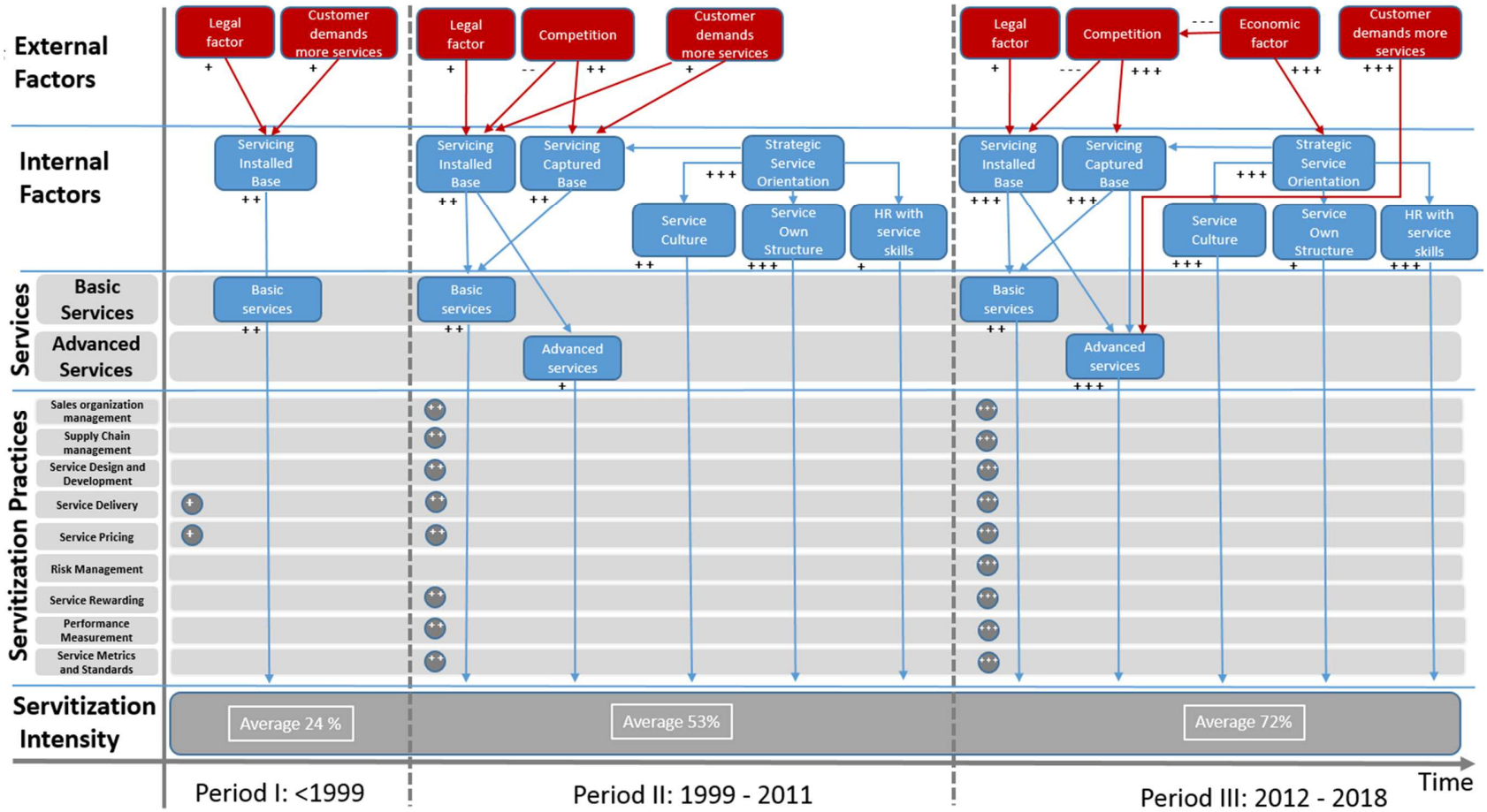
Period I | Period II | Period III

Figure 2 – Timeline of the service offerings, servitization practices and servitization intensity.

During phase three of the analysis, we focused on conclusion drawing, and we carried out a pattern analysis of the data via a causal network i.e. a “display of the most important independent and dependent variables in a field study and of the relationships among them’’ (Miles and Huberman, 1994, p. 153). Causal networks are associated with analytic texts describing the meaning of the connections among factors. This has been used in operations management by Sousa (2000) and Sousa and Voss (2001), following Miles and Huberman’s (1994) guidelines. Afterward, we searched for relationships among the constructs and variables. These methods were not linear, but formed a recursive, process-oriented, analytic procedure that continued until we understood the emerging theoretical relationships.

Finally, we used group debriefing (Leonard-Barton, 1990), i.e. engaging all the respondents involved in the study to discuss emerging relationships between external and internal factors, service offerings and servitization practices, available in the data. Three different sessions of two hours with all the respondents were held. A convergence was attained and the emerging patterns served as a basis for developing our propositions. This information was registered in the case study database.

Figure 3 depicts the final patterns over time.



Legend: + weak ++ moderate +++ strong positive relationship
- weak - - moderate - - - strong negative relationship
weak moderate strong

Figure 3 – Influence of external and internal factors across the three servitization implementation periods

6. Discussion

6.1 External and internal factors

The manufacturer's servitization journey seems to progress through three distinct servitization implementation periods (see Figure 3). Each period is characterized by a unique pattern of factors that promote or hinder servitization. We first discuss the factors that were at play in each period, followed by an overall analysis of the three periods.

In the **product-oriented period**, two external factors emerged, both promoting servitization intensity (although in a weak way): the "legal factor" and "customer demand for more services factor". Triggered by the critical aspect 'safety of end-users', there is a legal obligation that all elevators installed and in use have regular maintenance. The owner of the elevator must sign a maintenance contract with a certified elevator company. As a consequence, through the provision of basic services to the own installed base, Up-Down Elevators increased smoothly the servitization intensity over time. In this period, the company was still product-centric, focusing on selling new installations. With each new elevator sold and installed, a new simple maintenance contract was signed. Nevertheless, the manufacturer is selling mainly products, although providing some basic services only to its own installed base, merely adopting service delivery and service pricing practices.

As one respondent said:

> "The firm getting to install the elevator would automatically get the maintenance contract. Therefore, the company would invest every cent into the selling of new installations".

From 1995 on, customers started demanding more services. One of the Co-CEO stated that:

> "[...] with the aging of the elevators, customers began to demand other basic services, such as modernization."

In the **service-led period**, the legal factor is still present. However, competition seems to be the main trigger for providing services not only to the own installed base, but also to elevators installed by other OEMs. We will call it the captured base. Up-Down Elevators had to react and started actively servicing the installed base from other OEMs. Therefore, competition also seems to simultaneously hinder servitization intensity, because the manufacturer lost some of the existing maintenance contracts to other competitors, leading to a reduction in service prices. As one service manager said:

> "New competitors entered the market and started an aggressive campaign to acquire new maintenance contracts, mainly through a significant price reduction".

The creation of a separate service organization structure, together with a strategic service orientation contributed to a strong promotion of servitization intensity in this period. Servitization intensity increased from 41% (in the end of 1998) to more than 65% (in 2011). The training of human resources on service skills was also stated by the respondents, despite leading to a feeble promotion of servitization intensity. The implementation of servitization is triggered mainly by an external factor (Competition), that simultaneously promotes and hinders servitization intensity, followed by internal factors (Goal - providing services to the installed base, goal - providing services to the captured base, capability - creating a separate service organization structure, goal - developing a strategic service orientation).

Finally, concerning **the advanced services period**, the legal factor remained present. A new external factor seems to have emerged as a trigger for impacting servitization intensity: the economic factor. Due to the 2008 financial crisis (with repercussions felt in 2010), the new installations market suffered a severe setback. The economic factor hindered servitization intensity, because customers had less money to spend on services, therefore leading to a high pressure on service prices. As one senior service manager stated:

> "The maintenance contract prices fell more than 30% in one year, with customers renegotiating their existing and valid contracts. In this period, we had over a thousand renegotiations per year."

But this factor seems to have also led to a strong promotion of servitization intensity, since selling more services to the captured base was the strategic orientation defined by the company. During this period Up-Down Elevators provided basic and advanced services to both the installed and captured base. The implementation of servitization is promoted strongly by external factors (Economic factor, consumer demand more services and competition), followed by internal factors (Goal - providing services to the installed base, goal - providing services to the captured base, goal - developing a strategic service orientation and capability - human resources with service skills).

We now discuss the prevalence of external and internal factors across the three periods. With regards to external factors, the legal factor seems to be a "neutral" factor, in the sense that it was found to promote (although in a weak manner) the implementation of servitization in all three periods. The factor "customer demands more services" seems to promote servitization intensity in the first period in a weak way, and was not relevant in the second period. However, in the third period, this factor had a strong impact on servitization intensity, with customers demanding new and more advanced services. The major impact on servitization intensity seems to be achieved

through the provision of more advanced services. Thus, customer demand seems to be a key factor to trigger the offering of new services (basic and advanced services). Competition seems to promote but also hinder servitization intensity. It promotes servitization, leading the manufacturer to provide new services and existing services not only to the *installed base* but also to the *captured base* – elevators installed by other manufacturers, but it also seems to hinder servitization intensity, since competition may lead to a reduction on service prices. This dual relationship with servitization intensity increased from moderate (in the second period) to high (in the third period). Finally, the economic factor had a strong impact on servitization intensity, either by increasing the competition intensity, which leads to a reduction in service prices, or by impacting the strategic service orientation factor.

Considering internal factors, the creation of a separate service organization to handle the service offering, through the development of a dedicated sales force and a structure with dedicated service managers, engineers and technical staff, seems to have only a strong positive impact on servitization intensity at the implementation moment (in the second period). A separate organization unit seems to protect the emerging service culture with its metrics, control systems and incentives. It also seems to be easier to initiate service orientation in the corporate culture and therefore improve direct service profitability, the quality of customer relationships and the selling of more services over time. Today, it also helps the manufacturer to disseminate knowledge across the network and to better manage the service personnel. Once adopted, this factor seems to lose the power to promote servitization intensity.

This dynamic analysis leads to the following proposition:

Proposition 1. Over time, external factors seem to be the main factors for starting the transition to the next servitization implementation period (leading to a higher servitization intensity), followed by the corresponding adaptation of the internal factors, service offerings and servitization practices.

6.2 Service offerings

Our findings also provide new insights into the provision of basic and advanced services over time.

Looking at the services over the first period, the manufacturer only provided basic services to the installed base. In the second period, basic services were also provided to the captured base and, for the first time, also some advanced services were provided, but only to the own installed base.

In the third period, basic and advanced services were provided to the installed and to the captured base. In this last period, the advanced services seem to promote strongly servitization intensity, but basic services are still present (although in a moderate way).

The product-oriented period in our data differs from the results of Sousa and da Silveira (2017) obtained in a cross-sectional sample in engineering industries. These results suggested that providing basic services alone for an extended period of time might not be sustainable. This may not be the case of the elevator industry, in which there is a legal obligation for customers to contract basic services, namely the maintenance of the elevators. In the second and third periods, servitization intensity seems to be building on product - basic services combinations, by adding advanced services, but without ever giving up the provision of basic services. Over these periods our findings are largely consistent with the work of Sousa and da Silveira (2017), i.e., basic and advanced services coexist, with basic services acting as a platform for the expansion of advanced services. However we are able to provide finer-grained insights based on longitudinal data and the uncovering of dynamics involving the installed and captured base of the manufacturer.

Throughout the servitization journey, the manufacturer provides basic services followed by advanced services first to the installed base, and only then to the captured base. In the earlier periods of the journey, the manufacturer seems to be reluctant to offer services for the captured base, due to the business risks and difficulties involved in obtaining the necessary new skills and spare parts. The manufacturer may face a higher risk of guaranteeing the availability of a competitor's equipment, due to the potentially higher repair costs, or due to installation proprietary rights exclusive to the competitor. With increasing experience (knowledge about competitors' products and its technology), the manufacturer provides services to cover both the own and the competitors' products. The provision of services to the captured base might serve as an entry point to the customer and, consequently, an opportunity to generate more business, either through more basic and advanced service sales or through new equipment deliveries.

It is important to mention that, over time, and even in the very high servitization intensity periods, the manufacturer continues to supply products to increase the installed base (we call it the cumulative installed base). This large installed base ensures that there is an ongoing demand for basic and advanced services in the future. The installed base provides key data about the customer, the equipment and the service history. Combining data from service operations and products allows the manufacturer to improve the coordination of all service activities and to develop new, value-adding services.

Therefore, we present the following propositions:

Proposition 2. Over time, the provision of basic and advanced services seems to coexist, with the manufacturer consolidating the provision of basic services first, followed by the development of advanced services.

Proposition 3. Over time, and even in the advanced services period, the servitized manufacturer continues to supply products to increase the installed base.

Proposition 4. Over time, the manufacturer provides basic services followed by advanced services - first to the installed base, and only then to the captured base.

6.3 Servitization practices

In the first period, only service delivery and service pricing practices were used. In the second period, new practices were adopted, mainly due to a strategic service orientation, but still with a weak positive impact on servitization intensity. During the last period, with an increase in the provision of advanced services, the manufacturer adopted all identified servitization practices with high intensity. The risk management practice is newly adopted, because of the impact that the more intense provision of advanced services has on the installed and captured bases. The advance service contract covers all costs related to the operation of an elevator system, over a long period of time. Therefore, the risks associated with the operation of the elevator ought to be covered solely by the service provider.

These findings suggest that servitization practices work together as a bundle, mirroring other manufacturing best practices, such as lean and quality management (Shah and Ward, 2003). Specifically, we postulate three bundles of interrelated and internally consistent practices:

i. the “product-oriented period practices bundle”, consisting of *service pricing* and *service delivery* practices adopted only to support the provision of basic services to the installed base. Pricing was defined only once a year for most of the services and these were delivered through a standard process, which did not change over the years of the product-oriented period.
ii. the “service-led period practices bundle”, consisting of the two aforementioned practices, and complemented by *sales organization management*, *supply chain management*, *service design and development*, *service rewarding*, *performance measurement* and *service metrics and standards* practices to support the provision of basic services and some advanced services, mainly to the installed base. These practices were adopted in a moderate way. The increase in the number of servitization practices in this period resulted

mainly from two aspects: i) the need to provide basic services to the captured base and advanced services to the installed base and ii) the creation of a separate service organization structure, which led to a structured introduction of new servitization practices.

iii. the "advanced services period practices bundle", consisting of all the aforementioned practices, and adopted in a rather strong way, complemented by the *risk management* practice, which is extremely important for the provision of advanced services to the installed, but also the captured base. As mentioned before, risk management is actively used in the continuous and dynamic pricing activity, because of the shift of technological and operational risks from the customer to the provider. Therefore, a service accounting system and risk mitigation simulation models and software are needed.

We have empirically identified our bundles (see Appendix 5) and examined their effects on servitization intensity over time. The results suggest that the implementation of each of the bundles contributes substantially to the servitization intensity of the manufacturer over time. In summary, the following proposition is offered as an overarching principle:

Proposition 5. Implementing interrelated and internally consistent bundles of servitization practices aligned with the type of services provided over time, contributes positively to servitization intensity.

6.4 Comparison with earlier servitization implementation studies

Earlier studies such as Martinez *et al.* (2017), Lütjen *et al.* (2017) and Baines *et al.* (2019) have been essential to developing new ideas around the structure of the servitization journey that the manufacturer may follow.

In our study we suggest that the manufacturer is progressing through several servitization implementation periods, rather than following a linear and gradual transition process across the product-service continuum, similarly to said prior studies. We contribute to this research stream by examining in-depth a long implementation journey (over 30 years) and by characterizing it across multiple dimensions encompassing not only the macro process of progression but also a fine grained analysis of the content of servitization implementation over time.

Our three implementation periods are consistent with the work of Lütjen *et al.* (2017), who also presented a three-stage servitization journey. These authors used several longitudinal cases (over a period of seven years) on one non-manufacturing industry, from a single country. This study resorts to service offerings, service innovativeness and invested internal and external resources to explain the servitization journey. The implementation periods were defined according

to the service transition barriers and an explanation on how to overcome them. Unlike this study, our research addresses the causal mechanism factors behind servitization implementation over time, providing a fine-grained analysis that includes not only external and internal factors, and service offerings, but also servitization practices bundles.

By using longitudinal cases of three manufacturing firms over a period of seven years, Martinez *et al.* (2017) explore how the servitization journey of a manufacturer may develop. This study shows how the change journey unfolds within the context of process-based change models. The seven stages of the proposed service strategy model present relevant differences from our work. The model is far more complex to be followed by a manufacturer, since the seven stages are interdependent and need to operate simultaneously to increase service performance. Alternatively, our study offers manufacturers a parsimonious, even if multidimensional framework, that describes not only the process, but also the content of servitization implementation.

Finally, Baines *et al.* (2019) describe the change process that a manufacturer undergoes through the servitization journey (in line with Martinez *et al.*, 2017), identifying four distinct macro-stages. These authors argue that the progression from one macro-stage to the next seems to be unidirectional and structured. But when looking into each individual stage, the activities developed by the manufacturer are unstructured, leading to eventual multiple crises or tipping points. Similarly to these authors, we agree that the progression in the servitization implementation path seems to be significantly influenced by external and internal factors. However, our study differs from this one, as external factors seem to be the main trigger of transition to the next servitization implementation period. By analysing not only the process, but also the content of servitization, we argue that in each period the external factors are complemented by the interplay of internal factors, service offerings and the servitization practices bundles.

7. Conclusions

7.1 Theoretical implications

While it is widely accepted in the literature that servitization is a long-term, often incremental process, most research only considers ‘snapshots’ or a single point in time. This research takes a more dynamic approach by examining how factors promote or hinder servitization over time and under which circumstances.

Hence, we have contributed to servitization research in four aspects.

First, our findings suggest that a manufacturing firm's service offerings per se do not completely describe its servitization journey. A multidimensional approach, which also considers bundles of servitization practices, as well as internal and external factors, (and their interplay), was used to observe the servitization transition periods. We have been able to identify three clear servitization implementation periods and to offer a more fine-grained understanding of the servitization journey.This is one of the few studies to explain how change unfolds step-by-step at a micro-process level over time, during the servitization journey of a manufacturing firm. We propose a servitization implementation framework that represents how the process of organizational change unfolds, as a manufacturer undertakes a servitization journey.

Second, external factors seem to be the main trigger for starting the transition to the next servitization implementation period, followed by the corresponding adaptation of the internal factors, service offerings and servitization practices.

Third, the service offering is addressed. There seems to be a coexistence between basic and advanced services over time, consolidating the provision of basic services first, followed by the development of advanced services. The manufacturer provides basic services, followed by advanced services - first to the installed base, and only then to the captured base. Over time, and even in the advanced services period, the servitized manufacturer keeps supplying products to enhance the installed base.

Finally, the data suggest that implementing interrelated and internally consistent bundles of servitization practices over time appears to make a substantial contribution to servitization intensity.

7.2 Practical implications

Our results should be helpful to managers who are raising their awareness of the different periods in a servitization journey. Managers should understand the characteristics of each period, along with the interplay of external and internal factors, service offerings and servitization practices that are key to success. Figure 2 and Table 3 are helpful to illustrate typical servitization practices in each period and the associated external and internal factors. Managers can use the provided framework to design their own firm's servitization journey. The practitioner should also consider that the time needed to progress through the three servitization implementation periods can be quite significant. It may take decades for a manufacturer to implement the servitization practices and to develop the capabilities needed to reach the "advanced services period" (as per Baines *et al.*, 2019). In industries characterized by the provision of services through the entire product life

cycle, namely concerning the installed base, represents a significant source of revenue, and the manufacturer should continue to sell products. This will help enhancing the cumulative installed base and will contribute to the provision of more basic and advanced services in the future.

7.3 Limitations and opportunities for future work

This research has certain limitations, which could provide opportunities for future work.

First, this study is based on a single case study, which limits generalizability. However, case study research relies on analytic generalization i.e. results are generalized to a broader theory rather than a larger population (Yin, 1994). Even though concerns about generalization reflect a common misconception about case study research rather than a limitation (Neu and Brown, 2008), we do encourage additional research to study whether other industries have different mechanisms that affect the interplay between the external and internal factors, the service offerings and the servitization practices bundles and servitization over time. In addition, all data were collected from respondents who were directly involved in the servitization transition process of Up-Down Elevators. Involving individuals with extensive first-hand experience with the service development process was deemed essential to gather in-depth qualitative data on which the findings of this study are based. Methodologically speaking, other types of firms and industries could add to the understanding of the servitization process. More cases are needed for comparison, so a multiple case study approach could be useful. Furthermore, applying the results to other cultural contexts could further enhance the transferability and generalizability of the results.

Second, our empirical research focused on the role of the manufacturer, and our data collection was limited to interviews and documents related to the focal actor. This approach was consistent with the stated purpose of identifying how external and internal factors promote or hinder servitization over time. As pointed out by Neu and Brown (2005), future research could benefit from comparing the present manufacturer perspective with insights from other actors in the ecosystem including customers of the focal service program and industry experts.

Third, we would benefit from a more detailed view on how each servitization practice becomes more sophisticated over time.

Taking these limitations into account, we believe that this research provides exploratory results that support the scientific development process on the movements and positions that companies pursue on the servitization journey.

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APPENDIX 1 - Research Protocol

Firm: “Up-Down Elevators”

1. Organization of this protocol

This protocol defines the field procedures to be followed, namely the scheduling of field visits, the selection of the interviewees and other sources of information. The research protocol also defines the on-site data collection by presenting the questions that the researcher must keep in mind and that must be answered about each factor.

2. Field procedures

This part will cover the field procedures to be followed, namely credentials and access to the case study sites, general sources of information and procedural reminders (Yin, 1994).

2.1 Initial scheduling of the field visit

2.1.1 Review of preliminary information

Before the visit begins, archival sources should be investigated to provide background information on the company. These may include annual reports, press clippings and company history, as well as databases (e.g. SABI, Bloomberg), and general information about the industry (e.g. Credit Suisse Reports).

The case study research relies on multiple sources of evidence and data collection techniques. In this research project, the sources of evidence include:

- Documentation and archival records: company files, business plans, financials, published reports by consultants, magazine and newspaper articles, slide-shows, emails, etc.;
- Interviews;
- Participant observation.

In line with Iacono *et al.* (2009), the role of the researcher in the study is that of a:

- Professional: the researcher has unparalleled access to sources and contacts (enquiry from the inside);

- Ethnographer: the researcher is immersed and functioning within the organization (enquiry from the inside);
- Historian: the researcher examines – retrospectively – data generated by the organization (e.g. company files, financials, etc.) and is detached from the organizational setting (enquiry from the outside)..

2.1.2 Verification of access procedures

A letter with a general description of the study and areas to be addressed should be sent to the CEO of the elevator manufacturing firm “Up-Down Elevators”. A “project champion” should be identified, and said person will act as the main coordinating link between the researcher and the firm.

2.2 Selection of interviewees and other sources of information

Initially, twenty semi-structured interviews are defined: two with co-CEOs, two senior service managers, two senior new installation managers and fourteen service managers. All of them should be recorded.

Additional interviews may be carried out until theoretical saturation is reached i.e. when no new information emerges.

Additional sources of information should be used to triangulate the data obtained from the interviews, including:

a. a review of company documentation (reports, memos, presentations, etc.)
b. data on delivered goods and services,
c. brochures and catalogs,
d. publicly available information about the company and the industry,
e. site visits.

2.3 On-site data collection

In the initial contact with the firm, the researcher should seek the project champion’s help to identify several individuals well-informed about the areas addressed by the study, and with whom semi-structured interviews will be conducted.

The researcher should collect information in four major areas:

A. Macro Environment: Political factors | Economic factors | Social Factors | Technological factors | Environmental factors | Legal factors
B. Micro Environment: Competition in the industry | Potential of new competitors in the industry | Power of suppliers | Power of customers | Threat of substitute products
C. Company Level: Shared values | Strategy | Structure | Staff | Skills | Systems | Style
D. Rich information that favours the understanding of service offering and the servitization practices used for each service, over time

The researcher should fill the following table (Figure 1) by the end of each interview, indicating the external and internal factors that are mentioned by the respondents, and its impact (or absence) on servitization intensity: if the factor promotes or hinders servitization intensity in a weak, moderate or strong way:

Factor		No Impact 0	Weak 1	Moderate 2	Strong 3
Factor 1	Promote				
	Hinder				
Factor 2	Promote				
	Hinder				
Factor n	Promote				
	Hinder				

Figure 1 – Relevant factors identified by interviewees

The next sections specify in detail how the data should be collected.

2.3.1 Macro Environment - Questions

The following table shows the context macro environment areas to be addressed, the questions that the researcher must keep in mind and that must be answered about each factor, and the field procedures and potential sources of information for answering those questions.

Macro Environment Factors	Questions	Field Procedures / Sources of Information
Political	These factors are about how and to what degree a government intervenes in the economy. This can include government policies, political stability or instability, foreign trade policy, tax policy, labor law, environmental law, trade restrictions. • What were the major political changes over time (last 20 years) that helped / hindered the provision of services? • What were the major political changes over time (last 20 years) that helped / hindered servitization intensity? • Introduction of public tenders (affecting also the maintenance of elevators): what were the main objectives? What were the criteria?	• Interviews • Archival sources (background information on the industry)
Economic	Economic factors have a significant impact on how an organization does business and also how profitable it is. These factors include – economic	• Interviews • Archival sources (background

	growth, interest rates, exchange rates, inflation, disposable income of consumers and businesses. • What were the major economic changes over time (last 20 years) that helped / hindered the provision of services in the country? • What were the major economic changes over time (last 20 years) that helped / hindered the servitization intensity in the country? • Introduction of public tenders (affecting also the maintenance of elevators): what were the results?	information on the industry)
Social	Are the areas that involve the shared belief and attitudes of the population. These factors include – population growth, age distribution, health consciousness, career attitudes and so on. These factors are of particular interest as they have a direct effect on how marketers understand customers and what drives them. • What were the major social changes over time (last 20 years) that promoted / hindered the provision of services in the country? • What were the major social changes over time (last 20 years) that promoted / hindered the servitization intensity in the country?	• Interviews • Archival sources
Technological	Technological factors may affect marketing and the management in three distinct ways: New ways of producing goods and services, new ways of distributing goods and services and new ways of communicating with target markets. • What were the major technological changes over time (last 20 years) that promoted / hindered the provision of services? • What were the major technological changes over time (last 20 years) that promoted / hindered the servitization intensity?	• Interviews • Archival sources
Environmental	Environmental factors become important due to the increasing scarcity of raw materials, pollution targets, doing business as an ethical and sustainable company, carbon footprint targets set by governments. • What were the major environmental changes over time (last 20 years) that promoted / hindered the provision of services? • What were the major environmental changes over time (last 20 years) that promoted / hindered the servitization intensity?	• Interviews • Archival sources
Legal	Legal factors include - health and safety, equal opportunities, advertising standards, consumer rights and laws, product labelling and product safety. • What were the major legal changes over time (last 20 years) that promoted / hindered the provision of services? • What were the major legal changes over time (last 20 years) that promoted / hindered the servitization intensity?	• Interviews • Archival sources

2.3.2 Micro Environment - Questions

The following table shows the context micro environment areas to be addressed, the questions that the researcher must keep in mind and that must be answered about each factor, and the field procedures and potential sources of information for answering those questions.

Micro Environment Factors	**Questions**	**Field Procedures / Sources of Information**

Competition in the industry	Key characteristics of the business environment (industry, growth rate of the markets served, market share, etc.)
	• Is the intensity of competition high:
	  o In the new installations business?
	  o In the service business?
	• Is there a high concentration on the supply side (over time)?
	• What kind of products are provided?
	• What kind of services are provided? Has there been a change in the services offered over time?
	• How are revenues (product and service revenues) evolving over the last 20 years?
	• Are services also provided to elevators from other manufacturers? Since when? Has there been a change over time?
	• How is the servitization intensity evolving over time?
	• How is the installed base evolving over time? Is the installed base relevant for the provision of services?
		• Interviews
		• Archival sources (background information on the industry)

Potential of new competitors in the industry	• Are new elevator companies entering the industry? If yes, what kind of companies are entering the industry (only manufacturers, only service providers or servitized manufacturers)?
	• Are existing elevator companies leaving the industry? If yes, how many and why?
	• What are the barriers to entry in this industry?
	  o In the new installations business?
	  o In the service business?
		• Interviews
		• Archival sources (background information on the industry)

Power of suppliers	• Do the suppliers have power over the elevator companies? • Is there any supplier that made it possible to provide a new service?	• Interviews • Archival sources (background information on the industry)
Power of customers	• Do product customers have power over the supplier? • Do service customers have power over the provider? • Are customers open for advanced services? • What are major changes in customer demands in past years? • What are the order winners and qualifiers for major customers in terms of services? • How would you characterize the relationship with customers? • What is the customer involvement in new service design / introduction? • What were major changes in customer demands and business conditions in past years? • Are customers price sensitive (over time)?	• Interviews • Archival sources (background information on the industry)
Threat of substitute products	Ability of substitute products or services to displace those being provided (over time) • What products have been introduced as substitutes to existing products over time? • What services have been introduced as substitutes to existing services over time?	• Interviews • Archival sources (background information on the industry)

2.3.3 Company Level - Questions

The following table shows the context areas to be addressed at the company level, the questions that the researcher must keep in mind and that must be answered about each area, and the field procedures and potential sources of information for answering those questions.

Company Level Factor	**Questions**	**Field Procedures / Sources of Information**
Superordinate Goals / Shared values	These are the core values of the company that are evidenced in the corporate culture and the general work ethic. • Is up-down elevators more product or more service oriented? How has been the development over time?	• Interviews
Strategy	"Those actions that a company plans in response to or anticipation of changes in its external environment – its customers, its competitors. Strategy is the way a company aims to improve its position vis-a-vis competition" (Waterman *et. al*, 1980). The plan devised to maintain and build competitive advantage over the competition. • What strategies have been implemented to lock in customers, over time? • Are there any strategic programs concerning service orientation communicated explicitly by the management of up-down elevators, over time? • Are services used to increase global revenues? • How is the company differentiating the service offering? • Are services used to help selling (more) products? • Is technology used to lock in customers? If yes, what has been done by the company over time? • What services have been provided? Has there been a change over time? • Do services have a higher profit margin than the products installed by "up-down elevators" over time?	• Interviews • Archival sources

	• Are there any global goals for service? • How are results and performance measured? • How are services designed?	

Structure	The way the organization is structured and who reports to whom.
	• Is there a separate structure between new installations and service?
	  o In the front offices? Since when?
	  o In the back office? Since when?
	• What are the different job classifications?
	• Have there been changes in the structure of the company, over time?
	• How many hierarchical levels are there in the service business?
	• Proximity to customers: the geographical location of branches and service centers.
	• Organizational chart.
		• Interviews
		• Documentation (Organizational chart)

Staff	The employees and their general skills: • Are there meetings with managers about service? If yes, how many are done per year? • How did the training of service technical staff evolved over time? (Training: frequency, systematic vs. Ad-hoc, specific in depth vs. Broad skill base) • How do you recruit service technicians? What are the relevant capabilities that you look for when recruiting? • How is the acceptance of services in the company? • What is the % of multi-skilled employees? • What is the number of employees in service processes vs. other staff? • Which incentives are defined for service staff?	• Interviews
Skills	The actual skills and competencies of the employees working for the company. • What are the skills that the branch- | service managers have? Has there been a shift over time? • How are service managers recruited? What hard and soft skills are needed? • Awareness of service management: What are the main sources on service management? Do the service managers participate in seminars, workshops or other training activities? What is the background of the service managers?	• Interviews
Systems	"[...] all the procedures, formal and informal, that make the organization go, day by day and year by year: capital budgeting systems, training systems, cost accounting procedures, budgeting systems" (Waterman *et. al*, 1980). the daily activities and procedures that staff members engage in to get the job done • What facilities have been created in the last 20 years to increase the proximity to customers? • How is the spare parts logistics managed over time? • Is there a remote monitoring system installed? Since when? How does it work? What are the goals? • How are the service employees trained? Is there an academy? Who train them? How is the training developed?	• Interviews
Style	The style of leadership adopted. • What is the identity and background of directors and management? • Are there specific formal meetings about service? If yes, since when? What subjects are discussed? How are these subjects discussed?	• Interviews

2.3.4 Rich information enabling the understanding of service offering and the servitization practices used for each service, over time - Questions

The researcher should also collect any relevant information about the usage of the servitization practices. Of interest, is information contributing to the understanding of the reasons behind the observed patterns of use of servitization practices over time. Examples of possible questions, for each service provided, include:

- When was the servitization practice introduced?

- What was the major reason for its introduction?
- What difficulties are currently experienced?
- What strategies are in place to deal with said difficulties?
- What were the goals of the practice? Have the goals been met? What was the result of the initiative?
- How satisfied is the respondent with the outcome of the practice from a cost benefit perspective? How would the respondent characterize the success of the practice, taking into account the implementation effort and the resulting benefits (if any)?
- What were the major lessons that were learnt from the implementation of the practice?
- Does the respondent think the firm should increase or decrease the use of the practice? What reasons prevent an increase in the use of the practice (difficulties/ barriers)?

In the final stages of the field work, the researcher should select one or several respondents with a good overview of servitization practices. The researcher should orally summarize the use of several servitization practices that he/she observed in the firm, with the help of a brief list of titles if necessary. Then the researcher should ask the respondents if there are any servitization practices with which the firm is experiencing difficulties. The researcher should then inquire the respondent on the difficulties experienced, the likely reasons for said difficulties, and on any strategies that are in place to deal with those difficulties. The objective here is to get a broader picture of the effectiveness of individual servitization practices, in particular the identification of clear successes and failures.

3. Post-visit stage

It is important to produce a report as soon as possible, after the visit. It should contain all notes and documents categorized by research variable and organized into a coherent text within each category. It should also include any considerations by the researcher about the case-study question.

APPENDIX 2 – Start List of Codes

I. External and internal factors

Categories		Factors	Flag	Code
External		Market	Customer's demand for more services	E_STCD
			Competitor's impact on service provision	E_COMP
		Legal	Implementing services legal requirements	E_LEGF
		Environmental	Pressures for the mitigation of environmental impact	E_ENVF
		Economic	Impact of economic growth on service provision	E_ECON
Internal	Company Goals	Strategic	Strategies based on locking-in customers	I_STLI
			Strategies based on servicing the installed base	I_FIIB
			Strategies based on providing custom made products	I_TYPM
			Strategies based on providing basic services	I_TYPB
			Strategies based on providing advanced services	I_TYPA
		Financial	Fostering to increase revenues	I_FIIR
			Fostering to increase the profit margin	I_FIPM
	Capabilities	Capabilities	The development of facilities in close proximity to the customer	I_FACI
			The development of a separate services organizational structure	I_ORGA
			The development of a service culture	I_CULT
			The development of human resources with service skills	I_HRSK
			The development of service processes	I_PROC
			Fostering the use of information and communication technologies (ICT)	I_TECF

II. Servitization practices

Servitization Practices	Code
Sales organization management	P_SORM
Supply chain management	P_SCMG
Service design and development	P_SDDV
Service delivery	P_SDEL
Service pricing	P_PRIC
Risk management	P_RISK
Service rewarding	P_SRWD
Perfomance measurement	P_PERF
Service metrics and standards management	P_METR

APPENDIX 3 – Classification of the variables service offerings and servitization practices

Variables		Description	Classification / Score		
			0	1 (moderate)	2 (strong)
Service Offerings	Basic Services	Warranty	not provided	* A warranty is offered only to part of the sold elevators and modernizations. * Only provided if the customer demands it.	* A warranty is included in the first two years of usage. * A warranty is offered to all sold elevators and modernizations.
		Simple Maintenance: Own Brand	not provided	* Only part of the elevators installed by the firm have a simple maintenance contract. * The custormer is contacting the firm to sign the simple maintenance contract.	* Almost all elevators installed by the firm have a simple maintenance contract (unless the customer decides to contract with another service provider). * The firm is actively contacting the customer to sign the simple maintenance contract.
		Simple Maintenance: Other OEMs	not provided	* Simple maintenance is only provided to a restricted and selected type of elevators from other OEMs. * The firm is only selling simple maintenance contracts to a selected group of customers. * Only provided if the customer demands it.	* Simple maintenance is provided to all types of elevators from other OEMs. * The firm is actively selling maintenance contracts to all types of customers with elevators from other OEMs.
		Repair	not provided	* This service is provided only to a selected group of elevators. * Only provided if the customer demands it.	* This service is provided to all types of elevators. * The firm is actively selling this service.
		Spare Parts	not provided	* This service is provided only to a selected group of elevators. * Only provided if the customer demands it.	* This service is provided to all types of elevators. * The firm is actively selling this service.
		Modernization / Overhaul	not provided	* This service is provided only to a selected group of elevators. * Only provided if the customer demands it.	* This service is provided to all types of elevators. * The firm is actively selling this service.
		24 Hours Service / 24 Hours Central	not provided	* Only provided if the customer demands it. * This service is paid for separately from the simple maintenance contract.	* This service is provided to all types of elevators. * The payment of this service is included in the simple maintenance contract. * The firm is actively selling this service.
		Bi-directional Communication	not provided	* Only installed and provided if the customer demands it.	* Every new elevator has the system embedded. * The firm is actively selling this service.
		Remote Monitoring	not provided	* Only installed and provided if the customer demands it.	* Every new elevator has the system embedded. * The firm is actively selling this service.
	Advanced Services	Full Maintenance Contracts: Own Brand	not provided	* This service is provided only to a selected group of customers and if the customer demands it. * Only a small group of customers is demanding this service. * This service is provided only to a selected type of elevators (dependent on the type and age)	* All customer segments are demanding this kind of service. * This service is provided to all types of elevators. * The firm is actively selling this service.
		Full Maintenance Contracts: Other OEMs	not provided	* This service is provided only to a selected group of customers and if the customer demands it. * This service is only provided to a restricted and selected type of elevators from other OEMs (dependent on the type and age). * The firm is only selling full maintenance contracts to a selected group of customers.	* All customer segments are demanding this kind of service. * This service is provided to all types of elevators from other OEMs. * The firm is actively selling full maintenance contracts to all customer segments with elevators from other OEMs.
		Consultancy: Energy Efficiency Optimization Studies	not provided	* Only provided if the customer demands it. * Only a small group of customers is demanding this service. * This service is provided only to a selected group of elevators.	* All customer segments are demanding this kind of service. * This service is provided to all types of elevators. * The firm is actively selling this service.
Servitization Practices		Sales Organization Management	not implemented	* Services are sold by the new installations salespeople. * CRM (Custormer Relationship Management) System is used for service customers.	* Services are sold by specific service salespeople. * Adoption of weekly service sales meetings.
		Supply Chain Management	not implemented	* Creation of spare parts warehouses (spare parts from own elevators) in all branches.	* Sourcing of spare parts for elevators of other OEMs. * Also warehouses in all branches with spare parts from other OEMs.
		Service Design and Development	not implemented	* Services are designed internally, only by the service team.	* Services are co-designed with the customer. * A multidisciplinary team designs the service. * For each new service development a formal project is created.
		Service Delivery	not implemented	* Provision of certain services (e.g. full maintenance contracts) only in selected branches.	* Provision of all basic and advanced services in all branches, nationwide.
		Service Pricing	not implemented	* Pricing is defined once a year for most of the services. * Development of a pricing list.	* Development and deployment of a specific service accounting system. * Pricing is defined on a continuously way, i.e. not only once a year. * Pricing for all services is based on cost and market analysis. * Service prices are defined in the ERP-System and can be changed on a daily base. * Risk management data is actvely used in the pricing activity.
		Risk Management	not implemented	* Development of a simple risk assessment model (mainly used for the assessment of full maintenance contracts).	* Development of risk mitigation simulation models and software. * Using historic data from the ERP System. * Development of a specific service accounting system.
		Service Rewarding	not implemented	* Development and implementation of a service reward system. * The reward system only includes the service managers. * The reward system is only dependent on service revenues KPIs.	* The service reward system includes all employees in the service structure (service technicians, service administrative staff in the back office, and service managers). * The reward system is based on several service performance KPIs.
		Perfomance Measurement	not implemented	* Adoption of service performance measures aligned to selected individual customers. * Performance measurement is performed locally by each branch.	* Adoption of service performance measures aligned to all individual customers. * Active management of underperforming customers. * Performance measurement is performed centrally. * Development and deployment of a specific service accounting system.
		Service Metrics and Standards	not implemented	* Only a small set of service KPIs are defined. * Service KPIs are controlled monthly.	* Introduction of a detailed set of service KPIs. * Service KPIs are controlled weekly. * Development and deployment of a specific service accounting system. * Monthly benchmarks are conducted against competitors .

APPENDIX 4 – Hierarchical cluster analysis and statistical results

	Cluster 1 **The product-oriented period** (n=10)	**Cluster 2** **The service-led period** (n=13)	**Cluster 3** **The advanced services period** (n=7)
Basic Services			
Cluster mean	1.14	1.79	2
Std. deviation	0.18	0.11	0
Advanced Services			
Cluster mean	0.19	0.56	1.71
Std. deviation	0.18	0.36	0.35
Sales Organization Management			
Cluster mean	0	1.38	2
Std. deviation	0	0.50	0
Supply Chain Management			
Cluster mean	0	1.07	2
Std. deviation	0	0.27	0
Service Design and Development			
Cluster mean	0	1.07	2
Std. deviation	0	0.27	0
Service Delivery			
Cluster mean	1	1	2
Std. deviation	0	0	0
Service Pricing			
Cluster mean	1	1	1.86
Std. deviation	0	0	0.38
Risk Management			
Cluster mean	0	0.38	2
Std. deviation	0	0.50	0
Service Rewarding			
Cluster mean	0	1	2
Std. deviation	0	0	0
Perfomance Measurement			
Cluster mean	0	1	2
Std. deviation	0	0	0
Service Metrics and Standards			
Cluster mean	0	1	2
Std. deviation	0	0	0
Servitization Intensity			
Cluster mean	0.37	0.53	0.72
Std. deviation	0.03	0.08	0.02

$R^2 = 0.81$

Pseudo-F = 57.18

APPENDIX 5 – Convergence between respondents (in %) on each factor relationship classification.

Categories		Factors	Flag	Code	Period I						Period II						Period III					
					Weak		Moderate		Strong		Weak		Moderate		Strong		Weak		Moderate		Strong	
					Hinder	Promote	Hinder	Promote	Hinder	Promote	Hinder	Promote	Hinder	Promote	Hinder	Promote	Hinder	Promote	Hinder	Promote	Hinder	Promote
External		Market	Customer's demand for more services	E_STCD	0%	87%	0%	0%	0%	0%	0%	93%	0%	0%	0%	0%	0%	0%	0%	13%	0%	87%
			Competitor's impact on service provision	E_COMP	0%	13%	0%	7%	0%	0%	0%	13%	87%	87%	0%	0%	0%	0%	7%	0%	93%	100%
		Legal	Implementing services legal requirements	E_LEGF	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%
		Environmental	Pressures for the mitigation of environmental impact	E_ENVF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		Economic	Economic impact on service provision	E_ECON	0%	20%	0%	7%	0%	0%	0%	20%	0%	13%	0%	0%	0%	0%	0%	13%	87%	87%
Internal	Company Goals	Strategic	Strategies based on locking-in customers	I_STLI	0%	0%	0%	0%	0%	0%	0%	7%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%
			Strategies based on servicing the installed base	I_FIIB	0%	0%	0%	93%	0%	7%	0%	0%	0%	93%	0%	7%	0%	0%	0%	13%	0%	87%
			Strategies based on servicing the captured base	I_FCIB	0%	0%	0%	0%	0%	0%	0%	7%	0%	93%	0%	0%	0%	0%	0%	0%	0%	100%
			Strategies based on providing custom made products	I_TYPM	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
			Strategies based on providing basic services	I_TYPB	0%	13%	0%	87%	0%	0%	0%	13%	0%	87%	0%	0%	0%	7%	0%	93%	0%	0%
			Strategies based on providing advanced services	I_TYPA	0%	0%	0%	0%	0%	0%	0%	93%	0%	7%	0%	0%	0%	0%	0%	13%	0%	87%
		Financial	Fostering to increase revenues	I_FIIR	0%	0%	0%	20%	0%	0%	0%	7%	0%	20%	0%	0%	0%	0%	0%	27%	0%	0%
			Fostering to increase the profit margin	I_FIPM	0%	0%	0%	27%	0%	0%	0%	7%	0%	20%	0%	0%	0%	7%	0%	20%	0%	0%
	Capabilities	Capabilities	The development of facilities in close proximity to the customer	I_FACI	0%	0%	0%	13%	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	7%	0%	13%
			The development of a separate services organizational structure	I_ORGA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	80%	0%	7%	0%	13%
			The development of a service culture	I_CULT	0%	0%	0%	0%	0%	0%	0%	13%	0%	80%	0%	7%	0%	0%	0%	13%	0%	87%
			The development of human resources with service skills	I_HRSK	0%	0%	0%	0%	0%	0%	0%	87%	0%	7%	0%	7%	0%	0%	0%	7%	0%	93%
			The development of service processes	I_PROC	0%	0%	0%	0%	0%	0%	0%	13%	0%	7%	0%	7%	0%	0%	0%	20%	0%	13%
			Fostering the use of ICT	I_TECF	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%	0%	13%	0%	0%	0%	7%	0%	20%
	Servitization Practices		Sales organization management	P_SORM	0%	0%	0%	0%	0%	0%	0%	20%	0%	80%	0%	0%	0%	0%	0%	20%	0%	80%
			Supply chain management	P_SCMG	0%	0%	0%	0%	0%	0%	0%	13%	0%	87%	0%	0%	0%	0%	0%	13%	0%	87%
			Service design and development	P_SDDV	0%	0%	0%	0%	0%	0%	0%	20%	0%	80%	0%	0%	0%	0%	0%	7%	0%	93%
			Service delivery	P_SDEL	0%	87%	0%	0%	0%	0%	0%	20%	0%	80%	0%	0%	0%	0%	0%	7%	0%	93%
			Service pricing	P_PRIC	0%	87%	0%	0%	0%	0%	0%	7%	0%	93%	0%	0%	0%	0%	0%	7%	0%	93%
			Risk management	P_RISK	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%	0%	87%
			Service rewarding	P_SRWD	0%	0%	0%	0%	0%	0%	0%	13%	0%	87%	0%	0%	0%	0%	0%	13%	0%	87%
			Perfomance measurement	P_PERF	0%	0%	0%	0%	0%	0%	0%	20%	0%	80%	0%	0%	0%	0%	0%	20%	0%	80%
			Service metrics and standards management	P_METR	0%	0%	0%	0%	0%	0%	0%	13%	0%	87%	0%	0%	0%	0%	0%	20%	0%	80%

5. Conclusions

5.1 Discussion

This research is innovative in three ways. First, and to the best of our knowledge, it is the first longitudinal study to analyse the factors that impact servitization intensity, using qualitative and quantitative data from manufacturers from one single (worldwide) industry. Studying a single industry allows for the natural control of a number of contextual factors that may influence servitization intensity, as well as for a more granular insight into the factors that impact it. In addition, studying an industry over a long period mitigates the risk of uncontrollable factors that create noise in cross-industry studies.

Second, the study focuses on the dynamics of the impact of external and internal factors on servitization intensity over time.

Finally, this study is also one of the few to provide a theoretical formulation and an empirical test of an integrated longitudinal model to moderate the effects on performance outcomes of servitization strategies. The moderator analysis also provides a finer-grained view on the servitization intensity-performance link, so that we can identify the factors that promote (or hinder) the impact of servitization intensity on firms' performance.

The literature gaps identified in section 1.3 and listed in Table 5 have all been addressed on at least one of the three papers that are the basis of chapters 2-4. Moreover, each paper answers one research question of the thesis.

Table 5 – Match between literature gaps and the papers

	Literature gaps	Addressed in		
		Paper 1	Paper 2	Paper 3
	Gaps concerning research design			
1	Only a limited number of empirical studies have investigated in a holistic manner how external and internal factors promote or hinder servitization over time.	✓		✓
2	The evidence base used is relatively sparse. There are only a few authors that used large scale empirical data.	✓	✓	
3	There is a strong need for more longitudinal studies being in line with the argument that servitization is a long-term, often incremental process.	✓	✓	✓
4	More retrospective case studies are needed to help understanding the dynamics of servitization over time.			✓
	Gaps concerning the servitization intensity			
5	The scale or intensity of servitization is usually very difficult to obtain and measure.	✓	✓	✓
6	Prior research has rarely examined the drivers of servitization in highly servitized industries.	✓	✓	✓
	Gaps concerning the capabilities			
7	Much of the existing literature is normative and prescriptive, focusing upon what organisations aspire to do, but offer little insights into how attempts to integrate products and services occur, or the challenges organisations encounter.			✓
8	There seems to be a lack of a detailed understanding of how product-service strategies are operationalized.			✓
	Gaps concerning the performance			
9	It cannot yet be reliably stated which factors affect the impact of servitization on the performance of manufacturing firms, over time.		✓	
10	Scholars have called for an in-depth understanding of the financial performance outcomes of servitization.		✓	
11	It is not yet possible to indicate reliably what kind and/or intensity of service provision will lead to improved performance under which circumstances.		✓	✓
		↓	↓	↓
		RQ1	**RQ2**	**RQ3**

Legend: ✓ - the literature gap is addressed in the referred paper

The several research findings of this thesis can be better explained by clustering them into six groups using the framework of Figure 3.

After each finding, we indicate the source (paper I, II or III) and whether the finding results from theory testing or theory building.

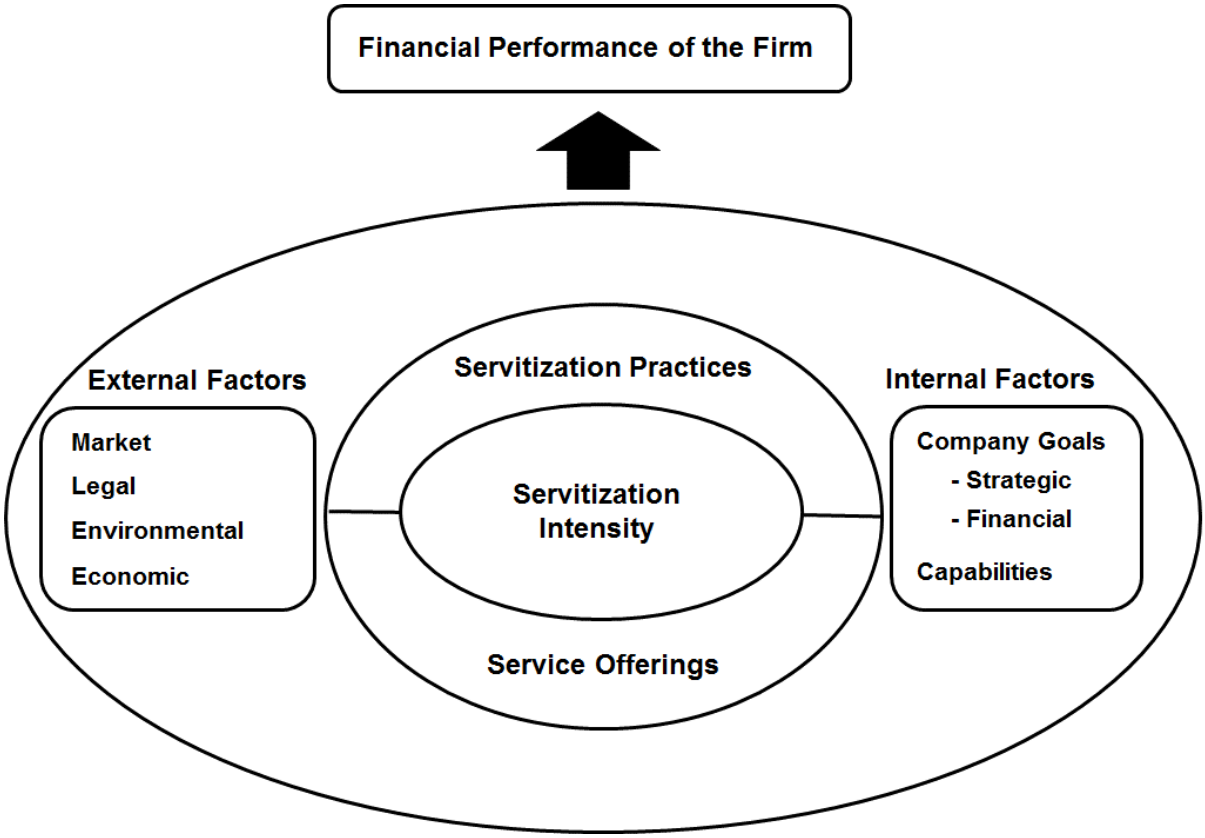

Figure 3 – Framework for clustering the research findings

Financial performance of the firm

Finding 1 We confirm that servitization intensity (share of revenues generated by services) has a positive impact on the profitability of the product firm (operating margin) over time (Source: Paper II | Theory testing).

Finding 2 There is no evidence of non-linear effects of servitization intensity on profitability. This means that the firm's profitability seems to increase consistently with the provision of additional services in an industry where servitization intensity is very high. Moreover, these positive effects seem to remain even at such high levels of servitization intensity (Source: Paper II | Theory testing).

Servitization practices

Finding 3 Implementing interrelated and internally consistent bundles of servitization practices aligned with the type of services provided over time contributes positively to servitization intensity (Source: Paper III | Theory building).

Service offerings

Finding 4 We obtained new insights into the provision of basic and advanced services. Over time, there seems to be a coexistence between basic and advanced services, consolidating the provision of basic services first, followed by the development of advanced services. Therefore, servitization intensity relies on product-basic services combinations, by adding advanced services, but without ever giving up the provision of basic services and the supply of products (Source: Paper III | Theory building).

Internal factors

Finding 5 Resource slack and advertising intensity are important positive moderating factors of the impact of servitization intensity on profitability. Regarding resource slack, its continuity supports the required investments in service specific assets and capabilities, without increasing the firm's financial exposure, or affecting other projects and goals. Therefore, product firms should absorb excess resources to be able to overcome the investment barriers encountered over time, while servitizing. Advertising intensity may be important because services are inherently intangible and therefore customers often struggle to understand and to compare service offerings from different providers. Since customers are more likely to source services from a trusted provider, we suggest that higher investment in advertising may increase the firm’s reputation and ultimately the customers’ perceived value. This seems to contribute to an increase in the profit margins of the services provided. (Source: Paper II | Theory testing).

Finding 6 Consistent with the highly servitized nature of the industry studied, the age and market share of the firm do not seem to have any moderating effect on the link between servitization intensity and firm profitability. We would expect that a product firm with a larger market share and with longer market activity, would be better positioned to extract profits from its service offerings than lower-share and recent competitors. However, our findings suggest that smaller and younger product firms may be equally well positioned to do so (Source: Paper II | Theory testing).

Finding 7 Looking at the financial factor, the company goal of increasing revenues has a positive impact on servitization intensity over time. From a longitudinal point of view, this finding is consistent with the notion that the service business is relatively unaffected by cyclical risks in the industry since services are less susceptible to the effects of an economic recession. A

decline in business resulting from fewer new installations may be virtually counterbalanced by a growth in services. Finally, through services, the manufacturer may be able to help cushion increasing product price pressures e.g. by introducing services based on new technologies to create value for customers (Source: Paper I | Theory testing).

Finding 8 There is no evidence that strategic factors – strategies based on locking-in customers and providing custom-made products – have a positive impact on servitization intensity over time. The lack of impact of strategies based on locking-in customers may be explained by the fact that servitization intensity has remained very high over time in the elevator industry; as a result, firms have already incorporated strategies based on customer locking-in into their business models. In the early years of the study, manufacturers indicated a clear orientation towards building strong relationships with their customers (Source: Paper I | Theory testing).

Finding 9 Surprisingly, there is a negative relationship between strategies based on providing custom-made products and servitization intensity over time. Looking at this issue from a dynamic perspective reveals opposing forces at play. On one side, and since custom-made products are more complex, it may be that customers are more open to the provision of full maintenance contracts (i.e. advanced services) than buyers of standard or mass produced goods. Because these contracts result in a constant revenue over time, no significant increase in service revenues is generated throughout the years that follow. On the other side, because custom-made products have higher selling prices, the revenues generated with the provision of these products may, over time, increase more than the revenues obtained through the selling of related services (Source: Paper I | Theory testing).

Finding 10 Localised facilities seem to enable a strong relationship with the customer, leading to the provision of additional services over time (positive impact of facilities in close proximity to the customer on the servitization intensity). In the case of an elevator, a 24 hour/365 day availability must be ensured; for instance, to release people that might be stuck in an elevator or to perform corrective actions. This implies that the service staff must be physically close to the equipment to ensure a prompt intervention. If the manufacturer provides performance-based services, the risk is significantly high, which could lead to financial penalties in case the equipment fails to perform as

specified. Therefore, the response time will have to be short. (Source: Paper I | Theory testing).

Finding 11 The development of specific service processes over time is positively associated with increasing servitization intensity. For instance, to succeed in selling more services over time, the manufacturer should design processes to support the customers' business goals and to deliver through-life performance. The transition from products to services also requires a different sales approach, because the sales process is often more complex, takes longer and requires stronger customer empathy (Source: Paper I | Theory testing).

Finding 12 The use of ICT is negatively associated with servitization intensity over time. ICT may preclude the provision of other services, which may harm existing service revenues (and thus, servitization intensity), or customers may not pay at all for these additional services. This finding diverges from other studies concerning the impact of the use of ICT on servitization (Source: Paper I | Theory testing).

Finding 13 The creation of a separate organization to handle the service offering via the development of a dedicated sales force and a structure with dedicated service managers and technical staff, has a positive influence over servitization intensity over time. This separate service organization seems to have only a strong positive impact on servitization intensity as soon as it is introduced (in the service-led period). Once installed, this factor loses the power to promote servitization intensity (Source: Paper III | Theory building).

External factors

Finding 14 Based on the longitudinal analysis of the worldwide industry, there is no evidence that external factors, namely market, and environmental factors, have a direct impact on servitization intensity over time. This finding diverges from suggestions from prior conceptual studies. The lack of impact of market factors (customer's demand for services) may relate to the high level of servitization maturity of the elevator industry. Firms in this industry have been providing basic and advanced services since the 1980s. This suggests that the impact of market factors may be contingent on the servitization maturity of the industry sector (Source: Paper I | Theory testing).

Nevertheless, when looking to the whole servitization journey, external factors seem to be the main trigger for starting the transition to the next servitization implementation period, followed by the corresponding

adaptation of the internal factors, service offerings and servitization practices. (Source: Paper III | Theory building).

Finding 15 The legal factor is a “neutral” factor, in the sense that it was found to promote (although in a weak manner) the implementation of servitization in all three periods (Source: Paper III | Theory building). The weak influence of legal factors on servitization intensity over time may be due to three reasons. First, the equipment maintenance is a legal requirement in several countries, and once introduced, this obligation remains over time. Thus, there will be no new source for a positive impact on service provision from the moment the legal obligation comes into force. Second, other service legal requirements (i.e. modernization) may have an effect that is limited in time. In the year when the legal imposition comes into force, service revenues increase. However, in the following years, as soon as the legal imposition is fulfilled, service revenues decline again, falling back to previous levels. Third, the introduction of a new legal requirements may lead to a reduction in the provision of existing services (Source: Paper I | Theory testing).

Finding 16 The environmental factor is not mentioned by any of the firms considered in the sample. It may result from the difficulty of firms in the elevator industry moving to product rental models in which the product ownerships rests with the manufacturer. The main reason is the fact that once the elevator is installed, it becomes part of the building, being very difficult to disassemble the equipment in case a customer does not pay the regular fee for the usage of the good. The manufacturer seems to be facing a very high risk that it is not able to incorporate into the existing business model (Source: Paper I | Theory testing).

Implementation of servitization

Finding 17 Our findings showed that a manufacturer’s servitization journey may progress through three distinct servitization implementation periods: “the product-oriented period”, “the service-led period”, and finally “the advanced services period” - via the interplay between external and internal factors, service offerings and bundles of servitization practices (Source: Paper III | Theory building).

In the following section we summarize the research contributions.

5.2 Research contribution

Our study makes five contributions to servitization research:

1. It emphasises a view of servitization that is longitudinal and dynamic, opposing the cross-sectional approaches that dominate extant empirical research, because of the difficulty in accessing data. The development of service offerings is inherently a dynamic process that requires a continuous adaptation to changing customer needs, technologies and general market trends. More specifically, by resorting to longitudinal data, our study highlights the fact that the assessment of the factors that affect servitization needs to consider dynamic aspects, as well as the degree of servitization maturity of an industry. Several industries already exhibit high levels of servitization intensity, and a growing number of industries are expected to become highly servitized in the near future.
2. It concludes that manufacturing firms in an industry where servitization intensity is very high could operate past the inflection point without facing a service paradox. This means that firm profitability increases consistently with the provision of additional services and that this positive effect remains even at very high levels of servitization intensity over extended periods, i.e., over time servitization has a positive impact on the profitability of the manufacturing firm.
3. It shows that a manufacturer's servitization journey may progress through three distinct servitization implementation periods: "the product-oriented period", "the service-led period", and finally "the advanced services period". Over time, external factors seem to be the main factors for starting the transition to the next servitization implementation period, followed by the corresponding adaptation of the internal factors, service offerings and bundles of servitization practices. Thus, inside each period, factors that are controlled by the manufacturer - such as company goals and capabilities, service offerings and servitization practices – seem to influence servitization intensity.
4. Over time, the provision of basic and advanced services seems to coexist, consolidating the provision of basic services first, followed by the development of advanced services. In all three servitization implementation periods, the servitized manufacturer continues to supply products to increase the installed base. This large installed base ensures that there is an ongoing demand for basic and advanced services in the future. Combining data from service operations and products allows the manufacturer to improve the coordination of all service activities and to develop new, value-adding services.

5. It brings into light that over time, the manufacturer provides services to the installed base first and only then to the captured base. In the earlier stages of the journey, the manufacturer seems to be reluctant to offer services to the captured base, due to the business risks and difficulties involved in obtaining the necessary new skills and spare parts. The manufacturer may face a higher risk of guaranteeing the availability of a competitor's equipment, due to the potentially higher repair costs, or due to installation proprietary rights that the competitor could own. With increasing experience (knowledge about competitors' products and its technology), the manufacturer provides services to cover both the private and the competitors' products. The provision of services to the captured base might serve as an entry point to the customer and consequently, as an opportunity to generate more business, either through additional service sales or through new equipment deliveries.

In the following section, we focus on the managerial implications.

5.3 Managerial propositions

Our study provides significant propositions for practice, namely by advancing guidance for the deployment of servitization strategies:

- Manufacturers who wish to increase their servitization intensity over time in mature service industries should:
    i. maintain a strategic focus on revenue increase;
    ii. promote the development of key capabilities, namely, the development of service facilities in close proximity to the customer and service processes.

  Moreover, servitization should not only be a reaction to the external context, but rather a deliberate management decision associated with the establishment of suitable goals and development of appropriate capabilities.

- In highly servitized industries, product firms should:
    i. seek increasing service provision since it seems to contribute directly to a higher financial performance over time;
    ii. be able to build up a resource slack over the years, i.e. a cushion of actual and potential resources in order to help the firm adapting to new service strategies over time;
    iii. invest in advertising, since it enhances the positive impact of servitization intensity on financial performance over time.

We would expect that a product firm with large market share and with long market activity would be better positioned to profit from its service offerings than lower-share and recent competitors. However, our findings suggest that smaller and recent product firms may be equally well positioned to do so.

- Finally by acknowledging the dynamic nature of the business, the manufacturing firm should:
    i. be aware of the different periods in a servitization journey. The managers should understand the characteristics of each period, as well as the interplay of external and internal factors, service offerings and bundles of servitization practices – which are crucial to the firm's success;
    ii. have in mind that the time taken to progress through the three servitization implementation periods can be significant. It may take decades for a manufacturer to implement the servitization practices and to develop the capabilities needed to reach the "advanced services period". Nevertheless, the provision of advanced services has a positive impact on servitization intensity over time;
    iii. continue to sell products, while providing basic and advanced services. This will help enhancing the cumulative installed base and will contribute to the provision of more basic and advanced services in the future.

5.4 Future research

Despite the dissertation contributions, our research has limitations that open up opportunities for future research.

- First, and despite the fact that the in-depth analysis of a single industry has a considerable number of benefits, it limits the generalizability of the results. We believe that our outcomes may apply to some other highly servitized industries with a large installed base of products, like industrial machines, aircrafts, HVAC-Systems or medical equipment. Further empirical research in other industries will help sorting out these important issues, while supporting them and helping them understand the factors that impact their servitization.
- Second, servitization intensity is measured by means of service revenues over total revenues of the firm. To get a deeper insight into the servitization intensity it would be advisable to break down this metric across different types of services (e.g. basic and advanced services). One of the challenges in said process is that manufacturing firms typically do not usually report this information.

- Third, by analysing annual financial reports, we are looking at past strategies followed by the companies (or at least communicated as having been implemented), that may not trigger an immediate effect on servitization intensity in the year they are disclosed. We tested the models with lagged variables and there were no significant changes in the results, which additional research could eventually confirm.
- Fourth, firms may not reveal all their strategies. Nevertheless, and since annual reports are public, companies tend to inform the stakeholders about their strategies helping investors and creditors to understand the company's economic risk and value (Beattie *et al.*, 2008).
- Fifth, we were not able to take into account the type of services that each manufacturer was providing. Hence, it would be interesting to further analyze how the provision of different types of services impacts the profitability of product firms over time.
- Sixth, we assessed the impact of servitization on the product firm's performance through financial indicators. Other non-financial performance measures should also be used to assess the impact of servitization intensity, such as those proposed by Kaplan and Norton (2007) in the balanced scorecard.
- Seventh, it would be important to understand how other contextual factors may moderate the impact of servitization intensity on firm performance (Sousa and Voss, 2008; Voss et al., 2016; Sousa and da Silveira, 2017), namely by collecting additional data from companies' web sites or financial reports.
- Finally, servitization is often studied from the manufacturer perspective. Therefore, dynamic and longitudinal researches on servitization from the customers' point of view could be important, in order to assess the impact of their behaviour on the performance of the manufacturing company (see Franco *et al.*, 2019 for an initial research on this subject). Understanding the customer and its processes is vital for the delivery of profitable solutions based on (advanced) services. Future research should identify the opportunities for value co-creation and the ways of demonstrating value to the customer (how to promote value and how to communicate this to customers).

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Appendix 1 - Summary of the research findings of each paper

Respectively, highlighting in Paper I and II whether the raised hyphothesis were or not supported.

Paper I **Understanding what factors affect servitization intensity over time**

External factors

1. External factors (market, legal and environmental) impact positively servitization intensity over time: no evidence found. ✗

Internal factors

2. Strategies based on locking-in customers have a positive impact on servitization intensity over time: no evidence found. ✗
3. Strategies involving the provision of custom-made products have a positive impact on servitization intensity over time: the impact is negative. ✗
4. Fostering to increase revenues has a positive impact on servitization intensity over time. ✓
5. The development of facilities in close proximity to the customer has a positive impact on servitization intensity over time. ✓
6. The development of service processes has a positive impact on servitization intensity over time. ✓
7. Fostering the use of ICT has a positive impact on servitization intensity over time: the impact is negative. ✗

Legend: ✓ - the hypothesis is supported
✗ - the hypothesis is not supported

Paper II **Understanding what factors affect the performance of the servitized manufacturing firm over time**

1. Higher levels of servitization intensity are associated with higher firm profitability over time. ✓
2. The relationship between servitization intensity and firm profitability is non-linear (i.e. quadratic, with a convex U-shape) over time: no evidence found. ✗
3. Resource slack positively moderates the effect of servitization intensity on firm profitability over time. ✓
4. The firm's market share positively moderates the effect of servitization intensity on firm profitability over time: no evidence found. ✗
5. Advertising intensity positively moderates the effect of servitization intensity on firm profitability over time. ✓
6. The age of the firm positively moderates the effect of servitization intensity on firm profitability over time: no evidence found. ✗

Legend: ✓ - the hypothesis is supported
✗ - the hypothesis is not supported

Paper III **Understanding how the external and internal factors promote or hinder servitization of a manufacturing firm over time**

1. Implementing interrelated and internally consistent bundles of servitization practices aligned with the type of services provided over time contributes positively to servitization intensity. ✅
2. Over time, the provision of basic and advanced services seems to coexist, consolidating the provision of basic services first, followed by the development of advanced services. ✅
3. Over time, and even in the advanced services period, the servitized manufacturer continues to supply products to enhance the installed base. ✅
4. Over time, the manufacturer provides services first to the installed base, and only thereafter to the captured base. ✅
5. Over time, external factors seem to be the main factors for starting the transition to the next servitization implementation period, followed by the corresponding adaptation of the internal factors, service offerings and servitization practices. ✅
6. Three clear servitization implementation periods emerged: "the manufacturing period", "the service-led period" and "the advanced services period". ✅
7. Our findings suggest that the legal factor is a "basic" factor, in the sense that it was found to promote in a weak manner the implementation of servitization in all three periods. ✅
8. The creation of a separate organization to handle the service offering by developing a dedicated sales force and a structure with dedicated service managers, engineers and technicians positively impacts the servitization intensity over time. ✅

Legend: ✅ - A new finding