To what extent does Lean Startup help manufacturing firms to overcome the service paradox?

Lino Schwepkes
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,

The concept of servitization and the potential impact on firm performance got increasing attention in the past. Nevertheless, the process towards becoming a servitized firm lacks robust academic literature. Furthermore, servitization is said to have a u-shaped relationship with firm performance due to, amongst others, higher costs needed for service implementation. After service sales rise that are attributable to servitization performance increases. That is why this research investigates (1) if the u-shaped servitization-performance relationship exists in the sample which indicates performance improvements after some time, (2) if Lean Startup has an impact on firm performance and (3) if Lean Startup moderates the servitization-firm performance relationship. For this a survey was created and distributed to employees that work in manufacturing firms. The survey asks respondents about their firm performance, the degree of servitization and Lean Startup. The results show that the u-shaped relationship exists. Furthermore, Lean Startup seems to have a positive impact on firm performance and a negative moderation on the u-shaped servitization-firm performance relationship. The findings regarding Lean Startup are applicable to this sample and should be prevented from general findings due to statistical concerns. This research adds to existing literature the potential influence Lean Startup has as a process guidance for servitization. Further research on this is necessary to get a more robust view on the influence of Lean Startup on servitization outcomes and to determine other factors that explain firm performance in this context.

Graduation Committee members:
Dr. A.M. von Raesfeld Meijer
PhD(c) Xander Stegehuis

Keywords
Servitization, service orientation, Lean Startup, Lean Startup Capability, firm performance, service paradox

---

1. INTRODUCTION

On the way for companies to gain competitive advantage the term servitization got increasing attention in the past. Nevertheless, the number of empirical studies concerning the servitization concept is still scarce (Wang et al., 2018) and this leads to the lack of theoretical completeness.

Especially the required processes of companies in order to servitize successfully are lacking academic literature (Baines et al., 2019). In other words, as Baines et al. clarified back in 2017, a major part of the research about servitization has focused on what changed and what were the circumstances during the process of servitization, whereas much less research was conducted on the process of organisational change itself accompanying the servitization transformation (Baines et al., 2017). Many researchers and practitioners are aware of this lack of academic literature and as a result manufacturing companies may struggle to achieve a smooth and successful transition from focusing on the sale of products to focusing on services as the main revenue stream (Baines et al., 2019). Additionally, actual research that studied the process found no clear but rather individualistic process characteristics for different firms (Martinez et al., 2016; Baines et al., 2019; Olivia & Kallenberg 2003). Baines et al. (2019) further direct at the need in the future to investigate into a more concise understanding of processes and contents in its different stages. Furthermore, service offerings possess specific degrees of complexity which in turn have different implications for the service business model. Martinez et al. (2016) stress the importance to direct future research at those different implications for the service business model stemming from the service variety available. Baines et al. (2017) acknowledge that the process of servitizing is gaining more understanding with time but especially advanced services require a higher attention. Furthermore, they suggest that provider of such advanced services should adjust the whole business model.

Already more than thirty years ago Vandermerwe and Rada (1988) acknowledged that services are an essential aspect to consider for businesses. They went beyond and stated that companies that offer services appropriately could ultimately gain competitive advantage. The high relevance of this concept mirrors in the fact that firms either already are or evolve to a firm that becomes increasingly dependent on revenues from services (Baines et al., 2017). Next to that, according to Neely (2008) the proportion of manufacturing firms that have servitized is more than one third worldwide. Additionally, the increasing tendency of firms towards offering services is supported by a technological push, like ICT, that makes exchanges and co-creation processes easier for the different actors (Breidbach & Maglio, 2016).

Although servitization potentially provides commercial benefits an important aspect to contrast these benefits is the potential performance sacrifice in the beginning of the servitization era which turns into increased performance after the service sales reach the "critical mass", which is roughly 20% to 30% (Fang et al., 2008). Fang et al. (2008) go further and explain this performance dip by "negative mechanisms" that occur in the early stage of servitization implementation and diminish as the service ratio improves. Gebauer et al. (2005) strengthen in their study the service paradox phenomena and explain this based on cognitive issues of the managers. These cognitive issues that lead to the performance sacrifice in the beginning of servitization are, for example, the service quality erosion which means that managers think tangible goods do have a higher economic potential and lower risk compared to services (Gebauer et al., 2005). Another managerial cognitive issue after initiating servitization is the high investment in human resources and additional employees, whereas Gebauer et al. (2005) state that it

is required to improve commitment and understanding by the employees of the potential benefits instead of purely investing in human resources.

The studies of Martinez et al. (2016) and Baines et al. (2019) observe following characteristics of the servitization process of their studied firms. Martinez et al. (2016) describe the process as emergent and intuitive due to forward and backward sequencing of firms between the steps. Additionally, the co-development of services with customers is stressed. Baines et al. (2019) call the sub-processes within the stages towards servitization unstructured too. These characteristics in combination with the academic incompleteness in terms of the servitization process guides this paper towards the concept of Lean Startup.

The Lean Startup concept tells us that thinking lean means aiming at the minimization of any kind of waste in an organization, specifically start-ups (Chesbrough & Tucci, 2020). Waste could be in form of decisions that turn out to be wrong afterwards and therefore lost time and resources. This theory proposes therefore an opposite advice to start-ups than traditionally, since the traditional advice for start-ups was to work like big firms at a small scale (Chesbrough & Tucci, 2020) This means that they create a business plan before launching a new product and adjust this plan once new information is gathered, thereby increasing the chance of wasting time and resources if the business plan turns out to attract no customers. An important aspect of the Lean Startup concept is the minimum viable product (MVP). The MVP is responsible for gaining early customer feedback in order to make adjustments to the product or business model with the ultimate aim to launch it with the security of having customers that are definitely accepting it (Chesbrough & Tucci 2020). For this purpose, Blank (2013) established the concept of customer development. This concept consists of four phases which are customer discovery, customer validation, customer creation and company building. The main essence of this concept to use the MVP and confront potential customers with it. The aim is to discover required changes that leads to attracting potential customers wanting to buy this product, therefore reducing the risk of having no customers.

As already indicated, although servitization got increasing attention by firms and literature the process of becoming a firm that integrates services into the business model successfully lacks academic focus. The presented Lean Startup concept fits in this domain since servitization is currently rising in attention and therefore does not have well-known best practices. Lean Startup is about exploration and learning which require customer insights and the iterative experimentation process and those attributes make it appropriate. Additionally, both concepts focus on customers' perceptions. Consequently, this paper tries to fill this research gap by investigating the effect of lean startup practices on servitization outcomes manufacturing firms. Simultaneously, the performance dip problem is included in this research by analysing the firm performance as a result of servitization initiation with the influence of Lean Startup practices.

With regard to the abovementioned paper objective the following research question will be addressed throughout this paper: "To what extent does Lean Startup help manufacturing firms to overcome the service paradox?"

2. THEORETICAL FRAMEWORK
2.1 Servitization

The first appearance of the term "servitization" is attributable to the work of Vandermere and Rada in 1988. According to Vandermere, Rada (1988) and Neely (2008), servitization is about adding appropriate services to products in order to

complement the product. Since servitization as a concept is becoming increasingly popular Desmet et al. (2003) define it as a trend that describes manufacturing firms' tendency to add more services in their offering. Companies aiming at offering services to products are interested in selling solutions to customers instead of finished products. Especially companies that are in an industry focusing on commodities are motivated to servitize in order to differentiate themselves from competitors. Additionally, the concept of servitization becomes advantageous in the case of selling products that are yet largely unknown and novel (Martinez et al., 2016). The business model does not stay untouched. In fact, Abou-Foul et al. (2020) strengthen the issue that firms that progress towards a service-centric business model require a fundamental organisational change. Firms should align the several firm dimensions like resource management, top management service orientation and their investment strategy (Abou-Foul et al., 2020). For firms that agree to conduct servitization customer co-creation is essential. If a firm decides to start offering services complementary to their products there will be a shift in focus from transactions between firms and customers to relationships between them supported by the co-development of such services from design until the final usage. In addition to that, the co-development processes with customers and the external environment in general lead to outcomes that are not easy and maybe not possible at all to predict in advance (Martinez et al., 2016).

2.1.1 Servitization process

Kohtamaki et al. (2015) suggest that the firm providing services should focus on customers' processes in order to increase the service value and efficiency. Thus, they can charge higher prices and decrease respective costs of providing services. This characterises the "service orientation" concept. Kohtamaki et al. (2015) stress that the concept is key for a successful transition towards offering services. This approach basically says that only offering services is not enough to be beneficial. Instead, for example the organisational structure should be adjusted in order to create value by co-creation. Furthermore, Kohtamaki et al. (2015) stress that complex solutions require the backing of the whole organisation and that is why the service orientation mindset should be established throughout the whole firm. The elements that must be oriented towards services are corporate values, employees' behavior, personnel recruitment, personnel training and personnel assessment and compensation. Homburg et al. (2003) argue that, once a firm decides to implement a service-oriented strategy, culture and human resources must be adjusted. Additionally, the emphasis on services rather than the number of services is important because a majority of services could be the result of customers asking for them. Therefore, many services must not mean a conscious switch from a product- to a service provider. This means that the organisational structure is the focus of the service orientation concept, especially human resources and culture. In other words, the higher the degree of alignment between the service-oriented business model and organisational structures the higher the servitization maturity. The "service orientation" concept seems appropriate to investigate in this paper considering the problem focus which is the service paradox.

Oliva and Kallenberg (2003) investigated the transition from products to services in the context of installed base services. They state that the sequence of the stages presents a structured and linear development of services. Firms that reach the fourth and last stage are considered pure service organisations because they take complete responsibility over customers' processes. In general firms create advanced services and routinize such capabilities before advancing to more complex services (Martinez et al., 2016; Olivia & Kallenberg 2003; Baines et al.,

2019). Compared to Olivia and Kallenberg (2003) in the study of Martinez et al. (2016) three distinct firms and their servitization journeys were investigated. They figured out in their research that, in terms of the pace of change, the firms tend to create two separate streams of services. The first one consists of basic and intermediate services which was set within the first three years. The second one builds on more complex and tailored services and developed after the fourth year. This study argues that servitization is an on-going process with different steps within this process. Next to that, Martinez et al. (2016) observe that the studied firms have a different sequence of the steps and all firms progress forward and backward during the servitization process. That is why they argue for servitization being continuous, emergent and intuitive. Baines et al. (2019) integrates both perceptions about the servitization process and describe it as having four stages which is similar to Olivia and Kallenberg (2003). The first stage is called "Exploration" and in here the firms focus on gaining an understanding of the market and what role services could play in the firms' growth. "Engagement" is the second stage and is about consolidating internal support. The third stage "Expansion" deals with launching and scaling developed services and the last stage, which is called "Exploitation", is about spreading the servitization mindset across the whole firm. Additionally, the progression towards more complex services is covered by this stage. All in all, the stages are similar to the structured approach by Olivia and Kallenberg (2003). Nevertheless, Baines et al. (2019) weaken the assumption of a structured process by stating that within these stages the processes are unstructured and intuitive. They argue that the contextual factors contribute to this. These factors are organisational commitment, organisational readiness, customer pull, technology push and value network positioning. Due to the continuous presence of these factors the characteristics like emergent and intuitive (Martinez et al., 2016) are strengthened in that different firms find themselves in different contexts. Therefore, individual processes for the different firms are expected. The stages and external factors combined result in the "servitization progression model" (Martinez et al., 2016).

2.1.2 Servitizaion performance

The servitization strategy influences both a firms financial and non-financial performance. Whereas profitability ratios belong to the financial performance category, non-financial performance measures could be customer satisfaction, customer loyalty, innovation level or organisational growth. The study by Wang et al. (2018) investigated the performance effect of servitization and the results tell us that servitization has a higher positive influence on non-financial performance than on financial performance due to invisible benefits like customer loyalty (Wang et al. 2018). Nevertheless, overall firm performance is improved due to the intangible nature of services and lower transparency in the market which requires increasing interaction between customer and seller (Fang et al., 2008), which in turn specifically impacts non-financial performance. That is why managers should consider both sides when thinking about servitization (Feng et al., 2021). Visnjic et al. (2016) indicate that market performance improves after servitization initiation but requires a high degree of R&D intensity. In case a firm has a low R&D intensity it could start to focus on a product-oriented business model and then develop towards a service business model parallel to an increasing R&D intensity. Feng et al. (2021) argue that an alignment of the three variables, namely strategy, environment and organization is required to improve the performance effect of servitization. Servitization performance is heavily dependent on firms' internal and external influences. The higher the national economic level the higher the chance to achieve the expected performance improvement due to, amongst

other things, practical experience of manufacturing companies in developed countries. Furthermore, Feng et al. (2021) and Wang et al. (2018) argue that industry characteristics influence the performance effect of servitization. Especially the degree of competition plays a role and servitization can make the competition fiercer in knowledge-intense and high-tech manufacturing industries. This is due to lower costs because of spillover effects of knowledge and technology. Fang et al. (2008) stress the contingency of the servitization-firm performance relationship on firm and industry characteristics too. In this study it is argued that the more the service offering is connected with the firms's core business the higher the expected perfomance improvement. The reason is that it will be hard to overcome the costs of the services that do not have a high impact on firm value. Resource slack positively influences firm performance after servitization initiation as well due to preventing organizational conflict. This means that there is less need to compete within the firm for resources which would lead to cutting resources from some projects and decreased firm performance (Fang et al., 2008).

Servitization requires firms to fundamentally change their organisational characteristics, for example the structure, and the resulting learning effect during the change leads to the u-shaped servitization-performance relationship. Especially the external aspects like industry characteristics forces firms to achieve alignment between strategy, organization and environment (Feng et al., 2021). Johnstone et al. (2009) found out that the company as a whole is affected by the change and the change will be more intuitive, supporting the possible obstacles before improving performance. Fang et al. (2008) characterises the change as having negative effects on firm value in the first phase until it eventually turns into positive effects. Naturally, change takes time and the adaptation towards it takes time too. Processes need to become standardized and employees require time to get used to the new organizational approach towards creating value. This procedure explains the proposed u-shaped relationship between servitization and firm performance. Quantitative studies on the servitization performance relationship support this, amongst others, Wang et al. (2018) and Fang et al. (2008).

H1: Servitization has a U-shaped relationship with firm performance.

2.2 Lean Startup and LSC

The concept of Lean Startup describes the process of exploring and validating potential innovative business models (Chesbrough & Tucci, 2020). Chesbrough & Tucci (2020) point out that customers' rejection of the new business model is most frequently the main reason for startup failure. Chesbrough and Tucci (2020) also underline the importance of applying lean thinking to startup creation and scaling since the most wasted activity is the usage of resources for a product offering that has no customers. Additionally, the potential waste of resources and the uncertainty about the business models' viability are two major forces driving companies to apply the lean concept in its infancy stage (Eisenmann et al., 2012). Eisenmann et al. (2012) describe the application of the lean concept in that the MVP tests beforehand established business model hypotheses and based on the information received the firm adjusts the corresponding business model. As Chesbrough and Tucci (2020) and Eisenmann et al. (2012) indicate the application of Lean Startup practices potentially reduces cost by preventing wasted activities, especially the development of a new business model that does not attract customers. The continuous testing of business model hypotheses and the resulting validated business model creates value for all stakeholders. The theory or concept of Lean Startup Capability was explored and operationalized by Harms and

Schwery (2020). This concept has the Lean Startup thinking at its core but recognizes its dimensions as a capability in that it is a bundle of activities. Conceptualizing these activities as an iterative process potentially allows the entrepreneurs to achieve a business model that is validated and scalable (Harms and Schwery, 2020). It consists of five process elements and the first one is (1) customer orientation, followed by (2) hypothesizing, (3) experimentation, (4) validation and (5) learning.

2.2.1 Lean Startup performance
According to Harms and Schwery (2020) Lean Startup Capability has a positive relationship with firm performance. This is achieved due to the reduction of waste like resources when going through the different steps of this process. Next to that, the data generated in this process helps firms to establish the learning effect and contributes to value enrichment (Harms and Schwery, 2020). According to Zuzul and Tripsas (2019) the frequent update of the business model depending on the circumstances generates a higher chance of success than strongly committing time and resources to an original idea or business model. This possibly results in less flexibility and organisational inertia (Zuzul and Tripsas 2019). Bojovic et al. (2019) strengthen the importance of experimentation and indicate that it can help to overcome inertia. Berends et al. (2016) consider experimentation as an enabler of continuous innovation and gives foundation by saying that the resulting new insights lead to accumulation of experiences that further lead to shifting perceptions about business patterns and potential new business activities. Autio et al. (2017) went beyond and point towards potential spillover effects even across industries that generate new ideas and knowledge based on both successful and failed experiments. Furthermore, experimental learning could support business orientation towards innovation by adjusting the internal structure and creating internal buy-in (Weissbrod & Bocken, 2017). Finally, Bocken and Snihur (2020) state that Lean Startup, due to its dimensions like iterative experimentation, initiates collective learning by including various stakeholders and thereby reducing uncertainty. Especially the stakeholder inclusion benefits firms by collective experimentation that potentially enables a more efficient search for the final business model (Bocken and Snihur, 2020). Additionally, Eisenmann et al. (2012) discuss the "Lean Startup Psychology" and argue that Lean Startup mitigates cognitive biases. One example of such a bias is confirmation bias, which describes humans' tendency to handle information in a way that confirm original ideas and beliefs rather than challenge them. Lean Startup can mitigate such a bias although it is critical to design the test as neutral as possible with all arguments and perspectives considered.

H2: Lean Startup has a positive influence on firm performance.

2.3 Lean Startup and servitization
Sjödin et al. (2020) investigated the process of digital servitization of manufacturing firms in order to address the digitalization paradox. This digitalization paradox means that greater revenues from digitalization fail to deliver greater profits due to increasing costs which describes the same problem as the servitization paradox. They propose the challenge to establish a "[…] five-phase agile co-creation process for developing digital services. An important characteristic is the iterative and agile way of working with micro-services to enable multiple short planning and execution cycles governed by customer and operational feedback and rapid change." (Sjödin et al., 2020, p. 484). The iterative and agile way of testing combined with the customer feedback indicate the similar dimensions between Lean Startup and servitization. As previously discussed, the aim of Lean Startup is to provide firms a method for business model testing including customer feedback or experimentation in order

to validate the business model before launching it (Chesbrough and Tucci, 2020; Eisenmann et al., 2012). Sjödin et al. (2020) go further and state that those micro-services are incremental investments that, through the iterative process including co-development with customers, minimizes risk and ideally progress to higher value generation as the process is repeated. From a Lean Startup Capability (Harms and Schwery, 2020) perspective these micro-services are comparable to the hypotheses in that both serve as a testing tool that improves after iteratively repeating the process and consequently provides greater value. In the study of Martinez et al. (2016) three distinct firms and their servitization journeys were investigated. The conclusion is that the servitization process is continuous, emergent and intuitive. One of the companies stresses the exploration phase in their journey which means to start with the customers. Harms and Schwery (2020) propose "customer insight" as the first dimension of Lean Startup Capability. Starting with customers and identifying their needs potentially helps firms to initiate servitization successfully from the start. In another of the three cases the co-development of services with customers is explicitly mentioned (Martinez et al. 2016). Similar to the study of Sjödin et al. (2020) the cases showed an incremental evolutionary development of services from basic to intermediate to complex services (Martinez et al., 2016).

According to Bocken and Snihur (2020) the co-development process is enabled by experimentation which should be done collectively by including various stakeholders. Next to co-development, different steps are included as well, for example the assessment of existing resources. A manager mentioned the possible frustration of going forward and backwards between the steps but highlights the learning factor by doing this (Martinez et al., 2016). Martinez et al (2016) explain that one reason for the intuitive and emergent characteristic of the servitization process is the companies' lack of excellence in this area compared to their core business and stresses the learning effect of these journeys, especially the trial and error aspect. Lean Startup could be a guidance here since it is based on the premise of iteration independently of a win or failure in the experimentation process because the learning effect holds and contributes towards finding a solution (Bocken and Snihur, 2020). This is in line with the service paradox phenomenon which holds that the organizational change is accompanied by negative performance implications in the beginning and positive after some time due to learning effects similar to the Lean Startup approach.

H3: Lean Startup negatively moderates the U-shaped servitization-performance relationship.
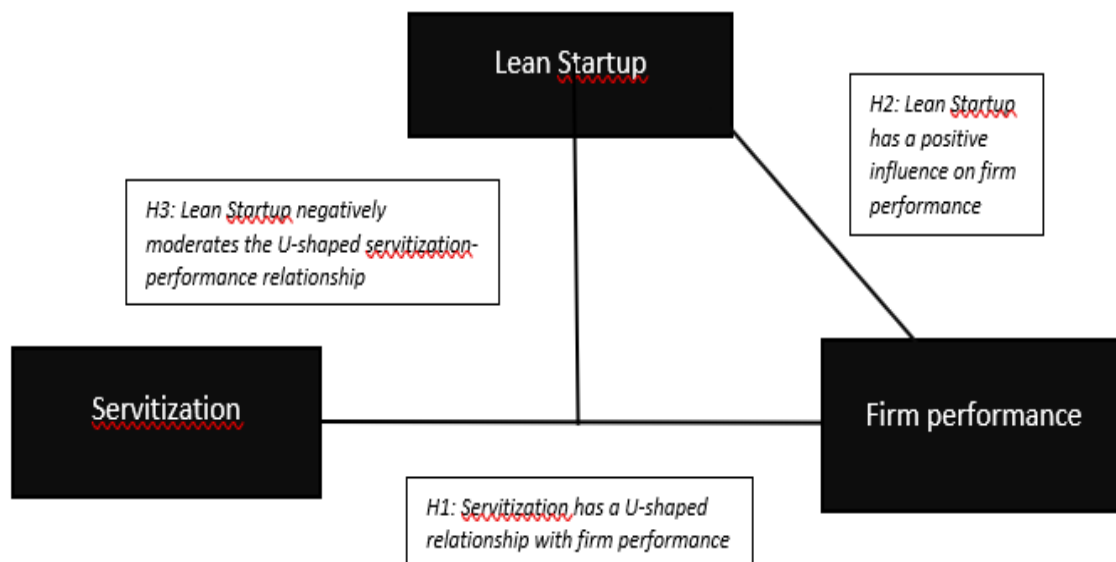
Figure 1: Theoretical model

3. METHODOLOGY
3.1 Research Design
In the following the methodology is outlined how this paper tries to answer the research question "To what extent does Lean Startup help manufacturing firms to overcome the service paradox?" The research setting consists of several dimensions. The aim of this paper is to study the moderating effect of Lean Startup on the servitization-performance relationships manufacturing firms. A web-based questionnaire was selected as the data gathering tool which employees of respective firms answered. The resulting type of data is quantitative. The decision

to use this tool was supported by the fact that the quick scalability realized the approaching of a large and geographically dispersed population in a short time and without high costs. The large population and thus the large group of respondents that filled in the questionnaire voluntarily contribute to the generalisability of the data (Lefever et al., 2007). Furthermore, this study followed the deductive way. A deductive research approach starts with a theory and progresses forward by formulating hypotheses, collecting and analysing data. The results of this will show if the hypotheses can be supported or not (Streefkerk, 2019).

3.2 Sample & Sampling process
The sampling process took place as follows. The target population is manufacturing firms that seem to be involved with

services. Manufacturing firms are the units of analysis since servitization deals with adding services to products. The professors from the University of Twente and Fontys University, student assistants from these universities and researchers themselves approached potential firms for the survey. The firms were selected from attendance lists of firm-specific events. We searched for contact information on the internet, especially the phone number. Before calling these firms, we searched on LinkedIn for employees that are able to give concise answers on these survey questions.

3.2.1 Descriptive statistics
Overall, 51 firms' representatives answered to the survey questions. After removing incomplete responses by employees, the sample size is 37. The descriptive statistics show some characteristics of data distribution (see table 1). The minimum value for a respondent per construct is above 3 for every construct except Lean Startup Capability. Here at least one respondent or firm indicates the lowest possible degree of Lean Startup Capability. For service orientation and firm performance, the maximum value is achieved at least once. The mean is lowest for Lean Startup Capability and highest for firm performance. The standard deviation is close to 1 for every construct. Lean Startup Capability has the only standard deviation above 1 with approximately 1.2.

Table 1: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ServiceOrientation	37	3.00	7.00	5.2601	.85360
LeanStartupCapability	37	1.00	6.17	4.7016	1.19648
FirmPerformance	37	3.70	8.00	6.0522	.96736
Valid N (listwise)	37				

3.3 Measures
The survey consisted of four distinct parts. Multiple-choice questions, percentage scales and 7-point Likert scales were most frequently used to measure the variables. Whereas the multiple-choice questions and the percentage scales were used to gain additional information like the employees' role or the employees' involvement in service development compared to goods development, the 7-point Likert scale was used to measure the concepts. The survey approximately took 15 minutes to complete. The service orientation concept was measured by adopting the approach of Kohtamaki et al. (2015). The dimensions of service orientation in (1) employees' behavior, (2) personnel recruitment, (3) personnel training and (4) personnel assessment were measured on 7-point Likert scales. The items to measure these dimensions were statements to which the respondents should indicate the degree of applicability, from 1: "Not at all applicable" to 7: "Very much applicable". Furthermore, Lean Startup was measured by the operationalization of Harms and Schwery (2020). Their Lean Startup concept "Lean Startup Capability" was measured by the same 7-point Likert scale as was the service orientation concept by indicating the degree of applicability towards statements that measure the dimensions of (1) iterative experimentation, (2) customer insight, (3) validation, (4) learning and (5) hypotheses testing. Firm performance is measured by the subjective measure of Kohtamaki et al. (2015). According to Dess and Robinson (1984) subjective performance measures are useful when it becomes problematic to gather objective performance data from firms. Especially multi-industry firms and privately-held firms

present obstacles towards obtaining objective and accurate performance data. Therefore, subjective performance measure is considered the next best alternative (Dess & Robinson, 1984). The six items that were measured are (1) sales level, (2) sales growth, (3) gross profit margin, (4) net profit from operations, (5) profit to sales ratio and (6) return on investment. A 7-point Likert scale was used again to first measure the importance of these items and then the respective satisfaction. The measures and items were formulated into statements mostly (see appendix table 5). Furthermore, this study investigated the effect of control variables on firm performance. One control variable was firm size. Firm size is said to have a positive relationship with financial performance due to a higher availability of resources and the resulting higher ability to be profitable despite the fixed costs (Atuahene-Gima & Murray, 2007). That is why this study was controlled for this effect. This firm size control variable was measured by asking the respondent about the number of employees using the full time equivalent (FTE) measure. The other control variable was customer heterogeneity. This variable is operationalized by asking how many customers the firm has. Usually, customer heterogeneity is not directly related to higher firm performance due to diverse expectations and higher costs to fulfil them. The effect of customer heterogeneity could also be different when firms achieve to integrate firm's know how with customer heterogeneity related knowledge (Wijekoon, 2020). That is why this study was controlled for this effect.

3.3.1 Validity
The validity of all 3 constructs, namely service orientation (Kohtamaki et al., 2015), Lean Startup Capability (Harms and Schwery, 2020) and the subjective firm performance measure by Kohtamaki et al. (2015) were investigated with the following results. The Kaiser-Meyer-Olkin (KMO) measure tells us if patterns of correlation between items is diffused or not which indicates the appropriateness of the sample size. We assume that the sample size is appropriately large for all concepts. For service orientation the KMO test had a good (Field, 2009) result of .708. The "Total variance explained" matrix shows that the two extracted factors, employee behavior and human resource management practices, together explain 73.180% of the variance. The pattern matrix reveals the individual factor loadings of the items after oblique rotation (see table 2). Rotation provides basis for discrimination between variables so that they load on only one factor. Oblique rotation was chosen since we can expect correlated factors due to data involving human responses and the nature of constructs (Field, 2009). The third human resource management item load quite evenly on both factors and was left out for further analysis. Then, the KMO decreased to .660, total variance explained by the two factors increased to 73.672% and no item has a high loading on both factors. Lean Startup Capability had a KMO of .645, which is considered mediocre (Field, 2009) but close to being a good value. The SPSS output indicated four extracted factors which together explain 81.761% of the variance. The first item for iterative experimentation and the fourth of customer insight loaded on two factors. When deleting both items, only three factors would be extracted and the resulting pattern matrix reveals that the hypotheses testing items load on more than one factor. I decided to delete the Customer Insight item, since this results in a higher KMO compared to leaving out the Iterative experimentation item. Still, the item not deleted loads on two factors, but that is preferable compared to losing one factor by deleting both items. The resulting KMO increased to .675 and total variance explained by the four extracted factors increased to 82.092%. For subjective firm performance by Kohtamaki et al. (2015) KMO was mediocre (.568). The Bartlett's test of

Table 2: Cronbach's alpha (CA) and Factor loadings (FL)

Service orientation

Service orientation in employee behavior (CA = .918)

Employees are aware of the importance of comprehensive, high-quality customer service and they act accordingly. (FL = .846)

Employees actively take on the role of problem solvers for customers. (FL = .930)

Customers' concerns are of high importance to employees. (FL = .866)

Employees have a distinctive service mentality. (FL = .886)

Employees are strongly engaged in solving customers' challenges. (FL = .830)

Service orientation in Personnel recruitment, training and assessment (CA = .764)

Newly recruited employees are required to have social competences for customer service. (FL = .961)

We examine newly recruited employees' social competences for customer service. (FL = .871)

Employee performance is recorded and evaluated systematically. (FL = .625)

Lean Startup Capability

Iterative experimentation (CA = .914)

The service project team views new service development as cycles of experiments, learning, and additional experiments. (FL = .478)

The service project team tries many different service solutions before the right one is identified. (FL = .805)

The service project team engages in many trial and error processes in service development before they have a complete understanding of the market and technology. (FL = .854)

The service project team repeats the process of testing until all key business model assumptions have been validated. (FL = -.632)

The service project team takes an experimental approach that relies on frequent trial and error to identify the right product/service solution. (FL = .894)

The service project team frequently designs and conducts experiments on elements of the business model. (FL = .816)

Customer Insight: (CA = .911)

It is important to gain deep market insight (= talking directly to customers) to better understand our customer's challenge. (FL = .788)

When developing the solution, the service project team always keeps the customer in mind. (FL = .721)

The service project team invests significant effort into understanding the challenge and learning about the user and its social context. (FL = .805)

Validation: (CA = .952)

The service project team uses metrics to measure the impact of service improvements on customer behaviour. (FL = .781)

The service project team uses data-driven tests to improve their human judgement in the decision making process. (FL = .910)

The service project team has metrics available to test the service acceptance by customers and sales performance. (FL = .819)

The service project team systematically analyzes their metrics. (FL = .980)

The service project team relies on data to assess and interpret metrics. (FL = .872)

Learning: (CA = .945)

The organization's ability to learn is considered essential to our competitive advantage. (FL = .877)

The basic values of our organization include learning as a key to improvement. (FL = .930)

Venture learning is an investment, not an expense. (FL = .812)

Learning in our organization is a key commodity necessary to guarantee organizational survival. (FL = .949)

The service project team is able to translate failure and mistakes into subsequent actions. (FL = .745)

Actions and decisions of the service project team are based on past experiences and results. (FL = .846)

Hypotheses testing: (CA = .946)

The service project team formulates a series of testable and falsifiable assumptions about the market needs and how to best deliver them. (FL = -.600)

The service project team translates the vision about the service and its value proposition into falsifiable assumptions. (FL = -.709)

The service project team explicitly formulates short and concise sentences reflecting expectations about the market needs and how to best deliver them. (FL = -.637)

The service project team formulates a series of assumptions that represent the expectations about relations between elements of market needs and how best to deliver them. (FL = -.770)

Firm performance

Sales performance (CA = .565)
Sales level (FL = .783)
Sales growth (FL = .822)

Profit performance (CA = .856)
Gross profit margin (FL = .911)
Net profit from operations (FL = .872)
Profit to sales ratio (FL = .695)
Return on investment (FL = .717)

sphericity indicates if the correlation is sufficiently large and if the result is significant, it means that the correlation matrix is significantly different from an identity matrix which has no clusters of correlations. For all three concepts we assume that correlations are appropriately large (.000).

3.3.2 Reliability

In order to test the reliability of the scales Cronbach's alpha was used (see table 2). Cronbach's alpha indicates the degree of homogeneity among several items. The higher Cronbach's alpha, the higher the homogeneity which means that the responses indicate that these items measure one underlying dimension or factor (Field, 2009). Generally, all scales had reliable scores (>7) except the sales performance scale extracted from firm performance. The reason for this could be the small number of items within this scale (2: sales level and sales growth). When using the performance measure as one scale the Cronbach's alpha is sufficient. Therefore, we proceed with both items.

3.4 Data analysis

The collected data was stored in a single database. Furthermore, regression analysis was applied on the research design. The statistical program SPSS was used to conduct multiple regression analysis on the data. This approach was suitable for this study since advantages of regression analysis are that it can show the severity of relationships between independent and dependent variables and effects of different independent variables on the dependent variable. Additionally, based on the regression model one can construct different scenarios and make predictions (Sarstedt & Mooi, 2014). Before conducting the multiple regression the data has to be checked.

3.4.1 Assumptions

The test of normality for the standardized residuals was done in SPSS using a histogram and the P-P plot plus the Shapiro-wilk test. Additionally, normality of the independent variables was tested by analysing the skewness and kurtosis of the distribution.

All three methods, the histogram, the probability plot and the Shapiro-wilk test indicate that the standardized residuals are normally distributed. In terms of skewness and kurtosis, service orientation and firm performance can be considered normally distributes since skewness and kurtosis are below 1, above -1 and not larger than twice the value of the respective standard error. However, Lean Startup Capability is not normally distributed since skewness and kurtosis have values outside the normality range and are larger than twice the standard error (see appendix table 6). Homoscedasticity was tested using a residual plot. This assumption is met since the dots are randomly distributed within the plot. A more random distribution is probably prevented by the small sample size. This means that at each level of one variable the variance of the other variable does not change (Field, 2009). Multicollinearity means that variables are strongly correlated. If variables are multicollinear it makes it difficult to identify the different effects of the variables in a multiple regression (Field, 2009). One measure to judge variables on collinearity is the variance inflation factor (VIF). Here, the VIF is 1.390 (<10) and therefore multicollinearity does not exist according to the variance inflation factor. Nevertheless, the correlation matrix (see table 3) indicates that service orientation and Lean Startup Capability are correlated and have to be treated with caution in the interpretation of the results.

3.4.2 Correlations

Pearson's correlation was used to compare the constructs since we assume normal distribution (see table 3). Correlation describes the interaction between two variables in terms of changes. If one variable changes, a highly correlated variable would change in a similar way (Field, 2009). Service orientation is correlated with Firm size to a moderate degree (.337). A cause for concern is the correlation between service orientation and Lean Startup Capability which is just high enough (>.5) to being considered strong (Field, 2009). This makes further analysis more difficult because it is harder now to define the separate effects of Service orientation and Lean Startup.

Table 3: Correlations between the independent and control variables

		Firm Size	Customer Heterogeneity	Service Orientation	Lean Startup Capability
Firm Size	Pearson Correlation	1	.254	.337*	.238
Customer Heterogeneity	Pearson Correlation	.254	1	.002	.224
Service Orientation	Pearson Correlation	.337*	.002	1	.502**
Lean Startup Capability	Pearson Correlation	.238	.224	.502**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

4. RESULTS

In table 4 the model investigating only the main effects (Model 1) and the full model (Model 2) are presented. The table shows that the quadratic term of service orientation is positive for the first model and the second model whereas the linear term is negative, also for the first model and the second model. Practically, when service orientation increases by 1, firm performance decreases by 1.087, whereas service orientation[2] lets firm performance increase by .115 per increase by one unit. The direction remains in the second model but the effects are stronger. This supports H_1 in the way that servitization, here

service orientation, has a u-shaped relationship with firm performance (see appendix figure 2). The negative linear effect indicates a negative effect of servitization on firm performance in the beginning. Nevertheless, the positive quadratic term provides basis for accepting H_1 because it increases as the servitization degree increases but rather slow compared to the initial negative linear effect. In contrast to the first model, the quadratic term is significant ($p < .05$) and the linear term too ($p < .1$) in the second model. Consequently, H_1 is accepted.

Model 1 and model 2 indicate that Lean Startup Capability has a positive linear effect on firm performance. The direction provides basis for supporting H_2. Looking

Table 4: Results of the multiple regression

Variables	Hypo theses	Model 1	Model 2
Intercept		6.553 (3.872)*	17.892 (7.195)**
Main Effects			
Service orientation	H_1	-1.087 (1.427)	-5.503 (2.727)*
Service orientation^2	H_1	.115 (.134)	.573 (.274)**
Lean Startup Capability	H_2	.415 (.249)	.258 (.262)
Moderating Effect			
Service orientation x Lean Startup Capability			.155 (1.619)
Service Orientation^2 x Lean Startup Capability	H_3		-.984 (1.592)
Control Variables			
Firm Size		-.000003 (.000)	-.000006 (.000)
Customer heterogeneity		-.000095 (.000)	-.000090 (.000)
R^2		.231	.323
Adjusted R^2		.099	.148
F-statistics		1.746	1.843

Dependent variable: Firm Performance

*$p < .1$

**$p < .05$.

***$p < .01$.

Notes: We report unstandardized coefficients with Standard Errors in brackets.

at the first model increasing Lean Startup Capability by one unit increases firm performance by .415 units. The effect is not very high and decreases in model 2 compared to model 1. The significance in model 2 (.334) and model 1 (.107) avoids acceptance of H_2 too. This means that this finding could happen by chance alone. Due to the non-normal distribution for Lean Startup Capability the t-value is no reliable source for statistical significance anyway.

Next to the main effects, model 2 exposes the moderating effect of Lean Startup Capability on the u-shaped servitization-firm performance relationship. As model 2 indicates the quadratic effect of Lean Startup Capability is negative compared to the positive linear effect. In other words, Lean Startup Capability negatively moderates the u-shaped servitization-firm performance relationship. The significance (.542), when Lean Startup Capability would have been normally distributed, prevents H_3 from acceptance, but the direction provides support for it.

The R^2 statistic tells us to what extent the variables included in the model explain the outcome variable. Model 2 (.323) has a higher R^2 than model 1 (.231). This means that the variables in model 2 explain the outcome variable, here firm performance, to a higher degree. This is not unexpected, since model 2 has more variables included. Nevertheless, model 2 explains 32.3% of the outcome variable and this tells us that the remaining 67.7% is attributable to other factors not investigated in this analysis. Some additional investigations were done by leaving out some relationships. See appendix tables 7 and 8.

5. DISCUSSION

Prior literature mostly suggests a positive impact of servitization on firm performance. Fang et al. (2008) contributes to this area with the finding that firms have to reach a "critical mass", that is

approximately 20%-30% of service sales until performance improvements are achieved due to servitization. This paper contributes to this since there is a u-shaped relationship in our sample. Wang et al. (2018) supports this finding too and argues that implementation issues like resources and investments are responsible for the service paradox. The reasons for a u-shaped relationship become more obvious when thinking of a learning curve. A firm initiates a new strategy and has to adapt several characteristics like structure, employee behavior, culture or the investments. Additionally, the intuitive and emergent nature of the servitization process can provide obstacles towards an instant firm performance improvement too (Johnstone et al., 2009). Unanticipated situations expose the lack of excellence and experience in terms of the new service-business model. It is easier when one puts him- herself in a situation in which something new is studied, learned or applied. As experience with the new circumstances accumulate performance usually improves at a progressive rate.

Furthermore, Fang et al. (2008) use a different servitization conceptualization than this paper does, namely service ratio. Nonetheless, this paper's finding supports their finding which strengthens the general view of the effect of servitization on firm performance. Whereas service ratio refers to the amount of revenue generated by services from the total revenue, service orientation refers to employee behavior and human resource management practices (Kohtamaki et al., 2015) which are not obvious figures as the revenue is. The relationship is the same. In terms of service orientation literature, Kohtamaki et al. (2015), Homburg et al. (2003) and Gebauer (2007) used service orientation as a mediating role instead of a conceptualization as the independent variable. Homburg et al. (2003) used two organisational soft factors, corporate culture and human resource management, which are identical to the service orientation dimensions. Furthermore, they argue that the importance of these

soft factors does not stem from instant profits but rather from the enhanced relationships to customers. All results suggest that service orientation is critical and positively influences the relationship between the servitization strategy and firm performance. Additionally, it is stressed that orientation towards services should be implemented throughout the whole firm. Kohtamaki et al. (2015) went beyond the servitization-performance analysis and found a positive impact of service offerings on service orientation. With this argumentation it seems appropriate to start with offering services and then continually develop service-oriented structures. This sequence accelerates the development of service orientation within the firm and improves firm performance more than using one of these servitization strategies alone. Service orientation is often used as a mediating role to enhance the performance of the servitization strategy. This research investigated the relationship with service orientation as the independent variable and therefore distinguishes itself in this regard from other research designs. We must admit that the operationalization is similar in terms of employee behavior and human resource management practices but compared to abovementioned authors parts of the cultural aspect, specifically corporate values, were excluded. The customer was an essential component in the survey items which we adopted from Kohtamaki et al. (2015). Nevertheless, the applicability is shown by proving the u-shaped servitization-performance relationship. Consequently, the customers play a very influential role in servitization and respective performance implications, especially conceptualized and operationalized according to service orientation literature. Visnic et al. (2016) found two prevalent service business models: the product-oriented business model and the customer-oriented business model. The product-oriented business model is preferred when firms aim to gain short-term benefits, whereas the customer-oriented business model has a positive linear effect on long-term knowledge and performance.

Customers are an important aspect in Lean Startup literature too. But in this research the statistics including the Lean Startup variable (H_2 and H_3) must be assessed with caution due to non-normal distribution which makes the p-value (significance) irrelevant. Still, the direction and magnitude can be assessed. Although there is a lack of profound academic literature on the process of shifting from a product-centric firm towards a service-centric firm some general attributes of the servitization process have been identified by different authors before. For example, servitization progresses in stages but still is emergent and intuitive within these stages and that service capabilities improve so that firms progress from basic to more advanced services (Olivia and Kallenberg, 2003; Baines et al., 2019; Martinez et al., 2016). The emphasis on customers plus these process attributes suggest a good fit between initiating servitization strategy and using Lean Startup for strategy implementation. Although H_2 is rejected Lean Startup has a positive linear effect on firm performance. This finding is in line with the finding by Harms and Schwery (2020) although their finding is significant. Next to that, it is important to mention that the context of their study is different since their population are technology-based startups from Berlin. Expectation is higher to have a result that indicates a positive and significant impact of Lean Startup on firm performance in a context like this. The underlying purpose of the Lean Startup approach is specifically aimed at startups validating a business model before entering the market. The goal is to avoid costly failures that customer rejection towards the new business model would create (Chesbrough and Tucci, 2020). Although we find no significant effect of Lean Startup on firm performance, the effect is linear positive and indicates that Lean Startup is generally improving firm performance in this sample.

Furthermore, Chesbrough and Tucci (2020) argue that Lean Startup is derived from practices explicitly for startups to validate future business models. The distinction is made between business model design for startups and business model reconfiguration for existing firms which create different challenges that managers should consider. In other words, the rationale for using these practices is different and therefore they are not applicable according to Chesbrough and Tucci (2020). After this research we can add that these practices originally established for startups do impact firm performance for existing firms too. Although we conceptualized Lean Startup and operationalized the items according to Harms and Schwery (2020), who did their research for software startups in Berlin, Lean Startup practices seem to have a positive impact on firm performance for large and existing firms, at least in this sample, too. One could argue for Lean Startup to be a tool for reducing uncertainty. The uncertainties for startups are arguably higher and more critical than for existing firms but generally Lean Startup and the iterative process provides insights and reduces uncertainty. This can be connected to Visnic et al. (2016) who argue that for a customer-centric business model a high R&D intensity is required. Therefore, less wrong decisions will happen and performance will not decrease due to wrong decisions. In other words, firm performance will improve.

Additionally, this research adds to existing literature the findings of H_3 which investigates the moderating effect of Lean Startup on the u-shaped servitization-performance relationship. We can support this hypothesis because the interaction term negatively moderates this relationship. Although the result is not significant, which means that it could result by chance alone, this sample benefits from Lean Startup. In other words, in this sample there is reason to assume that the higher the degree of Lean Startup within a firm that has some degree of servitization, the less deep the u-shaped relationship will be. Performance improvements due to servitization will be achieved earlier since the services gain a higher acceptance once offered.

Previous literature acknowledged that customer co-creation is important for the service business model to work. A business model that is adjusted towards servitization puts the customer more in the centre since the focus shifts from transactions to relationships between firms and customers (Martinez et al., 2016). One could argue that the service business model increases attractiveness of firms towards customers and Lean Startup increases acceptance. The higher attractiveness mirrors in the improved firm performance, especially the focus on customer relationships and resulting more individual relationships between firms and customers. Following this line of reasoning, the higher the servitization maturity the higher the sophistication and complexity of services and therefore the more individual the relationship between firms and customers. That is why it is worth mentioning the positive impact of servitization on non-financial performance aspects like increased customer loyalty (Wang et al., 2018) because these aspects are strongly affected by creating more complex services. This is based on the invisible nature of services that requires a higher amount of interaction and trust (Fang et al., 2008). Lean Startup strengthens this as a co-development implementation tool that is based on increasing customers' acceptance. Combining both concepts arguably create synergistic effects that improves firm performance even more than the sum of both concepts separately. This assumption is based on the fact that both, servitization and Lean Startup, are focusing on creating customer value by co-development with customers. Both service orientation dimensions employee behavior and human resource management, and in general service delivery, are established around the aim to satisfy the customers that need or wish services. For Lean Startup, here

conceptualized as Lean Startup Capability, the customer insight dimension specifically contributes to servitization outcomes by gaining more information about customers. Generally, the process of Lean Startup contributes to the servitization strategy in that it raises awareness among the employees about what customers needs. This, in turn, improves the service orientation dimensions because customer needs are clearer. Recruitment, training and assessment can be adjusted with the new insights and employee behavior improves accordingly. This means that newly recruited employees are showing higher service-oriented behavior in the first place. Additionally, existing employees become more service-oriented due to the continuously generated new customer insights.

5.1 Contributions

Firstly, this paper contributes to existing literature that assumes a u-shaped relationship between servitization and firm performance. This sample provides ground to support the u-shaped servitization-firm performance relationship. Additionally, Lean Startup, separate from servitization, has a positive impact on firm performance and remains a promising approach to enhance firm performance by co-creating with customers. In terms of the interaction with servitization, this research finds arguments for Lean Startup influencing the servitization outcome. Referring to the literature gap identified in the introduction Lean Startup can be a tool for firms to structure the servitization process and mitigate performance sacrifices after servitization initiation. In other words, it negatively moderates the u-shaped servitization-firm performance relationship. The assumption that Lean Startup fits to the servitization process as an implementation tool becomes more mature after this research. Practically, managers could think of a separate business unit that conducts the iterative Lean Startup process. Depending on industry characteristics and respective market turbulence the process is conducted more frequent. Generally, Lean Startup should be done continuously to get the highest impact on servitization and performance. In this way, the business unit would support the customer service or, if it exists, the service department. Depending on firm size the customer service itself conducts Lean Startup practices. This is preferable as long as customer service employees are available for that. That is because they are already skilled in customer interactions and have accumulated experiences that could lead to more promising Lean Startup effects early on.

5.2 Limitations

This paper contributions towards existing literature must be acknowledged with caution. Firstly, the sample size is very small and barely sufficiently large to generalize data on the wider population. Connected to that, the small sample size decreases the chance of a valid and reliable dataset. One aspect to mention here is the different degree of servitization between the sample firms which gap can be as large as between a non-servitized firm and a firm only providing services. The non-normal distribution of Lean Startup (skewness and kurtosis) prevents this research from assuming statistical significance regarding this variable. Nevertheless, the direction and magnitude of the regression outcomes supports H_2 and H_3 whereas these results are not statistically significant anyway. Furthermore, although multicollinearity in terms of the variance inflation factor does not exist, according to the correlations table service orientation and Lean Startup are significantly and strongly correlated (.502). This finding makes it more difficult to divide the effects of both variables on firm performance. Secondly, the measures of service orientation and Lean Startup Capability are specific compared to firm performance. Although performance is also divided in separate measures it is investigated by the subjective perceptions of the firm respondents. The R^2 statistic indicates that 67.7% of firm performance is explained by other factors outside our investigated variables. Next to the R^2 measure, these subjective perceptions provide basis for the assumption that there are more factors contributing to performance that are out of the scope of the respondents. Thirdly, this research mainly investigated firms in the Netherlands and some from the UK and Iceland. Firms outside these countries could produce different results. Fourth, this research took place within a set time frame. The time frame at itself and the data collection delay within this frame limited the research scope and the exploration of further potential factors explaining the firm performance.

5.3 Recommendations for future research

Several findings in this study are promising but not generalisable. Even if all hypotheses could be proved, it is preferable to extend such a research into more regions for validation. Additionally, the sample size could be larger for respective conclusions about the population and in general a more robust research. Another alternative could be non-parametric tests which do not rely on normality assumptions. Lean Startup, although not being significant in this research and not normally distributed creates the expected impact on firm performance in this sample. An extension of this research into a larger research with more respondents seems worthwhile in order to generalise findings regarding the moderating effect of Lean Startup on the servitization-firm performance relationship. Connected to that, a research setting in which objective firm performance measures are attainable provides more accurate and objective data and improves generalisability.

6. CONCLUSION

This research investigated Lean Startups appropriateness as the servitization process and the impact on firm performance. Coming back to the research question "To what extent does Lean Startup help manufacturing firms to overcome the service paradox?" this research indicates that Lean Startup helps manufacturing firms. First aspect to mention is that the u-shaped relationship exists in this sample. Furthermore, substance exists that Lean Startup has (1) a positive impact on firm performance and (2) a negative moderation on the u-shaped relationship between servitization and firm performance. A more promising answer to this research question is not possible due to the lack of statistical significance in the regression that is also depending on the sample. Nevertheless, this research shows the promising interaction of servitization and Lean Startup by reviewing both literature streams and the regression results that showed the expected effects although not significant.

7. ACKNOWLEDGEMENTS

8. REFERENCES

Abou-foul, M., Ruiz-Alba, J. L., & Soares, A. (2020). The impact of digitalization and servitization on the financial performance of a firm: an empirical analysis. *Production Planning & Control*, 1-15. https://doi.org/10.1080/09537287.2020.1780508

Atuahene-Gima, K., & Murray, J. Y. (2007). Exploratory and Exploitative Learning in New Product Development: A Social Capital Perspective on New Technology Ventures in China. *Journal of International Marketing*, *15*(2), 1-29. http://www.jstor.org/stable/25049081

Autio, E., Nambisan, S., & Thomas, L. (2017). Digital Affordances, Spatial Affordances, and The Genesis of Entrepreneurial Ecosystems. *Strategic Entrepreneurship Journal*, *12*. https://doi.org/10.1002/sej.1266

Baines, T., Ziaee Bigdeli, A., Bustinza, O., Shi, V., Baldwin, J., & Ridgway, K. (2017). Servitization: Revisiting the State-of-the-art and Research Priorities. *International Journal of Operations & Production Management*, *37*, 256-278. https://doi.org/10.1108/IJOPM-06-2015-0312

Baines, T., Ziaee Bigdeli, A., Sousa, R., & Schroeder, A. (2019). Framing the servitization transformation process: A model to understand and facilitate the servitization journey. *International Journal of Production Economics*, *221*. https://doi.org/10.1016/j.ijpe.2019.07.036

Berends, H., Smits, A., Reymen, I., & Podoynitsyna, K. (2016). Learning while (re-)configuring: Business model innovation processes in established firms. *Strategic Organization*, *14*, 1-39. https://doi.org/10.1177/1476127016632758

Blank, S. (2013). Why the lean start-up changes everything. *Harvard Business Review*, *91*, 63-72.

Bocken, N., & Snihur, Y. (2020). Lean Startup and the business model: Experimenting for novelty and impact. *Long Range Planning*, *53*(4), 101953. https://doi.org/https://doi.org/10.1016/j.lrp.2019.101953

Bojovic, N., Sabatier, V., & Coblence, E. (2019). Becoming through doing: How experimental spaces enable organizational identity work. *Strategic Organization*, *18*(1), 20-49. https://doi.org/10.1177/1476127019864673

Breidbach, C., & Maglio, P. (2016). Technology-enabled value co-creation: An empirical analysis of actors, resources, and practices. *Industrial Marketing Management*, *56*. https://doi.org/10.1016/j.indmarman.2016.03.011

Chesbrough, H., & Tucci, C. (2020). The Interplay Between Open Innovation and Lean Startup, or, Why Large Companies Are Not Large Versions of Startups. *Strategic Management Review*, *1*, 277-303. https://doi.org/10.1561/111.00000013

Desmet, S., Dierdonck, R., & Looy, B. (2003). Servitization: Or why services management is relevant for manufacturing environments. *Services Management: An Integrated Approach*, 40-51.

Dess, G. G., & Robinson, R. B. (1984). Measuring organizational performance in the absence of objective measures: The case of the privately-held firm and conglomerate business unit. *Strategic Management Journal*, *5*(3), 265-273. https://EconPapers.repec.org/RePEc:bla:stratm:v:5:y:1984:i:3:p:265-273

Eisenmann, T., Ries, E., & Dillard, S. (2012). Hypothesis-Driven Entrepreneurship: The Lean Startup. *Harvard Bus. Entrepeneurial Manage. Case No. 812-095*.

Fang, E., Palmatier, R. W., & Steenkamp, J.-B. E. M. (2008). Effect of Service Transition Strategies on Firm Value. *Journal of Marketing*, *72*(5), 1-14. https://doi.org/10.1509/jmkg.72.5.001

Feng, C., Jiang, L., Ma, R., & Bai, C. (2021). Servitization strategy, manufacturing organizations and firm performance: a theoretical framework. *Journal of Business & Industrial Marketing*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/JBIM-04-2020-0184

Field, A. (2009). *Discovering Statistics Using SPSS*. SAGE Publications. https://books.google.de/books?id=a6FLF1YOqtsC

Gebauer, H. (2007). An Investigation of Antecedents for the Development of Customer Support Services in Manufacturing Companies. *Journal of Business-to-Business Marketing*, *14*(3), 59-96. https://doi.org/10.1300/J033v14n03_03

Gebauer, H., Fleisch, E., & Friedli, T. (2005). Overcoming the Service Paradox in Manufacturing Companies. *European Management Journal*, *23*(1), 14-26. https://doi.org/https://doi.org/10.1016/j.emj.2004.12.006

Harms, R., & Schwery, M. (2020). Lean Startup: Operationalizing Lean Startup Capability and testing its performance implications. *Journal of Small Business Management*, *58*(1), 200-223. https://doi.org/10.1080/00472778.2019.1659677

Homburg, C., Fassnacht, M., & Guenther, C. (2003). The Role of Soft Factors in Implementing a Service-Oriented Strategy in Industrial Marketing Companies. *Journal of Business-to-Business Marketing*, *10*(2), 23-51. https://doi.org/10.1300/J033v10n02_03

Johnstone, S., Dainty, A., & Wilkinson, A. (2009). Integrating products and services through life: An aerospace experience. *International Journal of Operations and Production Management*, *29*. https://doi.org/10.1108/01443570910953612

Kohtamaki, M., Hakala, H., Partanen, J., Parida, V., & Wincent, J. (2015). The performance impact of industrial services and service orientation on manufacturing companies. *Journal of Service Theory and Practice*, *25*(4), 463-485. https://doi.org/10.1108/JSTP-12-2013-0288

Lefever, S., Dal, M., & Matthíasdóttir, Á. (2007). Online data collection in academic research: advantages and limitations. *British Journal of Educational Technology*, *38*(4), 574-582. https://doi.org/https://doi.org/10.1111/j.1467-8535.2006.00638.x

Martinez, V., Neely, A., Velu, C., Leinster-Evans, S., & Bisessar, D. (2016). Exploring the Journey to Services. *International Journal of Production Economics*, *192*. https://doi.org/10.1016/j.ijpe.2016.12.030

Neely, A. (2008). Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, *1*, 103-118.

Oliva, R., & Kallenberg, R. (2003). Managing the Transition from Products to Services. *International Journal of Service Industry Management*, *14*, 160-172. https://doi.org/10.1108/09564230310474138

Sarstedt, M., & Mooi, E. (2014). *A Concise Guide to Market Research*. https://doi.org/10.1007/978-3-642-53965-7

Sjödin, D., Parida, V., Kohtamäki, M., & Wincent, J. (2020). An agile co-creation process for digital servitization: A micro-service innovation approach. *Journal of Business Research*, *112*. https://doi.org/10.1016/j.jbusres.2020.01.009

Streefkerk, R. (2019). *Inductive vs. deductive reasoning*. Retrieved May 14, 2021 from https://www.scribbr.com/methodology/inductive-deductive-reasoning/

Vandermerwe, S., & Rada, J. (1988). Servitization of business: Adding value by adding services. *European Management Journal*, *6*(4), 314-324. https://doi.org/https://doi.org/10.1016/0263-2373(88)90033-3

Visnjic, I., Wiengarten, F., & Neely, A. (2016). Only the Brave: Product Innovation, Service Business Model Innovation, and Their Impact on Performance. *Journal of Product Innovation Management*, *33*(1), 36-52. https://doi.org/https://doi.org/10.1111/jpim.12254

Wang, W., Lai, K.-H., & Shou, Y. (2018). The impact of servitization on firm performance: a meta-analysis. *International Journal of Operations & Production Management*, *38*(7), 1562-1588. https://doi.org/10.1108/IJOPM-04-2017-0204

Weissbrod, I., & Bocken, N. M. P. (2017). Developing sustainable business experimentation capability – A case study. *Journal of Cleaner Production*, *142*, 2663-2676. https://doi.org/https://doi.org/10.1016/j.jclepro.2016.11.009

Wijekoon, W. M. A. K. (2020). *Exploring the role of customer heterogeneity in innovation-based competitive strategy: A dynamic capabilities perspective* Queensland University of Technology].

Zuzul, T., & Tripsas, M. (2019). Start-up Inertia versus Flexibility: The Role of Founder Identity in a Nascent Industry. *Administrative Science Quarterly*, *65*(2), 395-433. https://doi.org/10.1177/0001839219843486

9. APPENDIX

9.1 Operationalization table

Table 5: Operationalization of the concepts

Concept	Definition	Operationalization
Servitization (service orientation)	Servitization: Servitization, in the very nature, is about adding appropriate services to products in order to complement the product (Vandermere and Rada, 1988; Neely, 2008). Service orientation: Service orientation describes the service providers' commitment towards understanding customer's processes and adjust	7-point Likert scale on "To which extent do the statements below apply to the firm?" with the values 1="Not at all applicable", 2="Not applicable", 3="Slightly not applicable", 4="Neutral", 5="Slightly applicable", 6="Applicable", 7="Very much applicable"on following items: *Employee behavior*: 1. Employees are aware of the importance of comprehensive, high-quality customer service and they act accordingly. 2. Employees actively take on the role of problem solvers for customers. 3. Customers' concerns are of high importance to employees. 4. Employees have a distinctive service mentality. 5. Employees are strongly engaged in solving customers' challenges.

	organizational structures respectively (Kohtamaki et al., 2015)	*Personnel recruitment*: Newly recruited employees are required to have social competences for customer service. We examine newly recruited employees' social competences for customer service. *Personnel training*: Newly recruited employees are trained carefully for interactions with customers. *Personnel assessment:* Employee performance is recorded and evaluated systematically.
Lean Startup Capability	Lean Startup: Lean Startup is specifically aimed at startups validating their future business model and avoid any kind of waste (Chesbrough and Tucci, 2020). Lean Startup Capability: Lean Startup Capability is defined as a bundle of activities that firms perform iteratively when exploring potential business models (Harms and Schwery, 2020).	7-point Likert scale on "To which extent do the statements below apply to the service project team(s) (i.e., team or unit within the organization responsible for developing or innovating services)." With the values 1="Not at all applicable", 2="Not applicable", 3="Slightly not applicable", 4="Neutral", 5="Slightly applicable", 6="Applicable", 7="Very much applicable": *Iterative Experimentation*: 1. The service project team views new service development as cycles of experiments, learning, and additional experiments. 2. The service project team tries many different service solutions before the right one is identified. 3. The service project team engages in many trial and error processes in service development before they have a complete understanding of the market and technology. 4. The service project team repeats the process of testing until all key business model assumptions have been validated. 5. The service project team takes an experimental approach that relies on frequent trial and error to identify the right product/service solution. 6. The service project team frequently designs and conducts experiments on elements of the business model. *Customer Insight:* 1. It is important to gain deep market insight (= talking directly to customers) to better understand our customer's challenge. 2. When developing the solution, the service project team always keeps the customer in mind. 3. The service project team invests significant effort into understanding the challenge and learning about the user and its social context. 4. It is important to gain deep market insight into how the solution resolves the customer's challenge. *Validation:* 1. The service project team uses metrics to measure the impact of service improvements on customer behaviour. 2. The service project team uses data-driven tests to improve their human judgement in the decision making process. 3. The service project team has metrics available to test the service acceptance by customers and sales performance. 4. The service project team systematically 14 nalyses their metrics. 5. The service project team relies on data to assess and interpret metrics. *Learning:* 1. The organization's ability to learn is considered essential to our competitive advantage. 2. The basic values of our organization include learning as a key to improvement. 3. Venture learning is an investment, not an expense.

		4. Learning in our organization is a key commodity necessary to guarantee organizational survival.
		5. The service project team is able to translate failure and mistakes into subsequent actions.
		6. Actions and decisions of the service project team are based on past experiences and results.
		Hypotheses testing:
		1. The service project team formulates a series of testable and falsifiable assumptions about the market needs and how to best deliver them.
		2. The service project team translates the vision about the service and its value proposition into falsifiable assumptions.
		3. The service project team explicitly formulates short and concise sentences reflecting expectations about the market needs and how to best deliver them.
		4. The service project team formulates a series of assumptions that represent the expectations about relations between elements of market needs and how best to deliver them.
Firm performance	In this research firm performance is about financial measures that determine specific sales and profit performances.	7-point Likert scale on "How important do you consider the following measures to assess firm performance?" with the values 1="Very unimportant", 2="Unimportant", 3="Slightly unimportant", 4=" Neutral", 5="Slightly important", 6="Important", 7="Very important" on following items:
		1: Sales level
		2: Sales growth
		3: Gross profit margin
		4: Net profit from operations
		5: Profit to sales ratio
		6: Return on investment
		7-point Likert scale on "How satisfied are you with your firm's performance in terms of the following measures?" with the values 1=" Not satisfied at all", 2=" Not satisfied", 3=" Slightly not satisfied", 4=" Neutral", 5=" Slightly satisfied", 6=" Satisfied", 7=" Very satisfied" on following items:
		1: Sales level
		2: Sales growth
		3: Gross profit margin
		4: Net profit from operations
		5: Profit to sales ratio
		6: Return on investment

9.2 Additional tables and figures

Table 6: Skewness and kurtosis

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
ServiceOrientation	37	.166	.388	.842	.759
LeanStartupCapability	37	-1.571	.388	3.254	.759
FirmPerformance	37	-.440	.388	-.072	.759
Valid N (listwise)	37				

Figure 2: U-shaped servitization-firm performance relationship
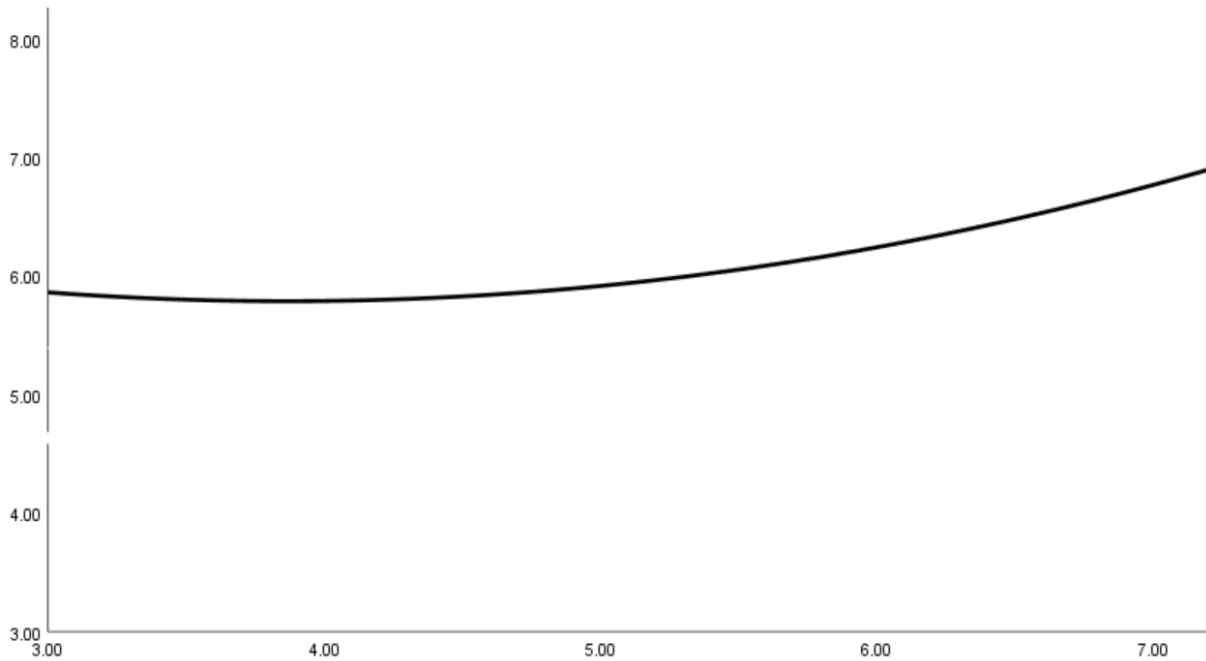
(Y-axis: firm performance; X-axis: service orientation)

Table 7: Multiple regression without the linear moderator

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.553	3.827		1.712	.097
	FirmSize	-3.353E-6	.000	-.061	-.338	.738
	CustomerHeterogeneity	-9.511E-5	.000	-.248	-1.412	.169
	ServiceOrientation	-1.087	1.427	-.988	-.762	.452
	ServiceOrientationSquared	.115	.134	1.119	.858	.398
	LeanStartupCapability	.415	.249	.354	1.664	.107
2	(Constant)	18.026	6.932		2.600	.015
	FirmSize	-6.132E-6	.000	-.112	-.640	.527
	CustomerHeterogeneity	-8.828E-5	.000	-.230	-1.370	.181
	ServiceOrientation	-5.534	2.659	-5.031	-2.081	.047
	ServiceOrientationSquared	.575	.268	5.601	2.140	.041
	LeanStartupCapability	.253	.252	.216	1.003	.325
	SOsquaredxLSC	-.837	.430	-.712	-1.948	.062

a. Dependent Variable: FirmPerformance

Table 8: Multiple regression without Lean Startup Capability and the linear moderator

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	7.591	3.885		1.954	.060
	CustomerHeterogeneity	-6.506E-5	.000	-.170	-.974	.338
	FirmSize	-3.213E-6	.000	-.059	-.315	.755
	ServiceOrientation	-.959	1.467	-.872	-.654	.518
	ServiceOrientationSquared	.125	.138	1.215	.906	.372
2	(Constant)	20.538	6.464		3.177	.004
	CustomerHeterogeneity	-7.080E-5	.000	-.185	-1.142	.263
	FirmSize	-6.528E-6	.000	-.119	-.682	.501
	ServiceOrientation	-6.220	2.570	-5.654	-2.420	.022
	ServiceOrientationSquared	.658	.255	6.414	2.578	.015
	SOsquaredxLSC	-.979	.406	-.833	-2.413	.022

a. Dependent Variable: FirmPerformance

9.3 SPSS Syntax

Syntax for descriptive statistics and skewness and kurtosis

```
DESCRIPTIVES VARIABLES=ServiceOrientation LeanStartupCapability FirmPerformance
 /STATISTICS=KURTOSIS SKEWNESS.

DESCRIPTIVES VARIABLES=ServiceOrientation LeanStartupCapability FirmPerformance
 /STATISTICS=MEAN STDDEV MIN MAX.
```

Syntax for correlations between control and independent variables

```
CORRELATIONS
 /VARIABLES=FirmSize CustomerHeterogeneity ServiceOrientation LeanStartupCapability
 /PRINT=TWOTAIL NOSIG
 /MISSING=PAIRWISE.
```

Syntax for factor analysis firm performance

```
FACTOR
 /VARIABLES SalesLvl_IMP SalesGrowth_IMP GPM_IMP NPO_IMP PTS_IMP ROI_IMP SalesLvl_SAT
   SalesGrowth_SAT GPM_SAT NPO_SAT PTS_SAT ROI_SAT
 /MISSING LISTWISE
 /ANALYSIS SalesLvl_IMP SalesGrowth_IMP GPM_IMP NPO_IMP PTS_IMP ROI_IMP SalesLvl_SAT
   SalesGrowth_SAT GPM_SAT NPO_SAT PTS_SAT ROI_SAT
 /PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION
 /PLOT EIGEN ROTATION
 /CRITERIA MINEIGEN(1) ITERATE(25)
 /EXTRACTION PC
 /CRITERIA ITERATE(25) DELTA(0)
 /ROTATION OBLIMIN
 /METHOD=CORRELATION.
```

Syntax for factor analysis Lean Startup Capability

```
FACTOR
 /VARIABLES LSC_IE_1 LSC_IE_2 LSC_IE_3 LSC_IE_4 LSC_IE_5 LSC_IE_6 LSC_CI_1 LSC_CI_2 LSC_CI_3
   LSC_CI_4 LSC_V_1 LSC_V_2 LSC_V_3 LSC_V_4 LSC_V_5 LSC_L_1 LSC_L_2 LSC_L_3 LSC_L_4 LSC_L_5 LSC_L_6
   LSC_HT_1 LSC_HT_2 LSC_HT_3 LSC_HT_4
 /MISSING LISTWISE
 /ANALYSIS LSC_IE_1 LSC_IE_2 LSC_IE_3 LSC_IE_4 LSC_IE_5 LSC_IE_6 LSC_CI_1 LSC_CI_2 LSC_CI_3
   LSC_CI_4 LSC_V_1 LSC_V_2 LSC_V_3 LSC_V_4 LSC_V_5 LSC_L_1 LSC_L_2 LSC_L_3 LSC_L_4 LSC_L_5 LSC_L_6
   LSC_HT_1 LSC_HT_2 LSC_HT_3 LSC_HT_4
 /PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION
 /PLOT EIGEN ROTATION
 /CRITERIA MINEIGEN(1) ITERATE(25)
 /EXTRACTION PC
 /CRITERIA ITERATE(25) DELTA(0)
 /ROTATION OBLIMIN
 /METHOD=CORRELATION.
```

Syntax for factor analysis service orientation

```
FACTOR
 /VARIABLES SO_EB_1 SO_EB_2 SO_EB_3 SO_EB_4 SO_EB_5 SO_HRM_1 SO_HRM_2 SO_HRM_3 SO_HRM_4
 /MISSING LISTWISE
 /ANALYSIS SO_EB_1 SO_EB_2 SO_EB_3 SO_EB_4 SO_EB_5 SO_HRM_1 SO_HRM_2 SO_HRM_3 SO_HRM_4
 /PRINT INITIAL CORRELATION SIG DET KMO EXTRACTION ROTATION
 /PLOT EIGEN ROTATION
 /CRITERIA MINEIGEN(1) ITERATE(25)
 /EXTRACTION PC
 /CRITERIA ITERATE(25) DELTA(0)
 /ROTATION OBLIMIN
 /METHOD=CORRELATION.
```

Syntax for Cronbach's alpha of firm performance

```
RELIABILITY
 /VARIABLES=SalesLvl_IMP SalesGrowth_IMP GPM_IMP NPO_IMP PTS_IMP ROI_IMP
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE CORR
 /SUMMARY=TOTAL.
```

Syntax for Cronbach's alpha of service orientation

```
RELIABILITY
 /VARIABLES=SO_EB_1 SO_EB_2 SO_EB_3 SO_EB_4 SO_EB_5
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE
 /SUMMARY=TOTAL.

RELIABILITY
 /VARIABLES=SO_HRM_1 SO_HRM_2 SO_HRM_4
 /SCALE('ALL VARIABLES') ALL
 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE
 /SUMMARY=TOTAL.
```

Syntax for Cronbach's alpha for Lean Startup Capability

```
RELIABILITY
  /VARIABLES=LSC_IE_1 LSC_IE_2 LSC_IE_3 LSC_IE_4 LSC_IE_5 LSC_IE_6
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE
  /SUMMARY=TOTAL.

RELIABILITY
  /VARIABLES=LSC_CI_1 LSC_CI_2 LSC_CI_3
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE
  /SUMMARY=TOTAL.

RELIABILITY
  /VARIABLES=LSC_V_1 LSC_V_2 LSC_V_3 LSC_V_4 LSC_V_5
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE
  /SUMMARY=TOTAL.

RELIABILITY
  /VARIABLES=LSC_L_1 LSC_L_2 LSC_L_3 LSC_L_4 LSC_L_5 LSC_L_6
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE
  /SUMMARY=TOTAL.

RELIABILITY
  /VARIABLES=LSC_HT_1 LSC_HT_2 LSC_HT_3 LSC_HT_4
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE
  /SUMMARY=TOTAL.
```

Syntax for firm performance computation

```
COMPUTE FirmPerformance=SalesLvl_SAT * (SalesLvl_IMP / (SalesLvl_IMP + SalesGrowth_IMP + GPM_IMP + NPO_IMP +
    PTS_IMP + ROI_IMP)) + SalesGrowth_SAT * (SalesGrowth_IMP / (SalesLvl_IMP + SalesGrowth_IMP +
    GPM_IMP + NPO_IMP + PTS_IMP + ROI_IMP)) + GPM_SAT * (GPM_IMP / (SalesLvl_IMP + SalesGrowth_IMP +
    GPM_IMP + NPO_IMP + PTS_IMP + ROI_IMP)) + NPO_SAT * (NPO_IMP / (SalesLvl_IMP + SalesGrowth_IMP +
    GPM_IMP + NPO_IMP + PTS_IMP + ROI_IMP)) + PTS_SAT * (PTS_IMP / (SalesLvl_IMP + SalesGrowth_IMP +
    GPM_IMP + NPO_IMP + PTS_IMP + ROI_IMP)) + ROI_SAT * (ROI_IMP / (SalesLvl_IMP + SalesGrowth_IMP +
    GPM_IMP + NPO_IMP + PTS_IMP + ROI_IMP)).
EXECUTE.
```

Syntax for assumption testing

```
REGRESSION
 /MISSING LISTWISE
 /STATISTICS COEFF OUTS R ANOVA
 /CRITERIA=PIN(.05) POUT(.10)
 /NOORIGIN
 /DEPENDENT FirmPerformance
 /METHOD=ENTER ServiceOrientation LeanStartupCapability
 /SAVE ZPRED ZRESID.
```

```
REGRESSION
 /MISSING LISTWISE
 /STATISTICS COEFF OUTS R ANOVA
 /CRITERIA=PIN(.05) POUT(.10)
 /NOORIGIN
 /DEPENDENT FirmPerformance
 /METHOD=ENTER ServiceOrientation LeanStartupCapability
 /SCATTERPLOT=(*ZRESID ,*ZPRED)
 /RESIDUALS HISTOGRAM(ZRESID) NORMPROB(ZRESID).
```

Syntax for the multiple regression

```
REGRESSION
 /DESCRIPTIVES MEAN STDDEV CORR SIG N
 /MISSING LISTWISE
 /STATISTICS COEFF OUTS R ANOVA CHANGE ZPP
 /CRITERIA=PIN(.05) POUT(.10)
 /NOORIGIN
 /DEPENDENT FirmPerformance
 /METHOD=ENTER FirmSize CustomerHeterogeneity ServiceOrientation ServiceOrientationSquared
   LeanStartupCapability
 /METHOD=ENTER SOxLSC SOsquaredxLSC
 /SCATTERPLOT=(*ZRESID ,*ZPRED).
```