Can lean startup be the key to servitization success?

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ABSTRACT,

Over the past decades an emergent approach to business has became a very interesting topic. This approach is servitization which showed clear signs in previous research on firm performance. However, it comes with a significant downturn to it which is that firms who apply it experience a dip in their profitability. That is until between 20-30% of their customers adapt their offered services. Our research used lean startup which has shown clear efficacy on other similar emergent models to see if it could be the key to solving the profitability dip. Our paper found statistically significant results that lean startup improves the firm performance of servitized models. The paper also found that there is a U-shaped relationship between servitization and firm performance. Finally this paper found signs that lean startup negatively moderates the U-shaped relationship between servitization and firm performance. Within this paper we investigate the key aspects of lean startup that could be key to servitization success. We also discuss why we expect lean startup to show efficacy when combines with servitization. This paper could have significant implications that are starting to build their business model since it could be the answer to the uncertainty that is attached with servitization.

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Keywords

Servitization, Lean Startup, Firm Performance, Economies of scope, Emergent model

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1. INTRODUCTION

Servitization has been an emerging approach to increase value co-creation in recent years which also saw an increase in literature signaling the success of this phenomenon in enabling success in firms. Servitization is the process of creating value by combining services and products as described by Vandermerwe and Rada (1988). Servitization has been proven to have a significant positive effect on firm value however this occurs after services reach a level of about 20-30% of the total firm sales which is described as the critical mass (Fang,2008). Servitization has been shown to create constraints on profitability in the short-run however firms using this strategy should see it as a means to achieve long-term gain (Visnjic,2016) which could be linked to the findings of Fang et al. A higher success rate is present when the services offered are strongly related to the firm's core business, when industry growth is sluggish, and when the industry is volatile (Fang, 2008). That is since it allows firms to have a wider diversification of offerings which can help aid the success of a business in an industry with slow growth. Digital technology has enabled the expansion of service offering to a much wider network. Digital technology provides the tools for more agility to adapt to changes as well as be able to reach customers more easily and quickly it also enables value co-creation with the consumer. Adopting a digitalized servitization approach is best managed as an incremental innovation process (Sjödin,2020). This helps hedge the risk of overestimating future revenue as well as helps the firm become more agile in a fast-changing market. Financial and non-financial performance is improved when applying servitization to manufacturing companies (Wang,2018). Although there is much research about the link between servitization and firm performance there is a lack of management frameworks that achieve high performance in servitization. It is still not known whether there are approaches that can help managers overcome the profit dip that happens before reaching a critical mass of 20%-30%

of the firm's total sales when servitizing. "Substantial investment in extending the service business leads to increased service offerings and higher costs but does not generate the expected correspondingly higher returns."(Gebauer,2005). An emergent approach such as the lean start-up approach which aims at minimization of waste and testing assumptions before executing them could be the key to understanding those mediating variables that are required to create successful servitization.

The concept of lean start-up has evolved over the last decade, the principle of minimization of waste remains key to the lean start-up approach (Chesbrough & Tucci 2020). The lean start-up approach helps develop an emergent business strategy before launching the product, which is falsifiable, meaning that the assumptions made could be wrong. That entails that new information could and should always replace previous knowledge about consumer preferences (Chesbrough & Tucci 2020). This helps entrepreneurs remove the bias of assuming consumers will like their product, leading us to the concept of (MVP), which is a minimal viable product. MVPs are products that use a minimal number of resources to test the assumptions with feedback from consumers. Principles such as the hypothesis-driven approach (Eisenmann,2012) have shown clear efficacy in determining consumer preferences and enables value co-creation with the consumer. This is due to the lean start-up approach as described in (Harms & Schwery,2020) that an entrepreneur following the lean start-up approaches could see it as a big experiment. That is due to the amount of testing done through the development of the product by building a feedback loop with the consumers. This enables entrepreneurs to understand customer preferences and enables the firm to not waste its resources on a product that customers do not want. Literature also explores many ways entrepreneurs often use to launch start-ups like for example "build and they will come" (Eisenmann,2012). This approach bypasses many of the steps

required for lean start-ups like demand validation and customer feedback which leaves the business to rely on the vision of the entrepreneur. This approach could lead the firm into building a product that is biased to the entrepreneur's vision and potentially does not meet the preferences of the market. Many products and firms in the market fail due to them bypassing such steps in developing their products and services. Lean start-up has shown efficacy as an emergent approach due to its hypothesis-driven approach which helps remove bias from decision making as well as enable the validation of ideas before a significant capital investment is required. This can enable the improvement of firms' financial and non-financial performance.

We have identified that servitization is very capital intensive and emergent in nature (Visnjic & Van Looy, 2013) however there is a lack of research about management frameworks to aid the success of servitization. Very little is currently known about which moderators affect the value of service transition as identified by (Fang,2008). Which is the research gap that we will attempt to fill within this research. An increased understanding of the mediating effect of lean start-ups that aid servitization could potentially be key to understanding what factors lead to the success of servitization. It can also help explain how servitized firms can escape the service paradox. That is why this paper will aim to investigate how efficient is Lean Start-up approach in moderating the relationship between servitization and firm performance?

Theory[1]

2.1 Servitization

Servitization is a phenomenon that could be traced back to 1988 where Vandermere and Rada described it as the process of combining services to products that they would complement. However, since then we have understood much more about servitization. We now understand that servitization can lead to a phenomenon described as the service paradox where companies experience a profitability dip (Visnjic & Van Looy, 2013) due to the fact that the cost of goods and services is higher. That is since labor costs are higher for servitized firms due to the different skill sets that are required for servitizing which could be higher than the average cost of employees (Neely,2008). Thus, increasing the labor costs and decreasing the profit margin, however, this does not mean that the concept of servitization is less profitable however, this means that a certain volume of customers' needs to be using the services offered to achieve economies of scale. A critical mass of services between 20-30% is where the profitability increases once more (Fang et al., 2008). Firms that fail to achieve this critical mass are in what is known as the service paradox in which firms achieve subpar performance which describes the u-shaped relationship between servitization and service performance. Once a critical mass is reached the firm can achieve a higher level of profitability due to reaching economies of scale as well as achieving the learning curve that enables more efficient use of resources. Thus:

H1: There is a U-shaped relationship between servitization and firm performance.

Further, servitization enables the focus on customer value co-creation and that is since when a firm chooses to add products to their services, they become integrated within the environment of the firm (Sjödin et al., 2020). Meaning that the customer has shifted from simply being a buyer to being a partner where there is a relationship with which increases value for both parties. This value co-creation can lead to un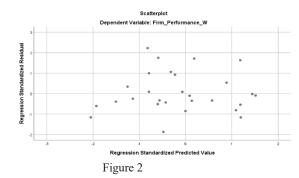predictable outcomes and a shift in how resources are managed (Sjödin et al., 2020). According to (Bennedettini, 2017) and (Wang,2018) there are 4 validated measures for servitization which are service orientation, service offering, service revenue, and service breadth. Furthermore, service breadth refers to the number of services provided by a manufacturing firm. We used services breadth as our

operationalization of servitization since it shows the extent to which a firm offers services. Which could be used as a validated way to measure servitization.

2.2 The Lean Startup approach

Lean startup is a toolkit to gain early customer insight through iterative experimentation that tests the assumptions about the venture (Harms and Schwery, 2020). By understanding those early insights costly mistakes can be avoided and a higher success rate of the venture is present (Harms and Schwery, 2020). The concept of lean startup capability was explored by (Harms and Schwery, 2020) where it combined several activities that are bundled to form LSC. Lean startup capability or in other words LSC is a process of experimental learning that helps the entrepreneur test their assumption and validate their hypothesis (Harms and Schwery, 2020). This consists of five phases beginning with customer orientation where the entrepreneur discovers the questions which will define the experiments which are best done through gathering low-cost high-value information (Harms and Schwery, 2020). Secondly is the hypothesis phase where the formulation of the hypothesis is the key activity where cause and effect relationships are to be investigated too, later on, allowing to develop generalizable knowledge (Harms and Schwery, 2020). The third is the experimentation phase where the hypothesis that was created is tested to allow to find false positives or negatives which deliver signals that represent potential returns of the opportunity (Harms and Schwery, 2020). Fourth is the validation phase where the results of the experiments are used in decision making where the data that is generated from the experiments is a key factor in the decisions in this phase (Harms and Schwery, 2020). The fourth stage is learning where the entrepreneur uses the validated evidence to learn(Harms and Schwery, 2020). This can happen in two distinct ways: the first is experimental learning which is concerned about states such as customer needs or product-market fit(Harms and Schwery, 2020). The other is error-based learning

which is triggered by specific learning events (Harms and Schwery, 2020).LSC results in the minimization of waste, such as resources and time that would have been used on following a possible product or service that does not fit with the customer or the market. Thus, lean startup enables the entrepreneur to meet budget requirements and avoid costly mistakes and that is why it has a positive correlation on firm performance (Harms and Schwery, 2020). Lean startup positively influences firm performance due to its efficiency in understanding the product or service market fit using low-cost data. This meaning the exhaustion of resources that occurs once implementing a new product or service is much less likely since there have been multiple series of testing and validating before the product or service is released to customers. That is why we expect the following hypothesis:

H2: Lean startup has a positive impact on firm performance

2.3` LS implications on servitization

A combination of both servitization and the lean start-up approach could lead firms into understanding customer preferences regarding servitized products to a higher level. This means using the lean start-up approach firms can understand what features customers want in terms of services, whether there should be many service options or just a few and what are the most wanted services that customers demand which could potentially improve servitization. Another key aspect of combining both servitization and lean start-up principles is that servitization is often capital intensive (Visnjic & Van Looy, 2013) thus it carries a high risk of implementation especially if firms have a limited budget and are still in the growing stage leading to a potential profitability dip. Also, servitization is often established as a way to create value co-creation with the customer (Sjödin et al., 2020) and be able to integrate the customer into the firm's environment. However, when the service offered does not match the customer's needs

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there might be a lower rate of adoption. This is directly linked to the profitability dip discussed above which can be solved after a critical mass of 20%-30% of customers adapts the services (Fang et al., 2008). However, such an adoption rate can only happen when the services match the customer's needs and that is where the significance of lean startup is tested. That is why we expect that LS minimizes waste by avoiding costly mistakes and helping the venture reach the product-market-fit requirement to be profitable more efficiently and with minimal resources. We also expect that LS can negatively moderate the u-shaped relationship by understanding what services fit customer needs. Thus, implementing lean start-up principles can enable these businesses to understand the product-service market through entering with their servitized product. Thus, they can reduce uncertainty and enter the market with a product they know consumers want. It is also quite costly for highly servitized firms to proceed with limited resources which could potentially be drained through a failed product entering the market. Thus, enabling lean start-up principles to guide the process of servitization in the firm by testing assumptions and having a deeper understanding of consumer preferences enabling value co-creation. The combination of both servitization and lean start-up in a rapidly changing and innovative market can lead to value co-creation with the customer that can lead to an unpredictable re-arrangement of assumptions and resources (Sjodin,2020). To conclude, the lean start-up approach could enable servitized firms to allocate resources to services that their customers want thus minimizing waste as well as enabling a higher level of service success. Thus H3: Lean startup capability negatively moderates the U-shaped relationship between servitization and firm performance.

3. METHODOLOGY.

3.1 Research design and sample

To be able to further investigate our research question primary data from Business-to-business manufacturing firms must be collected. This data is collected in the form of surveys which are formed of closed-ended questions which will help us understand the required concepts and gather quantitative data that can further aid our understanding. Our research focuses on firms operating in the Netherlands where the initial sample size was 51 companies and the final sample size after we removed the incomplete surveys is 37 with, 4 companies that do not have services and therefore we excluded them from the regression. Companies that offer services in B2B manufacturing were contacted and asked to respond to the survey. Personnel who are knowledgeable about the specific constructs in the survey such as they are involved in the service business and have a management position within the firm will be asked to complete the survey. An exploratory research design was created to investigate the Moderating role of lean startup principles in servitized companies on firm performance.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Firm_Performance_W	37	3.70	8.00	6.0522	.96736
Servicebreadth	37	.00	33.00	18.9730	9.80217
Lean_startup_use_AVG	37	1.00	6.22	4.7546	1.21726
Valid N (listwise)	37				

Figure 1

3.2 Measures

According to (Bennedettini, 2017) and (Wang,2018), there are 4 validated measures for servitization which are service orientation, service offering, service revenue, and service breadth. Furthermore, service breadth refers to the number of services provided by a manufacturing firm. The study identifies service breadth as the main variable of measurement to assess the level of servitization as used in (Oliva,2012). Which could be used as a validated way to measure servitization. This helps our research understand the level of servitization of a firm as validated in (Neely, 2008; Benedettini et al., 2017; Wang,2018) since service

breadth clearly distinguishes based on the number of services offered the different levels of servitization integration as well as reduces the bias that can emerge when analyzing other variables to measure servitization. This means that firms who offer a higher number of services will be represented by the metric of service breadth. As well as firms who have fewer services offered meaning they are less developed in servitization will be reflected upon by the service breadth score given to the specific firm. We plan to analyze subjective performance measures by using measurements adopted by (Kohtamaki,2015). Subjective performance measures were found to be the best next alternative that we could find due to the fact that we could not collect objective measures due to anonymity of the respondents which didn't allow us to combine their survey input and objective data from databases. Most survey questions are in the form of a Likert scale from 1 to 7 (1=Fully disagree) and (7=Fully Agree). Multiple questions are open-ended however that are specific to control variables or the option of comments. We analyze Subjective performance measures by using measurements adopted by (Kohtamaki,2015). Subjective performance measures were found to be a preferable alternative to EBIT since our paper offers anonymity for respondents therefore it would be difficult to collect EBIT data which is why this form of subjective data is optimal for our paper. Furthermore, the survey consists of different sections that measure different aspects of the model. These sections were based on proven questions that were applied and show efficacy in results by previous research. Firstly, using lean startup capability as applied in (Harms & Schwery,2020) were using subjective measures we analyze the different stages of LSC and create a score based on those shows the degree of LSC to be applied in the regression model. Furthermore, Servitization will be operationalized by using service breadth as our key metric (Neely, 2008; Benedettini et al., 2017) which would combine the sum of the number of services offered by the survey participants. This

would distinguish firms who are more servitized since they would have a higher number of services compared to less servitized firms. To assess the validity and reliability of our data multiple steps are conducted prior to the analysis. Beginning with firstly Testing Cronbach's alpha in SPSS to test the reliability of each construct and be able to distinguish between any variables that should be removed from the model which is displayed in the operationalization below table. Following that, we test the normality of the residuals as well as the heteroscedasticity of the data. This showed a clear indication about the normality of the data as well as pointed to that the model is explained by the variables included.

Figure 2

Finally, we tested our model for multicollinearity, and he found that no variables are not too highly correlated. Although some variables have a moderate level of correlation however this could be explained by the hypothesis in our paper. That is shown when looking at the moderator variables and their correlation score with firm performance. Which gives an early indication of what the results of our analysis will be. Thus, we see no multicollinearity in our model except for between both moderator variables; however, this could be explained by the fact that they are the same variable however one has a squared number of the service breadth score.

Correlation matrix								
Variables	1	2	3	4	5	6	7	8
1.Firm performance	1	0.027	-.0188	0.323	0.369	0.372	0.421	0.499
2.Firm size	0.027	1	0.254	0.210	0.248	0.289	0.269	0.245
3.Customer heterogeneity	-0.188	0.254	1	-0.094	-0.037	0.238	-0.047	-0.090
4.Service breadth	0.323	0.210	-0.094	1	0.954	0.098	0.281	0.364
5.Service breadth squared	0.369	0.248	-0.037	0.954	1	0.127	0.228	0.281
6.Lean start-up capability	0.372	0.289	0.238	0.098	0.127	1	0.079	0.153
7.Moderator variable squared	0.421	0.269	-0.047	0.281	0.228	0.079	1	0.956
8.Moderator variable	0.499	0.245	-0.090	0.364	0.281	0.153	0.956	1

Figure 3

3.3 Control Variables

Throughout the study control variables were used to see their effect on firm performance. As well as the ability of bigger firms to achieve higher firm performance as well as service performance. That is due to that larger firms are more efficient with resources due to reaching economies of scale and being able to utilize the costly workforce that is associated with servitization. That is why two key control variables were used throughout the analysis of the constructs in this research. Firstly, using the number of employees, we can control for the firm's size. This metric is key to understanding the size of the firm. Another key metric that was used to complement the first control variable is the number of customers. Which is also used to measure customers' heterogeneity. Thus, using these control variables will mitigate the bias that could occur for not accounting for potentially more efficient types of business models that require fewer employees and the number of customers a firm has.

3.4 Analysis

Furthermore, once the instruments were considered valid a linear regression and a quadratic regression will be made on the effect of servitization on firm performance. We created the first model that includes both the servitization and lean startup hypothesis as well as control variables. After the two hypotheses are tested, we conduct a multiple linear regression using control variables, LSC, Servitization, and the moderator variable and that to investigate the moderating relationship between LSC, servitization, and lean startup. The moderator variable is created by computing the z-scores of both LSC and Servitization squared. Thus, the moderating effect on firm performance can be analyzed effectively. We combined them with our second model which included the third hypothesis thus using two moderating variables. First moderator variable using lean startup capability x servitization and the second one using servitization squared x lean startup capability to be able to measure for the moderation effect that occurs on the U-shaped relationship. Firstly, an exploratory factor analysis KMO validity test was conducted which included all meaningful constructs which were the average scores of LSC and servitization with the SPSS result showing a significant value of (p-value=.001). Further, this means that our correlations are compact. The factor analysis also showed high extraction for each component with the lowest being .441 for design and development services AVG score (Appendix 1.1). We also computed Cronbach's alpha for all variables included in our theoretical constructs which are displayed in our operationalization table below. (See Figure 1.0 for operationalization table)

4. RESULTS

4.1 Hypothesis 1

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The results of the full model are displayed in table 1. We found that there is no significant effect on firm performance when having a higher level of servitization. The quadratic term of service breadth showed (B=.745, P=.161) showing no significant effect on firm performance. The linear result of Service Breadth shows (B= -.429, P=.413) showing a moderate negative non-significant relationship with firm performance. However, the sign of the standardized beta flipped thus showing the U-shaped relationship that occurs with servitization. Thus, proving H1 that there is sufficient evidence to accept H1 which implies that there is a U-shaped relationship between service breadth and firm performance.

4.2 Hypothesis 2

The second hypothesis which predicts that lean start-up capability has a positive effect on firm performance showed a positive significant effect on firm performance with (β= .419, P=.014). Thus, showing that lean start-up a moderately positive effect on firm performance thus proving H2. In addition, the control variables applied in the first model did not show a significant effect on the result with the number of employees showing (β=-.120, P=.475) and the number of customers showing (β=-.269, P=.107) showing that both control variables had no significant effect on the model.

4.3 Hypothesis 3

The third hypothesis states that lean start-up capability moderates the U-shaped relationship between servitization and firm performance; the model found no significant effect on firm performance (β=-.510, P=.324). Thus, there is no statistically significant effect which means we reject H3. However the model shows a moderate negative moderation with a β=-.510 however with no statistical significance. Further investigating model 2 we see that it has an R-squared of .553 meaning it explains 53% of the variability in the model. Also further investigating the independent variables in the model we see that service breadth squared has a

positive effect on firm performance (β=1.323, p=.011) which means that the moderating variables could have had an effect on the variable making it more statistically significant. Finally, our control variables showed no significant effect on our model with customer heterogeneity showing (β=-.207, P=.169) and firm size showing (β=-.202, P=.169). The table below summarizes all the above results for the hypothesis.

Variables	Hypothesis	Firm Performance (Standardized β)	
		Model 1	Model2
Intercept		3.597 (.981)**	4.813 (.969)**
Service Breadth	H1	-.429 (.051)	-1.175 (.049)*
Service Breadth2	H1	.745 (.001)	1.323 (.001)*
Lean startup	H2	.419 (.185)*	.311 (.169)*
Moderating effects			
Service Breadth x Lean Startup	H3		1.026 (.853)
Service Breadth2x Lean Startup	H3		-.510 (.819)
Control variables			
Customer heterogeneity		-.269. (.000)	-.202 (.000)
Firm Size		-.120 (.000)	-.207 (.000)
R squared		.339	.553
Adjusted R2		.225	.437
F-statistics		2.979	6.463

*p < .05.
**p < .001
SE=()

5. DISCUSSION

5.1

Throughout our research, we investigated the effects of servitization and lean start-up on firm performance and that is to

build on previous papers and investigate the link that lean startup could possibly create due to its positive effect on servitization-firm performance. Previous papers showed that firms experience a profitability dip due to increased costs that come with implementing a servitization strategy (Visnjic & Van Looy, 2013). We also saw in (Fang et al., 2008) that there has to be between 20%-30% of the business's customers using the services to overcome the profitability dip and achieve a higher firm performance which is referred to as the U-shaped relationship between servitization and firm performance. This relationship was investigated in the first hypothesis showing no statistically significant result. However, this could also be a result of many different aspects within the context of our research beginning with that the sample size is relatively small therefore could result in the skewness of the small number of respondents.

5.1.2

Another potential unseen effect on the result could be that our operationalization of servitization uses service breadth which could potentially be a key to further research about this topic. That is because a high number of services offered could mean the firm is highly servitized however it also means the services are more difficult to manage as well as they meet broad customer needs. Which could, in turn, cause a lower level of profitability thus lowering the strength of the relationships in our model however this needs further investigation to be able to see if there is a link between a very high service breadth and firm performance. This concept can also be linked to (Sjödin et al., 2020) which showed that servitization causes value co-creation and enables the customer to be part of the firm environment. However, when offering a very high number of services could mean customers have to be highly integrated within the firm to be able to have a high rate of adoption for the offered services. However, this could lead to the exhaustion of resources and a potentially lower rate of servitization success. This could be related to the concept of

economies of scope where services more efficient by using the workforce that is tasked on specific service types to develop more services within their field of expertise. Thus, meaning that instead of focusing on a variety of services the firm could focus on specific types of services that they have underused labor in and therefore can increase efficiency as well as service breadth. However, this way the firm won't exhaust their resources since utilizing economies of scope can be especially efficient within the context of service offerings.

5.1.3

Lean start-up capability (Harms and Schwery, 2020) implies the minimization of waste of all kinds by validating and experimenting to be able to offer a tailored service that the customer wants. Which was investigated in the second hypothesis which showed a significant positive impact on firm performance. Thus, implying that lean start-up capability does positively impact firm performance when applying it to firms with a high level of servitization. This means the more the firm tests its assumptions using the 5 steps of LSC (Harms and Schwery, 2020) the higher the service performance will be which has significant implications for managers. Finally, the third hypothesis which investigates Lean start-up capability negatively moderates the U-shaped relationship between servitization and firm performance which showed no statistically significant result. However, this does not mean that the hypothesis is invalid since the sample size is limited and could potentially skew the data or cause a lower significance. However, the data still showed positive signs that the hypothesis could indeed be correct however further research is required. Our result showed a standardized beta coefficient of -.510 which shows clear signs of negative moderation that is caused by lean start-up on the u-shaped relationship between firm performance and servitization. The beta coefficient also suggests that the negative moderation is strong however it is not of statistical significance in our model.

5.1.4

Our second model however found a significant relationship between servitization and firm performance and lean start-up and firm performance as independent variables. However, when combined into a moderating variable no significant relationship could be found for negative moderation. Thus, suggesting that further research should focus on obtaining a larger sample size to be able to conclusively accept or reject this hypothesis. Moreover, papers such as (Visnjic & Van Looy, 2013) suggest that servitization is often capital intensive and that is one of the main reasons of the profitability dip that occurs. Our results show that there is a potential negatively moderating effect by lean start-up on this profitability dip. That is why it is critical to further investigate this relationship to be able to prove this relationship which could be key to solving the service paradox. Although our research could not find a statistically significant relationship for H3 however we have found evidence that points towards the potential success of lean start-up moderating the U-shaped relationship between firm performance and servitization.

5.2 Implications

The results that are presented in the study can give practical implications for companies who are in the servitization process whether they are early in the U-shaped curve or further developed. Firstly, beginning with the implications of the first hypothesis which although there was no statistically significant finding between service breadth and firm performance, however, a possibly more practical implication was found. That is since our analysis realized a possible link between service breadth and a lower firm performance. This decline occurs when firms have either a very large number of services offered or a very low amount of services. This meaning for firms that the profitability dip in the initial stage of servitization is present, however, there is also a limit to how far you can stretch servitization without harming the

profitability of your services. So, managers should implement lean startup with their servitization strategy. That is due to the fact that once the firm uses LSC they have a much higher chance of succeeding. That is since a higher level of customer insights as well as constant experimentation are key to identifying what services are needed by the customer. Further, managers can use the data generated to meet these service requirements of customers and be able to have a more successful service offering. This will help servitized firms gain a higher level of service adoption, therefore, a higher level of firm performance. Using data-driven decision making the companies can reduce uncertainty and avoid costly mistakes that can occur in the initial stages of servitization which can be capital intensive and resource-consuming for SMEs. Furthermore, using the final hypothesis, we can see the potential of a moderating effect of lean startup on the U-shaped relationship between servitization and firm performance. Thus, B2B manufacturing firms should be using the principles of Lean Startup to make key decisions in their service offerings. This meaning that before a certain service is released to the customers of the business the offering firm must follow the steps of LS to verify that the service is indeed profitable as well as wanted by their customers. This can help build a closer relationship with the customer and be able to satisfy a high number of customers that could not be achieved without these key customer insights. Thus, this implication could be the key to the profitability dip that occurs when implementing servitization. Thus, firms should implement LSC principles especially in their initial stages of servitizing and that is to be efficient with resources and be able to have a higher rate of adoption which is key to surpassing the profitability dip otherwise known as the service paradox.

5.3 Limitations and future research

Due to the small sample size of the research, some results were not statistically significant however a bigger sample size would get a more accurate result of the hypothesis and can

potentially prove the hypothesis that our research could not find significant evidence for. Also, the results have the potential to be much stronger however since the sample size is low, any underestimation or overestimation of any of the constructs could have influenced the results especially that the final data had 37 respondents of which 4 were not included in two of the hypothesis analysis. A more accurate representation of the sample could be by combining subjective performance measures combined with financial performance measures like EBIT. Thus, researchers will be able to generate data about both subjective measures which are more accurate in terms of what the firm sees as important and what they perform well in. Also combining that with EBIT could give researchers a deeper insight into what the financial performance looks like which could be the key to many new insights in understanding servitization. Finally, although many studies focus on firm performance, a research gap is present in understanding the service non-financial performance as well as the service financial performance. Thus, future research should focus on them and investigate what makes a service perform better. Lean startup is the key to understanding what the product should look like and to have a good customer-service fit, however further research is required into what concepts or principles can be combined with Lean startup to get the best results. This research has significant implications on the field of research due to its key findings about Lean startup and firm performance. Our research provides findings especially relevant to firms that are still developing their business model. That is due to that we see a clear increase in firm performance due to servitization which could be an emergent approach for future businesses that increases firm performance. Our findings also significantly help these firms due to that it provides guidelines to how successful servitization looks like. That is especially important to firms entering a servitized model since we saw from previous research that there is a clear profitability dip that causes the exhaustion of resources. However,

our findings about lean startup provide a guide that could be key to future servitization success.

6. CONCLUSION

Firstly, we have found sufficient evidence to accept the first hypothesis which states that there is a U-shaped relationship between servitization and firm performance. Secondly, we have found a significant positive impact caused by lean startup on firm performance. Further, we also rejected our hypothesis that Lean startup mediates the U-shaped relationship between servitization and firm performance. This meaning that lean startup could be the answer to the profitability dip that occurs when a firm is beginning to become servitized. Further, there needs to be more research to understand what combination of optimal work practices can further improve service performance in combination with LSC as well as if there is a number of services offering that is too high. Also suggesting that further research focuses on the negatively moderating effect that lean startup has on the U-shaped relationship between servitization and firm performance.

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Appendix

1.0 (Operationalization Table)

Concept	Definition	Operationalization
Servitization "Service breadth" Alpha=.955	Servitization is the process of creating value by combining services and products as described by Vandermerwe and Rada (1988) Service breadth refers to the number of services provided by manufacturing firms (Neely, 2008; Benedettini et al., 2017).	1.Design and Development Services 2.Systems and Solutions 3.Retail and Distribution Services 4.Maintenance and Support Services 5.Installation and Implementation Services 6.Financial Services
Lean Startup Capability (lean startup) Alpha=.960	We define Lean Startup Capability as the LS-based cross-functional capability bundle (Grant, 1996) that the venture performs when it engages in opportunity incubation (Vogel, 2016)	**Iterative experimentation:** 1. We viewed new product/service development as cycles of experiments, learning, and additional experiments. 2. We did not try many different product/service solutions before we found the right one. 3. We engaged in many trial and error processes in product/service development before we had a complete understanding of the market and technology. 4. We repeated the process of testing until all key business model assumptions have been validated. 5. We took an experimental approach that relied on frequent trial and error to find the right product/service solution. 6. We frequently design and run experiments on elements of our business model. **Customer insight:**

		1. It is important to gain deep market insight (= talking directly to customers) to better understand our customer's problem.
		2. When we developed the solution, we never had the customer in mind.
		3. We invested significant effort into understanding the problem and learning about the user and its social context.
		4. It is important to gain deep market insight into how our solution solves the customer problem.
		Validation:
		1. We used metrics to measure the impact of product/service improvements on customer behavior.
		2. We did not use data-driven tests to improve our human judgment in the decision-making process.
		3. We have metrics available to test the product/service acceptance by customers and sales performance.
		Learning:
		1. The organization's ability to learn is not considered as key 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.
		Hypotheses testing:
		1. We formulated a series of assumptions about the market needs and how best to deliver it.
		2. We translated the vision about our product/service and its value proposition into falsifiable assumptions.
Firm performance (Subjective firm performance) (Kohtamaki,2015)	Financial performance is measured by analyzing subjective	1. How important do you consider the following measures to assess firm performance? - Sales level

Alpha=.857	performance measures as applied by (Kohtamaki,2015)	2. How important do you consider the following measures to assess firm performance? - Sales growth 3. How important do you consider the following measures to assess firm performance? - Gross profit margin 4. How important do you consider the following measures to assess firm performance? - Net profit from operations 5. How important do you consider the following measures to assess firm performance? - Profit to sales ratio 6. How important do you consider the following measures to assess firm performance? - Return on investment 7. How satisfied are you with your firm's performance in terms of the following measures? - Sales level 8. How satisfied are you with your firm's performance in terms of the following measures? - Sales growth 9. How satisfied are you with your firm's performance in terms of the following measures? - Gross profit margin 10. How satisfied are you with your firm's performance in terms of the following measures? - Net profit from operations 11. How satisfied are you with your firm's performance in terms of the following measures? - Profit to sales ratio 12. How satisfied are you with your firm's performance in terms of the following measures? - Return on investment

		5

1.1:KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.   .426

Bartlett's Test of Sphericity   Approx. Chi-Square   87.001

        df   45

        Sig.   .000

1.2

Correlation Matrix[a]

		IterativeEXPE RIMENT_AVG	Cutomer_Inst ights_AVG	Validation_AVG	Learning_AVG	DesignNDeve lopService_A VG	SystemsNDs olutionsAVG	RetailAndDist r_AVG	Maintainance andsupport_A VG	Instilationandi mplement_AV G	Financial_ser vices_AVG
Correlation	IterativeEXPERIMENT_AVG	1.000	.445	.190	.395	.494	.273	.429	.767	.325	-.003
	Cutomer_Instights_AVG	.445	1.000	.058	.945	.402	.680	.449	.710	.103	.225
	Validation_AVG	.190	.058	1.000	-.196	.183	.141	.640	.255	.453	-.121
	Learning_AVG	.395	.945	-.196	1.000	.346	.531	.267	.635	.098	.182
	DesignNDevelopService_AVG	.494	.402	.183	.346	1.000	.568	.331	.447	.291	.195
	SystemsNDsolutionsAVG	.273	.680	.141	.531	.568	1.000	.476	.444	-.021	.497
	RetailAndDistr_AVG	.429	.449	.640	.267	.331	.476	1.000	.609	.621	.147
	Maintainanceandsupport_AVG	.767	.710	.255	.635	.447	.444	.609	1.000	.543	.239
	Instilationandimplement_AVG	.325	.103	.453	.098	.291	-.021	.621	.543	1.000	.119
	Financial_services_AVG	-.003	.225	-.121	.182	.195	.497	.147	.239	.119	1.000
Sig. (1-tailed)	IterativeEXPERIMENT_AVG		.064	.268	.091	.043	.184	.072	.001	.139	.497
	Cutomer_Instights_AVG	.064		.426	.000	.087	.005	.062	.003	.369	.230
	Validation_AVG	.268	.426		.260	.274	.323	.009	.200	.060	.346
	Learning_AVG	.091	.000	.260		.124	.031	.189	.010	.375	.276
	DesignNDevelopService_AVG	.043	.087	.274	.124		.021	.135	.063	.168	.261
	SystemsNDsolutionsAVG	.184	.005	.323	.031	.021		.050	.064	.473	.042
	RetailAndDistr_AVG	.072	.062	.009	.189	.135	.050		.014	.012	.316
	Maintainanceandsupport_AVG	.001	.003	.200	.010	.063	.064	.014		.028	.216
	Instilationandimplement_AVG	.139	.369	.060	.375	.168	.473	.012	.028		.349
	Financial_services_AVG	.497	.230	.346	.276	.261	.042	.316	.216	.349	

a. Determinant = 1.501E-5

1.3

Correlations

		Firm_Performance_W	How many employees (FTE) does your firm have?	How many customers does your firm approximately have?	Servicebreadth	Service_Breadth_squared	Lean_startup_use_AVG	Moderator_variable_squared	Moderator_variable
Pearson Correlation	Firm_Performance_W	1.000	.027	-.188	.323	.369	.372	.421	.499
	How many employees (FTE) does your firm have?	.027	1.000	.254	.210	.248	.289	.269	.245
	How many customers does your firm approximately have?	-.188	.254	1.000	-.094	-.037	.238	-.047	-.090
	Servicebreadth	.323	.210	-.094	1.000	.954	.098	.281	.364
	Service_Breadth_squared	.369	.248	-.037	.954	1.000	.127	.228	.281
	Lean_startup_use_AVG	.372	.289	.238	.098	.127	1.000	.079	.153
	Moderator_variable_squared	.421	.269	-.047	.281	.228	.079	1.000	.956
	Moderator_variable	.499	.245	-.090	.364	.281	.153	.956	1.000
Sig. (1-tailed)	Firm_Performance_W	.	.440	.140	.029	.015	.014	.006	.001
	How many employees (FTE) does your firm have?	.440	.	.070	.113	.076	.046	.059	.078
	How many customers does your firm approximately have?	.140	.070	.	.295	.416	.085	.394	.303
	Servicebreadth	.029	.113	.295	.	.000	.287	.051	.016
	Service_Breadth_squared	.015	.076	.416	.000	.	.234	.094	.051
	Lean_startup_use_AVG	.014	.046	.085	.287	.234	.	.326	.190
	Moderator_variable_squared	.006	.059	.394	.051	.094	.326	.	.000
	Moderator_variable	.001	.078	.303	.016	.051	.190	.000	.
N	Firm_Performance_W	35	35	35	35	35	35	35	35
	How many employees (FTE) does your firm have?	35	35	35	35	35	35	35	35
	How many customers does your firm approximately have?	35	35	35	35	35	35	35	35
	Servicebreadth	35	35	35	35	35	35	35	35
	Service_Breadth_squared	35	35	35	35	35	35	35	35
	Lean_startup_use_AVG	35	35	35	35	35	35	35	35
	Moderator_variable_squared	35	35	35	35	35	35	35	35
	Moderator_variable	35	35	35	35	35	35	35	35

1.4

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
					Change Statistics				
1	.582[a]	.339	.225	.84149	.339	2.979	5	29	.027
2	.744[b]	.553	.437	.71716	.214	6.463	2	27	.005

a. Predictors: (Constant), Lean_startup_use_AVG, Servicebreadth, How many customers does your firm approximately have?, How many employees (FTE) does your firm have?, Service_Breadth_squared

b. Predictors: (Constant), Lean_startup_use_AVG, Servicebreadth, How many customers does your firm approximately have?, How many employees (FTE) does your firm have?, Service_Breadth_squared, Moderator_variable_squared, Moderator_variable

c. Dependent Variable: Firm_Performance_W

1.5

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.546	5	2.109	2.979	.027[b]
	Residual	20.535	29	.708		
	Total	31.081	34			
2	Regression	17.194	7	2.456	4.776	.001[c]
	Residual	13.887	27	.514		
	Total	31.081	34			

a. Dependent Variable: Firm_Performance_W

b. Predictors: (Constant), Lean_startup_use_AVG, Servicebreadth, How many customers does your firm approximately have?, How many employees (FTE) does your firm have?, Service_Breadth_squared

c. Predictors: (Constant), Lean_startup_use_AVG, Servicebreadth, How many customers does your firm approximately have?, How many employees (FTE) does your firm have?, Service_Breadth_squared, Moderator_variable_squared, Moderator_variable

1.6

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	VIF
1	(Constant)	3.597	.981		3.667	.001		
	How many employees (FTE) does your firm have?	-6.590E-6	.000	-.120	-.724	.475	.828	1.208
	How many customers does your firm approximately have?	.000	.000	-.269	-1.661	.107	.867	1.154
	Servicebreadth	-.042	.051	-.429	-.831	.413	.085	11.708
	Service_Breadth_squared	.002	.001	.745	1.438	.161	.085	11.786
	Lean_startup_use_AVG	.481	.185	.419	2.604	.014	.881	1.134
2	(Constant)	4.813	.969		4.964	.000		
	How many employees (FTE) does your firm have?	-1.137E-5	.000	-.207	-1.415	.169	.769	1.300
	How many customers does your firm approximately have?	-7.727E-5	.000	-.202	-1.441	.161	.845	1.184
	Servicebreadth	-.115	.049	-1.175	-2.332	.027	.065	15.353
	Service_Breadth_squared	.004	.001	1.323	2.743	.011	.071	14.049
	Lean_startup_use_AVG	.357	.169	.311	2.120	.043	.769	1.301
	Moderator_variable_squared	-.822	.819	-.510	-1.005	.324	.064	15.542
	Moderator_variable	1.639	.853	1.026	1.920	.065	.058	17.269

a. Dependent Variable: Firm_Performance_W

1.5

Variables	Hypothesis	Firm Performance (Standardized B)	
		Model 1	Model2
Intercept		3.597 (.981)**	4.813 (.969)**
Service Breadth	H1	-.042 (.051)	-1.175 (.049)*

Service Breadth2	H1	.002 (.001)	1.323 (.001)*
Lean startup	H2	.419 (.185)*	.311 (.169)*
Moderating effects			
Service Breadth x Lean Startup	H3		1.026 (.853)
Service Breadth2x Lean Startup	H3		-.510 (.819)
Control variables			
Customer hetrogeniety		-.120. (.000)	-.207 (.000)
Firm Size		.000 (.000)	-.202 (.000)
R squared		.339	.553
Adjusted R2		.225	.437
F-statistics		2.979	6.463

Syntax file computations

COMPUTE Firm_Performance_W=Q14_1*(Q13_1/(Q13_1+Q13_2+Q13_3+Q13_4+Q13_5+Q13_6))+Q14_2*

(Q13_2/(Q13_1+Q13_2+Q13_3+Q13_4+Q13_5+Q13_6))+Q14_3*(Q13_3/(Q13_1+Q13_2+Q13_3+Q13_4+Q13_5+Q13_6))+

Q14_4*(Q13_4/(Q13_1+Q13_2+Q13_3+Q13_4+Q13_5+Q13_6))+Q14_5*(Q13_5/(Q13_1+Q13_2+Q13_3+Q13_4+Q13_5+
        Q13_6))+Q14_6*(Q13_6/(Q13_1+Q13_2+Q13_3+Q13_4+Q13_5+Q13_6)).

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Q68_4
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(Q63_2/(Q63_1+Q63_2+Q63_3+Q63_4+Q63_5+Q63_6+Q63_7))+Q24_3*(Q63_3/(Q63_1+Q63_2+Q63_3+Q63_4+Q63_5+

Q63_6+Q63_7))+Q24_4*(Q63_4/(Q63_1+Q63_2+Q63_3+Q63_4+Q63_5+Q63_6+Q63_7))+Q24_5*(Q63_5/(Q63_1+Q63_2+

Q63_3+Q63_4+Q63_5+Q63_6+Q63_7))+Q24_6*(Q63_6/(Q63_1+Q63_2+Q63_3+Q63_4+Q63_5+Q63_6+Q63_7))+Q24_7*
        (Q63_7/(Q63_1+Q63_2+Q63_3+Q63_4+Q63_5+Q63_6+Q63_7)).
        EXECUTE.

```
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 /DESCRIPTIVES MEAN STDDEV CORR SIG N
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 /CASEWISE PLOT(ZRESID) OUTLIERS(3)
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GET
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 EXECUTE.
 RELIABILITY
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  Maintainanceandsupport_AVG Instilationandimplement_AVG Financial_services_AVG
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  Instilationandimplement_AVG Financial_services_AVG
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2020)
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 /ROTATION NOROTATE
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RELIABILITY
```

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RELIABILITY
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 /MODEL=ALPHA
 /STATISTICS=DESCRIPTIVE SCALE CORR
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 /STATISTICS=MEAN STDDEV MIN MAX.




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 /SAVE
 /STATISTICS=MEAN STDDEV MIN MAX.




COMPUTE Moderator_variable_squared=ZSco02*ZService_Breadth_squared.
EXECUTE.




COMPUTE Moderator_variable_squared=ZSco02*ZService_Breadth_squared.
EXECUTE.
REGRESSION
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 /MISSING LISTWISE
 /STATISTICS COEFF OUTS R ANOVA COLLIN TOL CHANGE
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