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R&D Outsourcing by Scale-ups in the Medical Technology Industry
Motives, Barriers and Relationships

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# R&D Outsourcing by Scale-ups in the Medical Technology Industry: Motives, Barriers and Relationships

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Eindhoven, June 8, 2022

# Preface

This research was conducted as part of the completion of my Master Degree in Innovation Management at Eindhoven University of Technology. It was commissioned by NTS Group, which asked me to perform research on scale-ups in the context of the Medical Technology Industry in the Netherlands. The completion of this research marks the end of my academic journey, which I thoroughly enjoyed throughout the years. I am grateful for the opportunities I got to learn new things, challenge myself, and above all, meet great and inspiring people.

I would like to thank everyone at NTS Group that was involved in my thesis project for their help and enthusiasm. I am very grateful for the freedom and trust I was given to set up my own graduation project and pick a topic that was of relevance to both the academic world and the company. I want to thank Sven-Rudolf Schulte specifically for his guidance and helpful suggestion throughout the project.

Furthermore, I would like to thanks my supervisor at the Eindhoven University of Technology, prof. dr. Ed Nijssen. I enjoyed our weekly meetings very much, in which he always provided me with critical reflections on my work. His lively and spot-on analogies are something I will not forget anytime soon.

Finally, I would like to thank my friends, family and girlfriend, who have supported me throughout this entire journey. A thesis project is always a roller coaster, with a lot of ups and downs. Especially when things were not going the way I wanted, I could always count on their support and comforting words.

*Laurens C.M. Jansen, June 2022*

# Abstract

Scale-ups are defined as companies that experience an annual growth rate in revenue of at least 20% for three consecutive year, while also having at least 10 employees. Due to their high growth rate, they are inherently different compared to their slower growing counterparts. While distinctions have been made between e.g. small and large or low- and high-tech companies, scale-ups in particular seem to have received little attention, despite their large economic impact.

In this research, the differences between scale-ups and slower growing companies in the Medical Technology (MedTech) industry is explored. A pre-study was carried out, which involved interviewing three companies that operated in this industry. Based on the findings of these interviews, combined with existing research into outsourcing and open innovation practices, a set of motives and barriers was drafted that companies would probably face when outsourcing R&D. This included a set of new motives and barriers that was created specifically because they seemed to apply to scale-ups. Using a survey, data was collected from 70 companies operating in the MedTech Industry in the Netherlands, and using an Exploratory Factor Analysis (EFA), the drafted motives and barriers were either confirmed or rejected. Based on the EFA, a set of T-Tests was conducted to determine which motives and barriers were experienced to a significantly different degree. It turned out that the Organizational motive and the barriers Collaboration, Certification and Managerial Issues were experienced more severely by the faster growing scale-ups compared to the rest of the sample.

Finally, two find the link between the uncovered factors and other variables of interest, two sets of regression analyses were performed. The first determined which motives and barriers had a significant effect on how useful companies perceived outsourcing to be, and how being a scale-up affected this relationship. It turned out that the relationships between the motive Acceleration and the barrier Strategic Importance were moderated by whether a company was a scale-up or not. The second regression shed light upon the relation between perceived usefulness and actual outsourcing activity, and how being a scale-up affected this relationship. It turned out that perceived usefulness is a very significant predictor for both past and future outsourcing activity, but that this relationship is the same for both scale-ups and normal companies alike.

# Executive Summary

## Problem Definition

NTS group, an (opto-) mechatronical modules manufacturer, wants to add more scale-ups (specifically in the Medical technology market) to their customer base. Scale-ups are fast growing companies that oftentimes develop radical innovations. The typical scale-up has a lot of knowledge about the core-module, but to turn a technical concept into an actual, market-ready product, oftentimes requires skills and competences the scale-up does not have. NTS can unburden scale-ups in this domain, and help them to take their product and production process to the next level. For NTS, partnering up with scale-ups early in their growth process means the partnership will probably hold as the scale-up grows, and as a result, becomes more profitable for NTS. Given these circumstances, NTS wanted in understanding what factors drive and hinder scale-ups in making a decision regarding their R&D outsourcing.

The existing scientific literature already described motives and barriers that companies experience to R&D outsourcing, but none of them accounted for scale-ups. Given their high growth-rate and other characteristics that inherently differentiate them from normal Small and Medium Enterprises (SMEs), it was very likely that they experienced motives and barriers that normal companies do not. Therefore, existing motives and barriers had to be tested in a qualitative pre-study, and new factors that influenced the outsourcing decision specifically for scale-ups had to uncovered.

## Methodology

Respondents from three companies (one start-up, one scale-up and a company that was previously a scale-up) were interviewed to get better understand the outsourcing process. They were also asked about the motives and barriers related to R&D outsourcing their companies had experienced. These interviews were transcribed and codified, and resulted in all of the motives described by Varajão, Cruz-Cunha, and da Glória Fraga (2017) being mentioned by at least one of respondents. All barriers described by Bigliardi and Galati (2016) were also mentioned by the respondents to a certain degree. On top of these factors, four new barriers were identified that did not overlap with the existing barriers of Bigliardi and Galati (2016). These barriers seemed to be especially applicable to scale-ups in high-tech environments.

After the initial set of motives and barriers was identified, a survey was set up to assess to what degree companies actually experienced these factors in the field. In total, 70 valid responses were received from companies operating in the Dutch MedTech industry. Of these 70 responding companies, 16 could be considered scale-ups when using criteria set by the Eurostat-OECD (2005).

After the data was gathered, three types of analyses would be performed: an Exploratory Factor Analysis (EFA), a set of Welch's T-Tests and a set of regression analyses. The EFA would be used to determine whether the motives and barriers that were hypothesized to exist based on the literature, did indeed exist as latent constructs. After the EFA, the sample was split into scale-ups and non-scale-ups, and the mean and standard deviation for each factor of these sub-samples was calculated. Using Welch's T-Tests (specifically selected because they before well on small sample sizes) it could be determined whether the difference between the sub-samples was significant. Finally, a set of regressions were performed to determine the relationship between the discovered factors and some other variables, while also checking to see if being a scale-up moderated these relationships.

## Results

The results of the EFA were more or less in line with what the literature had found thus far, and most interestingly, all four barriers discovered in the pre-study emerged from the EFA as well. Fur-

thermore, one of the three motives fell apart into two separate motives: Acceleration and Financial. All discovered factors were valid (Cronbach's Alpha of 0.7 or higher), except for Uncertainty Issues (which was a new factor that arose from the data). After the EFA had determined which factors arose from the data, the means for each factor were calculated. All motives played an important role in the sample, except for Financial. Of the barriers, Collaboration, Certification and Product Complexity appeared to be ones that were experienced most severely.

When comparing the scale-ups and their non-scale-up counterparts, it was found that there was one difference in means that was significant between the two: the Organizational motive. On average, the scale-ups rated this motive 4.375 on a 5 point Likert-scale in terms of importance. Two other motives (Acceleration and Knowledge) had some difference in means, but not enough to be considered significant. In addition to the Organizational motive, there were also three barriers that scale-ups experienced more severely: Collaboration, Certification and Managerial Issues. All these barriers (or the majority of their items in the case of Collaboration) came to light during the interviews in the pre-study.

The first set of the regression analyses showed that that was a significantly positive relation between the motives Knowledge and Acceleration, and how useful companies perceived outsourcing to be. Being a scale-up negatively moderated the relationships between Acceleration and Usefulness. Of the Barriers, Collaboration, Strategic Importance and Managerial Issues turned out to have significant relationships with Usefulness. Only the relationship between Managerial Issues and Usefulness was (positively) moderated by whether a company was a scale-up or not.

The final set of regression analyses found that there was a very strong and significant relationship between how useful companies perceived outsourcing to be, and whether they actually performed outsourcing activities. Furthermore, the relationship was also found to exist when it came to intentions to outsource in the future. The regressions on past outsourcing activity showed that being a scale-up did have an effect on the relationship, but the total number of non-outsourcing scale-ups was so small, no real conclusions could be drawn from those findings. The other regression (on future likelihood of outsourcing) did not show any significant moderation by the fact a company was a scale-up.

## Conclusion and recommendations

The main conclusion of this research is that scale-ups do indeed perceive the motives and barriers that are involved in the R&D outsourcing process differently compared to their slower growing counterparts. In terms of motives, they very strongly experience Organizational motives to outsourcing. This means they want to outsource because they either lack capacity, or do not want to make large structural changes to their organizations to be able to perform certain operations. Instead, they turn to an outsourcing partner. When it comes to barriers, scale-ups also perceive some of them more severely: Collaboration, Certification and Managerial Issues. Collaboration is mostly related to difficulties arising from working with a larger partner. Scale-ups often have the feeling these partner prioritize their larger clients because they usually more profitable on the short-term. They also feel like the management of outsourcing partners simply see scale-ups as less valuable because they often work with lower volumes and bear more risk. The second barrier, Certification, is experienced more severely by scale-ups because having a fast market entry is very important for them, and certification and regulations are seen as bureaucratic obstacles and inhibitors in the go-to-market process. In general, it can be stated that the faster you want to grow, to more impeding certification becomes. The final barrier, Managerial Issues, is characterized by the scale-up not having the managerial competences in-house to deal with the complexities that

arise from outsourcing. Managers at a scale-up are often the original founders of the company, which in high-tech industries are more likely to have an engineering background rather than a managerial background. The same principle plays a role as with the other barriers: the faster you want to grow, the sooner the fact that senior management does not have a background in business will become a hampering factor.

Of all the motives and barriers that were discovered, only a rather small set actually influenced how useful outsourcing was perceived to be. On top of that, only two of those relationships were moderated by the fact the company was a scale-up. The subsequent regression analyses also showed that there was indeed a relationship between perceived usefulness and outsourcing activities, but once again, being a scale-up did not play a major role in these relationships. Therefore, we can conclude that scale-ups do indeed perceive different motives and barriers, but that this does not necessarily influence how they look at outsourcing in general, and that they experience the same relationship between usefulness and outsourcing activities as other companies.

For companies like NTS, these findings can be integrated in their marketing and sales activities. If a company like NTS would like to attract more fast growing companies, they should focus on customers that come to them while being driver by the Organizational motive. They could message towards the market that providing capacity is something they are good at. They should also incorporate the three barriers that were discovered to apply more severely for scale-ups in their conversations with potential customers. In initial conversations, a company like NTS should make clear that scale-ups do not have to fear that they will be under-prioritized, that NTS has the correct Certification, and that they can assist a scale-up in managing complex outsourcing relationships.

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# 1  Introduction

## 1.1  NTS Group and the Medical Technology Industry

NTS Group is an Eindhoven based manufacturer of complex mechatronics solutions. The company is very strongly vertically integrated, which is beneficial for its customers: it serves as a 'one-stop-shop' for companies seeking to develop or manufacture an entire product or module. This gives NTS an interesting value proposition: they can act as a partner to smaller companies that do not have the specific manufacturing knowledge needed to turn a particular innovation into a market-ready product.

In the upcoming years, NTS would like to focus more intensely on scale-ups in the Medical Technology (MedTech) industry. The definition of MedTech is not standardized in literature, and is different from Healthcare Technology for example (which is a broader term). The World Health Organization (WHO) defines Healthcare Technology as "the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of life" (World Health Organization, 2021). Medical Technology is a sub-set of this definition, as it focuses mostly on the curing of diseases or ailments, while Healthtech is more general and can also refer to the preventing of diseases (as such, a wearable that tracks a healthy person's vital signs can be considered HealthTech, but not MedTech).

The MedTech Industry is a breeding-ground for scale-ups. As the industry that applied for the largest number of patents in 2020 in Europe (MedTech Europe, 2021), it can be regarded as highly innovative. The reason that this industry contains many scale-ups (and thus lends itself well for researching them), is that a lot of companies operating in this industry are centered around domain specific radical innovations. The MedTech industry contains a lot of fast growing companies with new concepts that do not always have the in-house knowledge or resources to guide such a concept to a market-ready product. Usually this process involves knowledge about peripherals (like specific electronics) or processes (like manufacturing) that scale-ups simply do not posses. To acquire knowledge and capacity, scale-ups can turn to outsourcing of these processes. This creates opportunities for companies that have extensive R&D and manufacturing knowledge and competences. They can assist Medtech scale-ups that want to accelerate their time-to-market (which in this industry has a big effect on product success). MedTech scale-ups can focus on their core technologies, while letting the R&D and manufacturing organization take care of the rest. On the other side of the bargain, scale-ups are fast growing, smaller companies, so this allows for the R&D and manufacturing organizations to enjoy a lock-in effect and grow together with the scale-ups in terms of production volume, and as a result, revenue.

NTS has had some customers in this segment, but the MedTech market only constitutes a small percentage of total revenue at this moment in time. To increase the total revenue from this market segment in the upcoming years, NTS is eager to learn why scale-ups in this market decide for or against outsourcing part of their R&D and manufacturing activities to them.

## 1.2  Scale-ups

A scale-up is defined by the Eurostat-OECD  (2005) as being a company that has had an average annualised growth of their return of 20% over the past 3 years, and had at least 10 employees in the beginning of this period. It is important to note that with this definition, a multinational company with thousands of employees can still be considered a scale-up. Scale-ups also make up 20% of the total value created by SMEs (ScaleUp Institute, 2020), while they only account for about 5% of their numbers. It is this category of companies specifically, scale-ups,that are interesting for

manufacturers like NTS because of their high growth rate. Their growth allows manufacturers like NTS to grow with these companies as their production volumes increase.

To keep up the momentum a scale-up has, it usually dedicates most of its resources and capacity towards its core activities (so the ones that allow it to add the most value in the market). Non-core activities usually add less value and require spending more resources than simply outsourcing these activities to a party that has made that specific non-core activity its primary business. NTS can help these companies by providing engineering and manufacturing knowledge, as well as very specialized manufacturing techniques, all under one roof. By being a preferred supplier in this phase of the scale-up's growth, NTS increases its chances of staying a preferred supplier when the company grows to become a larger player in its market. On the other side, scale-ups can also strongly benefit: they usually want to focus on bringing their (often radical) technological innovation to the market, but lack knowledge of non-core technologies required to turn their innovation into a market ready product. Finding a provider that can help them perform these activities is of great value to them.

## 1.3 Problem description

Companies that provide R&D, engineering and manufacturing services like NTS can greatly benefit from becoming a supplier of scale-ups when these scale-ups are still in an early growth stage. It allows for the R&D party to enjoy a lock-in effect and become preferred supplier once the scale-up ramps up its production. However, what factors impact the decision to eventually decide for or against outsourcing in scale-ups is unknown. This is a problem for companies like NTS, which would benefit from understanding the motives and barriers companies face when making the decision to outsource. Knowing the motives would allow for the creation of marketing material that specifically tailors to the needs of the scale-ups, while knowing the barriers would allow for taking away hesitation during business development activities.

## 1.4 Research gap

There is a lot of evidence in scientific literature that proves that outsourcing R&D in a high-tech industry is beneficial, especially for fast growing, small companies, yet research by Priyadarshini, Gao, and O'Gorman (2021) shows that up until now, less than half of innovative companies in Europe have embraced R&D outsourcing. These findings seem to contradict each other, and this research will try to shed light on what compels companies to decide against outsourcing, even if it is proven to have benefits.

Furthermore, much of the existing literature that researched motives and barriers to R&D Outsourcing focused on Small and Medium Enterprises (SME's), while there is no research focusing specifically on scale-ups. Van de Vrande, De Jong, Vanhaverbeke, and De Rochemont (2009) was the first major publication to discuss what motives and barrier companies experienced when outsourcing activities that contained extensive knowledge flows. They make a distinction between smaller and larger SMEs, and between different types of sectors, but do not discuss the growth of a company as a factor. The fact that scale-ups are very fast growing means that they might experience very different motives and barriers compared to other companies. This difference is as of yet undiscussed in literature.

Research has also been done on motives and barriers to outsourcing practises in the highly innovative industries like MedTech (Achiche, Howard, Ástvaldsdóttir, Andersen, & McAloone, 2012; McCormack, Fallon, & Cormican, 2015), but these studies were very limited in terms of geographic scale, did not focus on knowledge-intensive outsourcing, and used rather opaque methods for their data collection. In addition to that, the researchers adopted the motives and barriers defined earlier by Van de Vrande et al. (2009), without taking into account the fact that scale-ups operate in

very specific circumstances that could give rise to previously unencountered barriers. This research will try to uncover these scale-ups specific motives and barriers, and will also determine whether being a scale-up affects certain relationships, e.g. the relationship between how useful outsourcing is perceived to be and whether a company actually performs outsourcing activities.

## 1.5 Research questions

To close the research gap and uncover how scale-ups differ in their view on outsource R&D and manufacturing, the following main research question has to be answered:

**"Do scale-ups experience R&D outsourcing differently from slower growing companies?"**

To get more in-depth insights into the answer of this questions, the following sub-questions have been drafted:

- *"Which motives to R&D outsourcing do companies perceive?"*

- *"Which barriers to R&D outsourcing do companies perceive?"*

- *"Do scale-ups experience different motives and barriers to R&D and manufacturing outsourcing compared to slower growing companies?"*

- *"How do these barriers and motives relate to the way company perceive their outsourcing activities, and is this relation influenced by whether the company is a scale-up?"*

- *"How does the way scale-ups perceive their outsourcing activities affect their outsourcing activities, and is this relation influenced by whether the company is a scale-up?"*

The first two research questions are focused on determining which motives and barriers play a role in the context in which the research is carried out. (McCormack et al., 2015) and (Achiche et al., 2012) used the motives and barriers put forward by (Van de Vrande et al., 2009), however, they did not incorporate any motives and barrier specifically for scale-ups. Therefore, motives and barriers will be taken from a set of studies, all of which have validated their scales, and combined with the results from a qualitative pre-study to determine the set of motives and barriers to be used.

The third research question is central to this research, and serves as the main input for answering the main research question. Given that the motives and barriers are known after the first two research questions, the sample can be sub-divided into scale-ups and non-scale-ups. The means for each motive and barrier can then be compared to see if scale-ups significantly differ in their perception of them compared to the rest of the sample.

The fourth research question will uncover whether relations between motives and barrier on on hand and perceived usefulness of outsourcing exists, and if they do, whether being a scale-up influences these relationships.

Many researchers have made models and frameworks that guide or even predict outsourcing practises. Many of these directly link certain conditions to whether a company will outsource (e.g. more international experience will make it more likely that a company will outsource overseas ((Martinez-Noya, Garcia-Canal, & Guillen, 2012)). However, the relationship between motives and barriers and how they influence actual outsourcing behavior has not been researched. As can be derived from research question four, it is first checked how these factors influence general usefulness, before looking at whether usefulness influences the actual outsourcing behavior. The fifth research

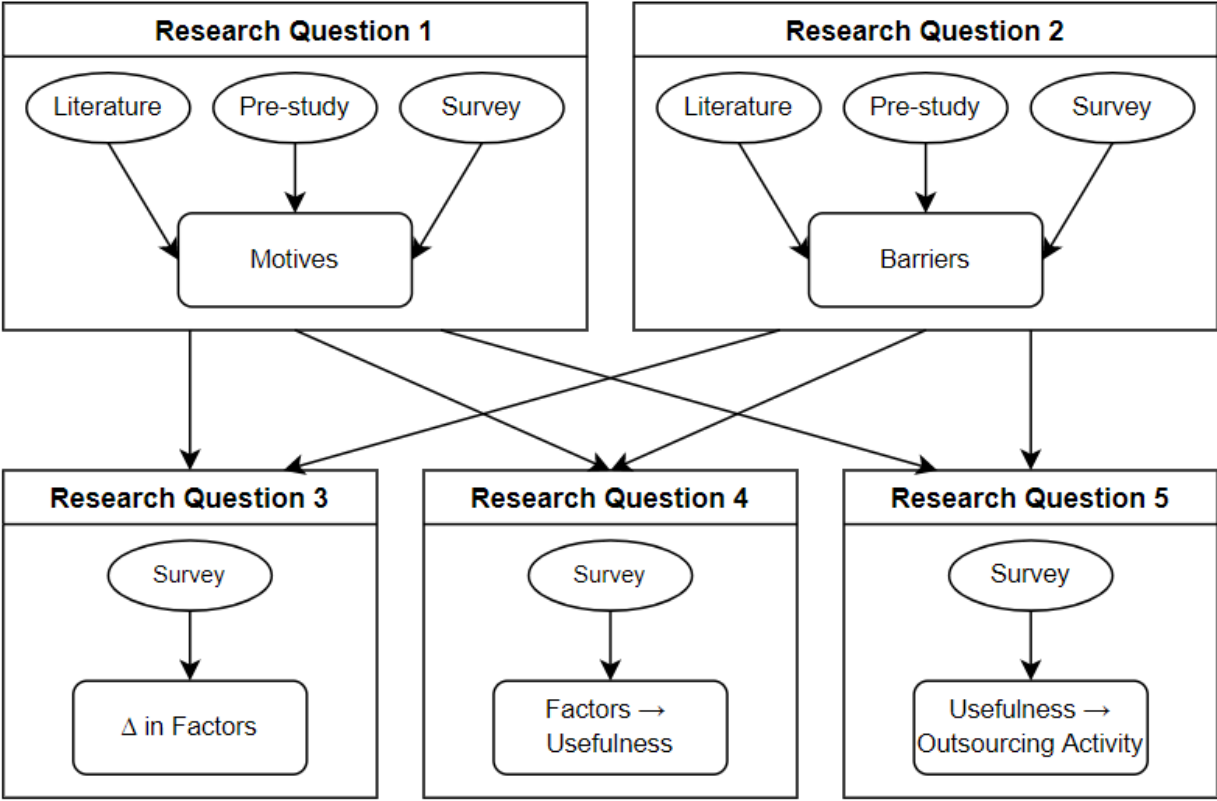Figure 2: The research questions and their relations

question looks at this final relationship, and once again checks whether the relationship is different for scale-ups.

By combining the third, fourth and fifth research questions, an answer can be given to the main research question. A visual overview on how the research questions relate to each other and the main research question is given in Figure 2.

## 2 Literature review

### 2.1 Definitions of Outsourcing and R&D Outsourcing

Outsourcing can be defined as "the act of transferring some of the company's recurring interval activities to outside providers through a contractual agreement" (World Trade Organization, 2005). When specifically looking at the outsourcing of R&D, Van de Vrande et al. (2009) define this activity as "Buying R&D services from other organizations, such as universities, public research organizations, commercial engineers or suppliers". Their research found that in their sample of 600 innovative Dutch SMEs, 50% participated in R&D outsourcing, and that the amount of companies that participated in this activity was in an upward trend. Van de Vrande et al. (2009) also found that the main reason companies decided to outsource R&D was because they sought specific knowledge that could not be found inside their own organizational barriers. This reason to adopt R&D outsourcing has remained constant over time, as around a decade later Bzhalava and Cantner (2018) found that in German companies outsourcing R&D and participating in long-term open innovation partnerships were still mainly driven by a need for external knowledge.

Diaz-Mora and Triguero-Cano (2012) reasoned that the higher degree of outsourcing in certain markets was often linked to the market's volatility: the more volatile a market is in terms of circumstances, the more flexible a company needs to be to perform well. As a result, in these volatile markets, companies also tend to outsource more often. Lin and Tsai (2007) also found that in these same circumstances (volatile market conditions), companies indeed tend to focus way more on their core activities and technologies than on non-core activities, and as a result, also tend to outsource the non-core activities more frequently. They also state that the fact that the company operates in a high tech market contributes to this phenomenon, which is in line with the findings of Cantone, Testa, Hollensen, and Cantone (2019). Demsetz (1997) already stated something similar in 1997, when he hypothesised that markets with a lot of uncertainty (be that through changes in technology or demand) required more flexibility and would also outsource more often to obtain this flexibility.

The research by Van de Vrande et al. (2009) and Bzhalava and Cantner (2018) was not performed in a specific industry, so one might argue that these general results will not always apply to industries that operate in unique and volatile circumstances, like the industries in which scale-ups usually operate. A few years after Van de Vrande et al. (2009) published their motives and barrier to Open Innovation (more on this topic later) in SMEs, Achiche et al. (2012) tried to verify whether the earlier findings also held for the MedTech industry, which is considered a high-tech environment with many scale-ups. Most of the motives and barriers did indeed overlap, and lack of technical knowledge was once again mentioned as the top reason for deciding to outsource R&D. The main reason for this was that in the medical industry, it is often cheaper to outsource non-core modules and activities. This is due to the fact that many of these non-core modules and activities are more standardised throughout the industry compared to the core-module, which is often a more radical innovation. Oftentimes, non-core modules require specific knowledge that the outsourcing company can not easily re-use in their other projects. This has led to the birth of companies that specialise in both the development and manufacturing of these modules so that the outsourcing company does not have to invest in skills, knowledge and capacity that it will only need for a limited amount of time.

Other important motives to outsource R&D in high-tech industries are capacity and focus (Achiche et al., 2012). Capacity is an important motive because, compared to operational activities, R&D is not a continuous activity but rather happens in short bursts over time. Companies can not

**Strategic Risk and extent of control over suppliers**

| Technological Domain | Low | High | Low | High | |
|---|---|---|---|---|---|
| | 2 ... 1 | 2 ... 1 | High | |
| Unfamiliar | | *Outsource* | | | |
| | 3 ... 4 | 3 ... 4 | Low | |
| **Broad** | | **2** | **1** | | |
| | 6 Outsource 5 | 6 Keep in-house or Outsource 5 | High | |
| Familiar | | | | |
| | 7 Outsource or Keep in-house 8 | 7 Keep in-house 8 | Low | |

**Technological discontinuity** (left axis: Broad / Narrow)

| | 2 ... 1 | 2 ... 1 | High |
| | Outsource | Keep in-house | |
| **Narrow** Familiar | **3** | **4** | |
| | Outsource or Keep in-house | Keep in-house | Low |
| | 3 ... 4 | 3 ... 4 | |

Right axis: **Competitive Pressure** (time, costs, quality performance, investments required)

Bottom axis: Narrower — Broader

**Relative capabilities range of the sourcing company (vs competitors/suppliers)**

Figure 3: The outsourcing decision-making model for NPD activities (from Cantone et al., 2019)

always flexibly hire and discharge R&D personnel to account for this volatility in R&D activities, so outsourcing this to a company that specializes in doing R&D projects and providing capacity is a better option. The final motive, focus, is related to the fact that companies want to invest the resources they have in their core modules and activities. Having to juggle more balls is distracting and leads to a longer time to market on average, something that can be very detrimental to product performance in high-tech industries (Cantone et al., 2019). Interestingly enough, these two motives are not only important in the MedTech industry, but even more so for scale-ups: given their limited resources and desire to grow quickly, they tend to focus more on their core technologies to ensure the aforementioned fast time to market. Part of this strategy is dedicating most of their capacity to their core-modules, meaning they often simply lack the (human) resources to develop non-cure modules themselves.

Another interesting research related to outsourcing in high-tech markets (like MedTech) is the aforementioned publication of Cantone et al. (2019). They conclude their research with an interesting model that can be applied on the MedTech industry, which is the context of this research. The model prescribes whether a company should outsource R&D, based on the characteristics of their industry and product. This model can be seen in Figure 3.

Conclusions can not be drawn for every company in the MedTech industry, but some general assumptions based on industry characteristics can be made. Technological Discontinuity relates to whether the innovation involves either product or product innovation (narrow in the model) or both (broad in the model). This is specific to the activities of the company, so both are possible in the MedTech industry. The Technological Domain refers to whether the firm is venturing into a technological domain unknown to them, which is also strongly firm specific. Strategic Risk of outsourcing is usually low for non core modules and activities (which constitute the majority of a product), Competitive Pressure in the MedTech market is high, and the Relative Capabilities range is narrow (as these companies tend to focus on a specific technology) putting most MedTech

companies either in quadrant 2.2, 2.6, 3.2 or 3.3. All of these quadrants state that outsourcing would be beneficial according to Cantone et al. (2019) research, which indicates that the majority of MedTech companies would indeed be better off outsourcing R&D, given that the assumptions made about the MedTech industry are correct. This is in line with recent research by Dziurski and Sopińska (2020), who see R&D cooperation and outsourcing practices being adopted more often in industries that can be classified as high-tech. Earlier research by Chesbrough and Crowther (2006) stated that companies in traditionally more low-tech industries did not innovate differently than their high-tech counterparts. However, other research has shown that what leads up to the decision to outsource R&D in high-tech industries is definitely different from low-tech industries (e.g. (Schmidt, 2007; Bigliardi & Galati, 2016)). This is also in line with McCormack et al. (2015), who tried to replicate Achiche et al. (2012)'s research in the Irish MedTech industry, and found that R&D outsourcing was the most popular form of OI in that specific industry.

## 2.2 R&D Outsourcing as a form of Open Innovation

R&D outsourcing is a form of Open Innovation (OI). OI is defined by Chesbrough and Bogers (2014) as being "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model". As R&D and manufacturing outsourcing both include purposively managed knowledge flows, these activities fit the description of OI. Furthermore, the outsourcing company compensates the company that performs the R&D activities financially, which is a pecuniary mechanism. Dahlander and Magnusson (2008) found that in general, companies that were open to external knowledge had a better innovation performance, which in turn resulted in better company performance overall. This means that there seems to be a strong incentive for companies to look further than their own organizational boundaries for both knowledge and capacity.

It is very important to understand why manufacturing outsourcing has been grouped together with R&D outsourcing in this research, because the latter is arguably more knowledge intensive. The reason for this is that manufacturing outsourcing in the high-tech industry often involves activities like Value Engineering (VE, which explores how a module or component can be manufactured in the most cost effective way) and Design for Manufacturability (DfM, which explores how the initial module or component can be changed in such a way it is suitable for higher volumes manufacturing) (Kuo & Zhang, 1995). Both of these activities also include the purposely managed knowledge flow that is mentioned in the definition given by Chesbrough and Bogers (2014). The nature of manufacturing outsourcing might be less knowledge intensive, but given that it still involves engineers providing suggestions and improvements to a client's product, R&D outsourcing, manufacturing outsourcing and all the engineering those activities contain is considered as one activity for this research, and is from now on simply referenced to as R&D outsourcing.

## 2.3 Motives and barriers to outsourcing R&D

### 2.3.1 Motives to outsourcing R&D

Van de Vrande et al. (2009) described the motives SMEs experienced to engage in different kinds of OI activities, including R&D outsourcing. A motive is a reason that influences the outcome of the outsourcing decision in favour of deciding for outsourcing. This means that if the magnitude of the perceived motives is larger than the magnitude of perceived barriers, a company will perceive the advantages of outsourcing as larger than the disadvantages.

By far the most mentioned motive to outsource R&D was Knowledge. Gaining knowledge and bringing outside expertise into the organization constituted 59 of the 134 motives mentioned by respondents, which is more than the 3 next most-mentioned motives combined. As R&D outsourcing

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is a very knowledge intensive activity, this does not come as a surprise. It is also in line with the earlier stated fact that innovative, fast growing companies do not have the knowledge in-house to cover all their technological non-core domains. It is important to note that this differs from most other OI activities companies perform, where the largest motive was Market (defined as keeping up with market trends and increasing market share) (Van de Vrande et al., 2009).

The research by (Van de Vrande et al., 2009) provides the initial categories that will likely be encountered in the field, but it does not provide any concrete items that can be used to measure these constructs. Furthermore, whether a company experienced a motive was measured in a binary way (either a company experienced the motive, or they did not). This means that knowledge for example is merely the motive most companies experienced, not the motive that was experienced most severely on average, which is a very important distinction. Given these circumstances, it was decided to use another set of motives than those described by Van de Vrande et al. (2009). A research performed on motives to outsourcing practices by Varajão et al. (2017) was used. This research examined the outsourcing of high-tech IT activities, and therefore, was close enough to R&D outsourcing to be considered a good candidate. Furthermore, the research provided all the items they used to come to their final motives, used Likert scales, and proved their scales had sufficient Cronbach's Alphas, all of which Van de Vrande et al. (2009) did not. As a result, the motives of (Varajão et al., 2017) were used in this research.

### 2.3.2 Barriers to outsourcing R&D

A barrier is a factor that influences the outsourcing decision in favour of deciding not to outsource. The work by Van de Vrande et al. (2009) is also the most influential piece of literature when it comes to barriers to outsourcing R&D. At the time of publishing of their research, open innovation literature primarily focused on large, multinational companies. Van de Vrande et al. (2009) took it upon themselves to examine the state of open innovation in SME's, with a focus on trends, motives and barriers. One of their findings is that there is a relation between the size of a firm and its tendency to participate in open innovation. The study divided participating companies in Small (10-50) and Medium (50-500) sized enterprises, and found that the latter was more active in seeking knowledge outside the company boundaries (as was later confirmed by other studies, e.g. Diaz-Mora and Triguero-Cano (2012). The main reason for this was that, in general, the smaller firm experienced some barriers more intensely than larger firms. Van de Vrande et al. (2009) also deliberately excluded micro-sized companies (companies with less than 10 employees) from their sample, as these companies often have limited structured innovation activities.

Van de Vrande et al. (2009) found that the biggest barriers to R&D outsourcing amongst innovative Dutch SME's in the period of 2006 to 2009 was their Organization & Culture. This barrier is related to how the firm balances innovation with their operational tasks, communication within the organization, the alignment of partners and the organization of innovation activities within the firm in general. The 4 other significant barriers are, in order of level of occurrence: Quality of Partners (28%), Administration (19%), Resources (10%) and Finance (4%)). This is an interesting finding, the authors note, as time and resources turned out to be only minor barriers in the adoption. The researchers also state that for OI adoption in general (so all types of OI combined instead of looking only at R&D outsourcing), the barriers are very diverse, but that Organization & Culture is the biggest barrier of all.

It is important to note that over the years, many researchers have tried to define the barriers companies face when trying to outsource R&D. However, many of these barriers have been merged or unmerged over time, leading to different levels of aggregation within the lists of barriers. Bigliardi

and Galati (2016) reviewed all existing literature up until that point, and compiled a list of all the different barriers found across Open innovation literature (including (Van de Vrande et al., 2009)). After surveying a total of 157 innovative companies in Italy, they used a factor analyse to narrow their set of 17 compiled barriers into four main categories:

1. Knowledge barriers.

2. Collaboration barriers.

3. Organizational barriers.

4. Financial and Strategic barriers.

## 2.4   R&D Outsourcing and Scale-ups

As mentioned before, very little academic research has been done on outsourcing decisions for scale-ups. One notable work is that of Hogenhuis, van den Hende, and Hultink (2016), which focuses on the outsourcing decision in cases when start-ups and scale-ups want to set up a collaboration or outsourcing project with a larger manufacturer. However, their work looks at this phenomenon completely through the lens of a manufacturer, and as a result, their findings only provides actionable results for manufacturers, instead of understanding the process from the scale-up's point of view.

As mentioned before in this literature review, (Lin & Tsai, 2007) state that in turbulent conditions, companies tend to focus more on their core activities and favor outsourcing non-core activities or modules. This strategy can create big opportunities for companies (Cunningham, 2001). One can argue that scale-ups are per definition more turbulent, because they often work with more radical innovations. This would make it all the more likely for these scale-ups to outsource, and therefor even more peculiar that no research has been performed on this topic before.

Based on the aforementioned literature, it is clear that in many cases R&D outsourcing is beneficial. However, it is not clear what motivates scale-ups in high-tech industries have to seek knowledge outside of their organizational boundaries, nor is it known which motives and barriers they perceive when making this decision. Research has been performed on the motives and barriers SMEs experience in general, but the question remains to what degree they also apply for scale-ups. As the latter is a sub-set of the first with some inherent differences, it would not be warranted to simply assume that these findings also hold for scale-ups. As such, a qualitative pre-study is carried out to determine if these general findings also apply in this specific case.

# 3    Qualitative Prestudy

## 3.1    Decisions based on literature

After the literature review, a decision had to be made: should the barriers described by Van de Vrande et al. (2009) be used, or those of (Bigliardi & Galati, 2016). The main arguments to use Van de Vrande et al. (2009) are the following:

1. The research by Van de Vrande et al. (2009) has about 20 times more citations than Bigliardi and Galati (2016) according to Google Scholar

2. The research by Van de Vrande et al. (2009) categorizes Open Innovation into many different activities, of which one is R&D outsourcing. The barriers they provide in their research specifically refer to R&D outsourcing, while the barriers provided by Bigliardi and Galati (2016) are barriers for Open Innovation in general

The main arguments to use (Bigliardi & Galati, 2016) are the following:

1. The research of (Bigliardi & Galati, 2016) reviews the large amount of literature that built up during the years about barriers to Open Innovation, and reviews all barriers and items used in those publications (among which is the research of (Van de Vrande et al., 2009)). This means that their work has a broader literary input compared to (Van de Vrande et al., 2009)

2. Just as with the motives, (Van de Vrande et al., 2009) did not document the items used to assess their barriers in much detail. This is in contrast to (Bigliardi & Galati, 2016), who documented the exact wording of their items, and after performing their factor analysis also documented the Cronbach's Alphas of their barriers

After reviewing these arguments, it was decided to use (Bigliardi & Galati, 2016) as the leading article regarding barriers. Even though (Bigliardi & Galati, 2016) focus on Open Innovation in general, their methods are more replicable and robust, which was deemed as the most important factor.

## 3.2    Exploratory interviews

To determine if the motives and barriers currently used in the more general outsourcing and Open Innovation literature applied to scale-ups, a set of interviews was conducted. On top of that, the interviews also served as a way to uncover additional motives and barriers that might only be perceived by MedTech scale-ups, that have stayed under the radar in research with larger, more general populations. The interviews were conducted with 3 companies that had outsourced parts of their R&D and manufacturing to NTS in the past few years. The profiles of the companies can be seen in Table 1

Table 1: Characteristics of participating companies

| Company | Sub-market | Size | Stage of growth |
|---------|------------|------|-----------------|
| A | Proton Therapy Equipment | ± 2000 | Post scale-up |
| B | Surgical Robotics | ± 10 | Scale-up |
| C | Smart Catheters | ± 5 | Pre scale-up |

To select the companies that would participate in these interviews, convenience sampling was used. The advantages of convenience sampling is that data can be collected in a relatively short amount of time, without a lot of resources. In this case the sample included three customers of NTS operating

in the MedTech industry. Company A was a larger company that was a former scale-up, Company B can be described as scale-up according to the official definition of the OECD (Eurostat-OECD , 2005), and Company C was still a start-up. This meant that the set of cases was broader than the unit of analysis of this research (scale-ups). These were the only companies that were available within a reasonable time frame to discuss their outsourcing practises, that could also easily be reached through NTS.

The disadvantage of convenience sampling is that it endangers the generalizability of results (Etikan, Musa, & Alkassim, 2016). However, the sampling method is justified by the lack of availability of companies with the right characteristics, and the time frame of this research. Furthermore, the qualitative pre-study served as an exploratory way to investigate to what degree the existing literature overlapped with practice, not to draw conclusions on the magnitude or significance of any of these motives and barriers.

To get the interviewee in the right mindset, the context of the research was explained, and certain terms were defined in detail to make sure the questions or answers would be interpreted incorrectly due to semantic differences. The interviewee was introduced to the concept of R&D outsourcing and some real life examples (usually taken from the projects NTS did specifically for that company). The interviewee was encouraged to recall different outsourcing projects they had done in the past and compare how they were different. This was not very important for the overall results, but was used to let the interviewee re-live these projects and recall as many details as possible. Once the interviewee had refreshed their memory regarding these projects, the first real question of the interview would be to plainly ask why the interviewee's company had decided to outsource (so their motives), and afterwards whether they encountered obstacles that made them hesitant to actually outsource (barriers).

Apart from asking the interviewees which motives and barriers their organization experienced, they were also asked whether, based on their own experience, these motives and barriers were different for companies that operated in the MedTech Industry or companies that could be classified as scale-ups. These questions were asked to reveal to what degree being a scale-up or a MedTech company had an effect on the perceived motives and barriers. Based on the reasoning of the intervieee, a judgement was made on whether this was actually a motive or barrier for scale-ups.

During the interviews, follow-up questions were asked if the interviewee explained a motive or barrier too briefly. For example, an interviewee would recall a specific situation they had experienced in the past, but strongly focus on a specific motive or barrier in that context, while the interviewee also briefly mentioned other motives or barrier while describing the situation. In that case, probing questions were asked to make sure the interviewee described the new motive or barrier in more detail.

The structure of the interview can be found in Table 2.

## 3.3 Analysis

After the interviews were taken, they were transcribed. The next step was to code the interviews. All motives and barriers identified to be of importance in outsourcing and OI activities in general by Varajão et al. (2017) and Bigliardi and Galati (2016) were uploaded in a coding program, QDA Miner Lite. Furthermore, two extra codes were added: "Placeholder New Motive" and "Placeholder New Barrier". These codes were used to identify parts of the transcript that described a motive or barrier not present in the aforementioned sources. Instead of immediately making a new code for such a piece of the transcript, it would first be marked with the placeholder code to make sure

Table 2: Interview Questions

| Question category | Question |
|---|---|
| Role of interviewee | What is your role at company X? |
|  | How long have you been in this role? |
| Motives | What are the reasons for company X to look outside its company boundaries for a production or R&D partner? |
|  | Are there any ways in which these motives might be different for the MedTech industry than in the general? Are there other factors at play? |
|  | Do you think scale-ups (so smaller, fast growing companies) have different reasons to look for outside production or R&D partners? |
| Barriers | In your time with NTS, or other partners you have outsourced too, have you experienced any obstacles to the implementation or during such a partnership? |
|  | Do you think there are specific obstacles to making the outsourcing decision for the MedTech Industry? So that could be both obstacles to deciding to outsource in general, and obstacles occurring when wanting to form or having a partnership? |
|  | Do you think there are specific obstacles to making the outsourcing decision for the scale-ups? |

no conclusions were drawn until all the coding had been finished. This resulted in way more new codings related to barriers than codings related to motives. The reason for this big difference is due to the fact that the interviewees were a bit more general in their descriptions when it came to why they wanted to outsource in the first place, but when describing the pain points of outsourcing they had very specific examples. This can be attributed to the fact that during business encounters, negative experiences tend to influence the overall judgement of an encounter more severely, and they are usually easier to recall (Spreng, Harrell, & Mackoy, 1995).

Only after all transcripts had been coded, the whole set of placeholder codes was examined in more detail. Once reviewed, the newly identified motives turned out to be related to the existing motives in one way or another. As such, they would not be added as separate motives, but would serve as input for new items in the survey that would probably be related to the existing motives. The placeholder barriers were subdivided into 4 new codes describing previously undiscovered barriers, and then rechecked to ensure each coded transcript did indeed refer to only the newly created barriers, and no overlap occurred with existing ones

## 3.4   Results

An overview of the results of the coding process extracted from QDA Miner is given in 3.

Table 3: Coding results

| Category | Name | Count | % Codes | Cases | % Cases |
|---|---|---|---|---|---|
| Motives | Financial | 4 | 8.2% | 3 | 100% |
| | Organizational | 6 | 12.2% | 2 | 66.7% |
| | Technological Resources | 5 | 10.2% | 2 | 66.7% |
| Barriers | Collaboration | 4 | 8.2% | 2 | 66,7% |
| | Knowledge | 4 | 8.2% | 3 | 100% |
| | Organizational | 1 | 2% | 1 | 33.3% |
| | Financial and Strategic | 3 | 6.1 % | 2 | 66.7% |
| New Barriers | Standard & Regulations | 5 | 10.2% | 3 | 100% |
| | Partner's Management Dedication & Priority | 4 | 8.2% | 2 | 66.7% |
| | Strategic Importance of Module | 7 | 14,3% | 2 | 66.7% |
| | Product Complexity | 6 | 12.2% | 2 | 66.7 % |

Motives from Varajão et al., 2017, Barriers from Bigliardi & Galati, 2016, and New Barriers from interviews

As can be seen, all motives (Financial, Organizational, Technological Resources) and barriers (Collaboration, Knowledge, Organizational, Financial and Strategic) that were expected to be encountered based on Varajão et al. (2017) and Bigliardi and Galati (2016), were mentioned at least once. This means that all of them could be included in the survey that would be designed based on these interviews. Additionally, four new barriers were discovered during the interviews:

1. Standards and regulations: Related to legislation, regulations, standards and required certification. All interviewees indicated this to be a large barrier in finding a good partner. This was also to be expected in the MedTech market, but interviewees also stated that companies that wanted to grow fast would experience this obstacle more severely. The main reason for this is that processes related to this barrier are often slow and an administrative burden.

2. Partner's Management Dedication and Priority: Company B and C (so the two smaller companies) expressed that they felt like companies gave them less priority compared to larger customers. A scale-up often has limited volume, meaning that these companies are simply not high on the list of priorities for outsourcing partners.

3. Strategic Importance of Module: The 'Financial and Strategic' barrier does consider strategic decisions, but not in the way this barrier does. This barrier focuses on the fact that certain modules are at the core of what gives the company its competitive edge. This was mentioned so often (and for various reason) that it has been made into its own barrier.

4. Product/Module Complexity: Scale-ups often work with very complex, radical innovations. The interviewees expressed that certain parts of their product could not be outsourced due to its sheer technological complexity. This was either because the module itself was very complex, or because the large amount of dependencies between different modules.

Based on the qualitative pre-study, it can be concluded that the motives and barriers as listed in previous research do not cover all the motives and barriers encountered by MedTech scale-ups in the field. The interviews gave insights into which as of yet barriers seem to play a role in the outsourcing process, and helped create the conceptual model of this research.

### 3.5 Conceptual Model

Apart from the motives and barriers that arise from the literature and pre-study, there are several other variables that play a role in the outsourcing process. They will be discussed below, before being integrated into the conceptual model.

#### 3.5.1 Value or Usefulness

Together, motives and barriers determine how much value a scale-up perceives in outsourcing. Nijssen, Singh, Sirdeshmukh, and Holzmüeller (2003) define value as a subject's perception of the benefits enjoyed versus the cost incurred in a specific situation. In this case, the scale-up is the subject, the benefits and costs are the motives and barriers, and the situation is the outsourcing decision. One would assume that a high degree of motives and a low degree of barrier would thus lead to a high perceived value, and vice-versa. In the survey itself, this variable would eventually end up being called 'usefulness' because this term was easier to understand for respondents, as 'value' could be interpreted in multiple ways.

#### 3.5.2 Scale-up

As other parts of the literature review have already suggested, there is no academic literature describing how the aforementioned motives and barriers exactly apply to scale-ups. Given that the sample on which this research is performed contains both scale-ups and non-scale-ups, both sub-samples will be compared using T-tests. Furthermore, it will be tested whether being a scale-up has a moderating effect on the relationship between the motives and barriers and perceived usefulness of outsourcing. This helps in identifying which barriers and motives are important for both categories and which are especially applicable to scale-ups. To determine if a company is a scale-up, questions are included in the survey that probe whether a company adheres to the OECD's criteria for being considered a scale-up (Eurostat-OECD , 2005).

#### 3.5.3 Outsourcing Activity

Scale-ups might have a certain attitude towards the outsourcing process (which is encapsulated in perceived usefulness), but it is not clear how this attitude translates into action. Will looking favourably at the outsourcing process actually translate into making the decision to outsource? One would assume that that is indeed the case, but this research allows us to test that assumption. If the discrepancy is large between attitude and actual decision, this could imply that there are other variables that play a role in this process that have not been included in this research. To test this, participating companies will be asked about both their outsourcing history and their intentions for the future. So far, it has not been researched whether being a scale-up has any influence on this relationship, so combining perceived usefulness with outsourcing activities and company type allows for the investigation of this relationship.

The conceptual model in Figure4 shows how both the motives and barriers relate to Usefulness, which in turn relates to outsourcing activity, with the fact that a company is a scale-up moderating all relationships.
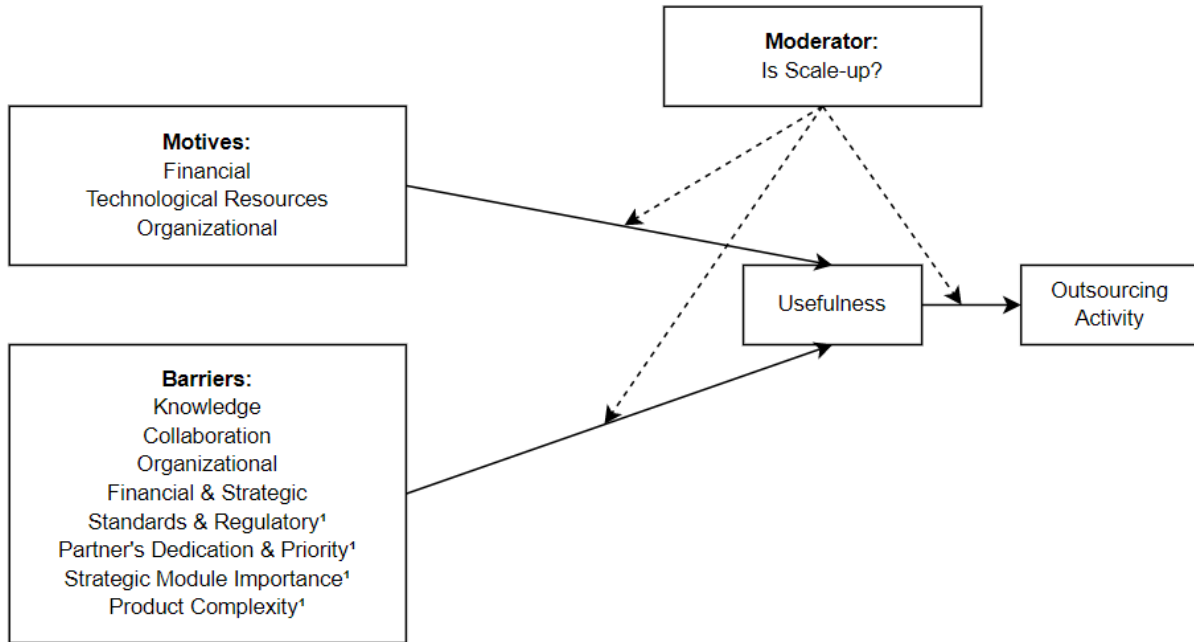
Figure 4: The conceptual model (Note: Barriers denoted with a 1 have been added based on the pre-study)

Each part of the conceptual model will serve a purpose in answering the research questions.

- The first and second research question can be answered by confirming whether these motives and barriers are indeed the motives and barriers that are experienced in the field by scale-ups.

- The third research question can be answered of the motives and barriers are confirmed. Means for the sub-samples of scale-ups and non-scale-ups can be compared to determine how they differ.

- The fourth research question can be answered by looking at the relationship between the found motives and barriers and Usefulness, and how being a scale-up influences that relationship.

- The fifth research question can be answered by looking at the relationship between Usefulness and Outsourcing activity (both past and future).

After these relationships were established, the data collection methods could be set up, and the population to extract the data from be identified. These activities are discussed in the next chapter.

# 4 Methodology

## 4.1 Population

This research was carried out in the Dutch Medical Technology Industry. Based on the industry's characteristics, it is believed that both the amount of scale-ups and the degree of R&D Outsourcing is high.

What is considered MedTech and what is not varies per source. As such, trying to figure out how companies operate within this segment in the Netherlands is difficult. A report by the Dutch government estimates the amount of companies operating in MedTech to be somewhere between 500 and 700 (Rijksoverheid, 2019).

The report also states that about 95% of all MedTech companies in the Netherlands are SMEs. While this gives an indication of what the MedTech landscape looks like, it does not help in determining the amount of scale-ups that operate in this industry. Doing a quick back-of-the-envelope calculation, it can be concluded that if 5% of the total SME-population consist of scale-ups (PricewaterhouseCoopers, 2018), that would amount to between 25 and 35 in the Dutch MedTech industry. However, the 5% is taken from research in North Africa and the Middle East, and does not focus on the MedTech market, so should be seen as an estimation.

## 4.2 Sample

Using LinkedIn Sales Navigator, and initial list of companies was identified. While the aforementiod research (Rijksoverheid, 2019) mentioned between 500-700 MedTech companies in the Netherlands, LinkedIn Sales Navigator identified about 1500 companies that had categorized themselves as such. Using the platform Fiverr, these 1500 companies were screened, and contacts were added where possible. A substantial amount of the company-pages on LinkedIn turned out to be empty or had only one (part-time) employee. For the remaining companies, the CEO was identified or a director-level employee that was involved in product development, depending on who's contact information was available. This initial contact list contained 342 companies and their respective contact persons. A second round of investigation (using various lists found on the internet instead of LinkedIn) yielded another 63 companies, increasing the total number of companies on the contact list to 405.

Eventually, of the 405 approached companies, 81 participated in the research, resulting in a response rate of 20%. Of these 81 respondents, 11 indicated that their company focused on selling products made by a third party. This led to them being designated as 'Merchants', and as a result, they were excluded from the research on the basis that they did not perform their own product development. This brought the total number of valid responses to 70. More descriptive characteristics of the participating companies is given in Chapter 5.1.

## 4.3 Scales/Items

Based on the literature review and the qualitative pre-study, a set of motives and barrier was identified that would probably be encountered when surveying the population. The motives were taken from Varajão et al. (2017), four of the barriers from Bigliardi and Galati (2016) and the rest of the barriers were drawn from the pre-study. Varajão et al. (2017) and Bigliardi and Galati (2016) both used multiple items to assess the their motives and barriers. These items were also documented in both publications, and their corresponding latent constructs verified for validity (all of which had a sufficient Cronbach's Alpha). For most of these factors, however, extra items were added (based on the pre-study) to make sure that a sufficient number of items would actually end up loading on the factors. All items, motives and barriers used in the survey are documented in

detail below. Please note that anything in bold was added for this research based on the pre-study. Furthermore, in the survey, every item was preceded by the question "How important were or are the following motivations in your outsourcing decision?"

The three motives and their scales were taken from (Varajão et al., 2017).

- Financial
  - Cost reduction.
  - Cost control.
  - Reduction of the need to invest ourselves.
  - Possibility to redirect existing resources.
  - Improving our accounting balance sheet.
  - Increasing our business' flexibility.
  - Sharing risk with another company/partner.
  - **Accelerate our go-to-market.**
  - **Increase the chance of capturing our market opportunity.**
- Technological Resources
  - Access to world-class capabilities outside the firm.
  - Access to cutting-edge technologies.
  - Access to technical proficiency and specialised human resources.
  - Obtaining resources not available internally.
- Organizational
  - Focus more on our core business.
  - **Prevent having to make major organizational/structural changes.**
  - **Compensate for our lack of capacity in this domain.**

Four of the eight barriers and their scales were taken from (Bigliardi & Galati, 2016). Once again, items in bold are additions made for this research.

- Knowledge
  - Potential loss of know-how.
  - Lack of availability of relevant external knowledge.
  - Problems linked to potential imitation of your innovation.
  - **Potential ambiguity of Intellectual Property Rights (so who owns the innovation after development).**
- Collaboration
  - Difficulties in finding the right partners.

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- – Fear for opportunistic behaviour of (potential) partners.

  – Cultural difference with (potential) partners.

- Organizational

  – Lack of adequate managerial competencies to select and manage outsourcing partners.

  – Managerial complexities of outsourcing.

  – Administrative and legal burdens that may result from outsourcing.

  – **Potential of getting locked into a relationship.**

- Financial and Strategic

  – Economic or financial issues.

  – Fear of granting a technology to others without a comprehensive understanding of its potential.

  – Cultural resistance inside our firm against outsourcing.

  – **Uncertain costs.**

Finally, the barriers that were developed specifically for this research and their respective items are documented below. Please note that they are not in bold because all barriers and items in this list were taken from the pre-study.

- Standards and regulations

  – (Potential) partners' lack of knowledge of rules and regulations.

  – (Potential) partners's lack of proper certification for our industry.

  – (Potential) problems with certification due to outsourcing.

- Partner's Dedication and Priority

  – Lack of partners willing to deal with our current low volumes.

  – Lack of partners willing to prioritise our projects (as they rather focus on larger customers).

  – Finding a partner that was willing to work with a company of our size.

  – (Potential) partners did not prioritise our projects in times of need.

- Strategic Importance of Module

  – (Potential) loss of core capabilities.

  – (Potential) loss of our competitive edge.

  – (Potential) loss of knowledge on our customer needs.

- Product complexity

  – Our product's high technical complexity.

  – (Potential) loss of synergy in engineering our product.

– Potential mistakes in design due to partner's lack of knowledge of our market and customers.

After the survey data was collected and the Exploratory Factor Analysis was performed, the motives and barriers changed slightly, and some items appeared to load stronger on other factors than was initially expected. This will be elaborated upon in Chapter 5.

## 4.4  Implementation

To ensure a good response rate, several measures were implemented based on (Fan & Yan, 2010):

1. Contact delivery modes: multiple methods of delivering the survey to the respondents was used. First, an email campaign was set up using Mailchimp, that sent out a personalized invitation and two subsequent reminders. Fan and Yan (2010) state that spam filters can be a problem, and this was also the case for the email campaign: more than 50% of the contacts never opened a single email in the campaign. As such, Fan and Yan (2010) advice to use multiple delivery modes to make sure the survey reaches the contact person. As a way to circumvent spam filters, emails were sent to general contact email addresses of the selected companies with the request to forward them to the right person. Finally, if this also did not yield any results, a direct phone call was made to the company to ensure the contact person would have the opportunity to fill out the survey.

2. Design of invitations: the initial email campaign was carefully designed. Through images and headers, the receiver could immediately see that the email was sent to collect data for academic research. Furthermore, they were made to look visually appealing and included a personalised salutation.

3. Incentives: to make it extra appealing to participate in the research, the respondent were notified that they would receive a copy of the research results (contain strategic insights on outsourcing) if they participated. On top of that, they could select one out of two charities to which a small donation would be made if they actually finished the survey.

This concluded the set-up of the survey, which was send out in multiple iterations over the course of 3 weeks.

# 5 Results

## 5.1 General descriptives

The 70 valid responses that were received could be categorized based on the two most important variables in this research: was the respondent's company a scale-up, and was the company currently outsourcing? This led to the following distribution within the sample:

Table 4: Scale-ups and Outsourcing

|                  | Scale-up | Non Scale-up | Total |
|------------------|----------|--------------|-------|
| **Outsourcer**   | 14       | 40           | 54    |
| **Non-outsourcer** | 2      | 14           | 16    |
| **Total**        | 16       | 54           | 70    |

As mentioned in the literature review, a company can be considered a scale-up if it has at least 10 employees, and experienced at least 20% revenue growth for at least 3 consecutive years (Eurostat-OECD , 2005). One of the first questions of the survey asked the respondent how large their company was, and any company with 1-10 employees was immediately disqualified from being considered a scale-up. A few questions later, the respondent was asked to indicate whether their company adhered to the 20% revenue growth criterion. Companies did indeed experience such revenue growth and had over 10 employees were considered scale-ups. There was one exception: some respondent indicated that they did not know for sure the revenue growth was 20% or more. Respondents that gave this answer were excluded from being scale-ups, except when they had answered their revenue had "Greatly increased" (the highest answer on a 7-point Likert scale) in the past 3 years in a prior question.
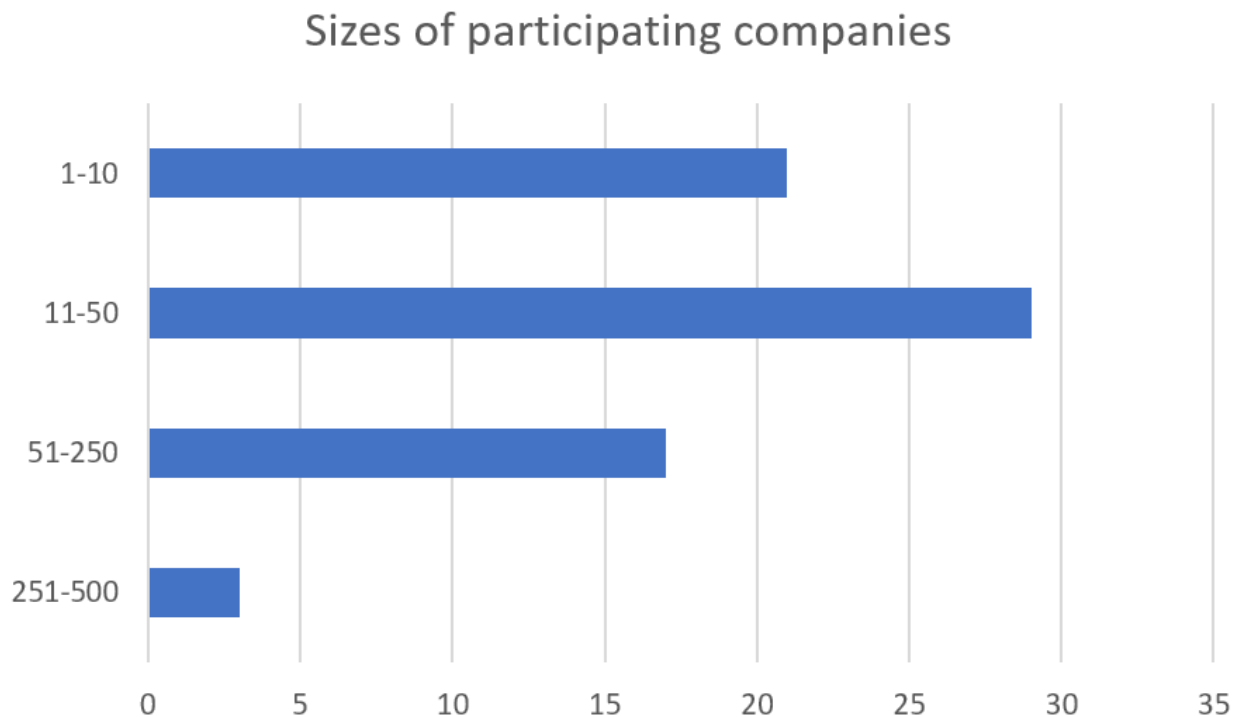
## Sizes of participating companies



Figure 5: Company sizes of the participating companies

In Figure 5 the company sizes of participating companies are shown. In the initial selection of companies for participation, companies with at least 10 employees were preferred (to make sure they could qualify as scale-up). However, not all company sizes found in this initial selection were correct, and therefore, 21 companies with less than 10 employees are part of the sample. These companies did contribute to data about non-scale-ups and helped with boosting the sample size for comparison of means between the scale-ups and non-scale-ups sub-samples.

Another important selection criterion for companies to be able to participate in the study, was that they were situated in the Netherlands. While some results will be generalize to other countries, conditions can vary which will lead to different perceptions of outsourcing. For this reason, only companies that actually operated in the Netherlands were allowed to participate. As Figure 6 indicates, all companies were either Dutch and operating in the Netherlands or were a Dutch subsidiary of an international company that operated in the Netherlands.

## Nationalities of participating companies



- Dutch organization
- Dutch subsidiary of international organization
- Non-Dutch organization

Figure 6: Nationality of participating companies

At the start of each section of the survey, respondents were reminded that it was preferable if they selected "I don't know" for an answer than making an estimation. Of the total of 5670 valid answers given by all respondents, only 37 were "I don't know", which equates to 0.65% of all answers. Important to note is that 15 of those 37 answers were given in the questions asking whether revenue growth was at least 20%. Answering "I don't know" for that question only affected the selection criteria for scale-ups, not the factor- or regression analyses. For the "I don't know" answers that affected the factor analysis, a mean substitute was used so that the program could still calculate factor scores. For the regression analysis, responses were removed if they had answered "I don't know" on either the dependent or independent variables (this resulted in only a single response being removed).

## 5.2 Exploratory Factor Analysis

The results of the factor analysis are required to answer the first research question, and also serve as input for further analysis to answer the other research questions.

### 5.2.1 Motives

Before starting the EFA, it is important to check the data set for common variance, which indicates the data set suits itself well for factor analysis. The Kaiser-Meyer-Olkin test yielded 0.7, which is above the 0.6 threshold which the literature recommends (Hoque, Siddiqui, Awang, & Baharu, 2018), suggesting the data is suitable for factor analysis.

There are two ways to determine the amount of factors that should be used for the initial analysis: using a scree-plot based on eigenvalues and using the 'elbow rule' (Schreiber, 2021), or using an eigenvalue of 1 as cut-off point, because this indicates a set of factor explains more variance than a separate set of items (Suhr, 2005). It was decided to go for the latter method in this exploratory research, because the scree-plot is a more rigorous way of determining the amount of factors. This could lead to potential factors not being picked-up that would have literary support to exist.

The eigenvalues are displayed in Table 13.

Table 5: Eigenvalues Motives

| Factors | Eigenvalue |
|---------|------------|
| 1 | 4.3107 |
| 2 | 2.1953 |
| 3 | 1.4384 |
| 4 | 1.3092 |
| 5 | 0.8477 |

Instead of 3 factors, like the literature suggested, it seems 4 factors arise from the data (as 1 is the cut-off point). This is an interesting finding, as it suggests one of the factor was to general and in fact consistent of 2 latent constructs. Running a factor analysis using Varimax rotation to decrease cross-loading, creates the factor loadings displayed in 6.

Table 6: Factor Loadings (Motives)

| Item | F1 | F2 | F3 | F4 |
|---|---|---|---|---|
| *Knowledge1* | 0.804 | | | |
| *Knowledge2* | 0.895 | | | |
| *Knowledge3* | 0.686 | | | |
| *Acceleration1* | | 0.664 | | |
| *Acceleration2* | | 0.612 | | |
| *Acceleration3* | | 0.850 | | |
| *Acceleration4* | | 0.574 | | |
| *Organizational1* | | | 0.633 | |
| *Organizational2* | | | 0.758 | |
| *Organizational3* | | | 0.691 | |
| *Finance1* | | | | 0.602 |
| *Finance2* | | | | 0.941 |
| *Finance3* | | | | 0.490* |
| **SS Loadings** | 2.29 | 2.13 | 1.70 | 1.67 |
| **Proportion Var** | 0.18 | 0.16 | 0.13 | 0.13 |
| **Cumulative Var** | 0.18 | 0.34 | 0.47 | 0.60 |
| **Cronbach's Alpha** | 0.87 | 0.80 | 0.78 | 0.71 |

*: items below the 0.5 threshold, all crossloadings below 0.35

For an overview on which codification relates to which items, see Appendix A.

Literature suggests using a cut-off for loadings of 0.5 (Awang, Afthanorhan, Mohamad, & Asri, 2015). However, this is merely a rule of thumb and the actual cut-off point differs from research domain to research domain. For example, Tabachnick, Fidell, and Ullman (2007) state that 0.45 is still a fair cut-off point when items have different frequency distributions (which is the case in this research). As such, loadings that were very close to 0.5 were deemed acceptable by the researcher if there was literary support to do so. For the motives, this meant that 'Improving our accounting balance sheet' with its loading of 0.49 was not dropped, resulting in every item loading on exactly one factor.

When looking at the loadings, it seems that the Factor Costs has split into two different factors. If the items are compared, a clear distinction between them can be made: one set of items clearly relate to finances (e.g. 'Reducing costs'), while the other set relates to business growth and accelerating time-to-market. Their low cross-loadings also indicate that the decision to use 4 factors seems to be the right one. As a result, a total of 4 motives were identified based on the data: Knowledge (F1), Acceleration (F2), Organizational (F3) and Finance (F4). As figure X shows, Cronbach's Alpha for all factors are considered either acceptable ($\geq 0.7$) or good ($\geq 0.8$). This indicates that the scales used to measure the factors are sufficiently internally consistent. Furthermore, the squared sum loadings per factor, variance explained per factor and cumulative variance are stated in 6. The 4 factors together explain 60% of the variance. What is considered to be a decent amount of variance explained once again differs from research domain to research domain, but given this is an exploratory research in management sciences, 0.6 is considered sufficient (Samuels, 2017).

If the initial number of factors would have been used that the literature suggested, total variance explained would 0.52, which is considerably lower than when 4 factors are used. This fact, combined with the Cronbach Alpha's, suggest that 4 factors is indeed the better choice.

### 5.2.2 Barriers

The method for determining the factors that were perceived as barriers is the same as with the motives. Calculating the Keyer-Meyer-Olkin test yielded 0.66, suggesting there is less common variance in the barrier dataset, but still passing the 0.6 threshold. Calculating the eigenvalues yield the following Table 7:

Table 7: Eigenvalues Barriers

| Factors | Eigenvalue |
|---------|-----------|
| 1 | 6.9046 |
| 2 | 3.8643 |
| 3 | 2.5415 |
| 4 | 1.7152 |
| 5 | 1.3740 |
| 6 | 1.2745 |
| 7 | 1.1279 |
| 8 | 1.0535 |
| 9 | 0.9402 |

The data suggested that there are a total of 8 latent constructs, which is the exact amount that was anticipated based on the literature and the quantitative pre-study. However, running the analysis revealed there was one factor that had only one item above the 0.5 loading threshold. A factor with only one item makes little sense, so the amount of factors was decreased to 7. The factor analysis with 7 factors revealed that a set of items had either very high cross-loadings or did not get close to the 0.5 threshold. The following items were omitted (one at a time):

1. Lack of availability of relevant external knowledge

2. Cultural differences with (potential) partners

3. Potential of getting locked into a relationship

4. Economic or financial issues

5. Cultural resistance inside our organization against outsourcing

6. Potential of getting locked into a relationship

After these items were removed, all remaining items only loaded on 1 factor. However, there were still four items that loaded between 0.4 and 0.5 on 1 factor, and not above 0.4 on any others. Once again, these items were still incorporated in their respective factors based on Cronbach's Alpha and the literary support of this decision. This resulted in the final factors as seen in Table 8

| Item | F1 | F2 | F3 | F4 | F5 | F6 | F7 |
|------|------|------|------|------|------|------|------|
| *Collaboration1* | 0.945 | | | | | | |
| *Collaboration2* | 0.796 | | | | | | |
| *Collaboration3* | 0.769 | | | | | | |
| *Collaboration4* | 0.528 | | | | | | |
| *Collaboration5* | 0.494* | | | | | | |
| *Collaboration6* | 0.465* | | | | | | |
| *Certification1* | | 0.887 | | | | | |
| *Certification2* | | 0.841 | | | | | |
| *Certification3* | | 0.814 | | | | | |
| *Certification4* | | 0.657 | | | | | |
| *Strategic1* | | | 0.887 | | | | |
| *Strategic2* | | | 0.690 | | | | |
| *Strategic3* | | | 0.654 | | | | |
| *Strategic4* | | | 0.503 | | | | |
| *Product1* | | | | 0.830 | | | |
| *Product2* | | | | 0.629 | | | |
| *Product3* | | | | 0.470* | | | |
| *Knowledge1* | | | | | 0.744 | | |
| *Knowledge2* | | | | | 0.549 | | |
| *Knowledge3* | | | | | 0.419* | | |
| *Managerial1* | | | | | | 0.873 | |
| *Managerial2* | | | | | | 0.563 | |
| *Uncertainty1* | | | | | | | 0.740 |
| *Uncertainty2* | | | | | | | 0.640 |
| **SS Loadings** | 3.25 | 3.12 | 2.65 | 1.86 | 1.57 | 1.50 | 1.30 |
| **Proportion Var** | 0.14 | 0.13 | 0.11 | 0.08 | 0.07 | 0.06 | 0.05 |
| **Cumulative Var** | 0.14 | 0.27 | 0.38 | 0.45 | 0.52 | 0.58 | 0.63 |
| **Cronbach's Alpha** | 0.85 | 0.89 | 0.82 | 0.76 | 0.73 | 0.76 | 0.63 |

*: items below the 0.5 threshold, all crossloadings below 0.35

For an overview on which codification relates to which items, see Appendix B.

Some factors came out different from what was initially anticipated. The differences were as follows:

1. Instead of having a separate factor Collaboration (based on Bigliardi and Galati (2016)) and factor Partner's Management Priority and Dedication (based on the pre-study), their items loaded on one factor. This makes sense, as all items of PMPD were actually items that assassed how dedicated a partner was (even in conditions that were not optimal to the partner), which is an aspect of collaboration between parties. As such, these items were merged into the factor Collaboration.

2. The factor Organizational did not emerge. The items related to organizational culture did not load on any other factors and were removed from the analysis. Of the remaining five items, two pairs of two formed new factors: Managerial Issues and Uncertainty Issues. The final item, Administrative and Legal Burdens loaded high on the Certification factor (which is very logical, and this factor related to barriers arising from laws, regulations and certfication

requirements).

3. The final deviation from the expected outcome was the item Loss of know-how. This item was expected to load on Knowledge, however, it ended up loading on the factor Strategic Module Importance. The factor SMI was created based on the pre-study, and contains items that relate to a module being so important that outsourcing it would create losses for the company, either in competitive edge, customer knowledge or synergy in engineering. Know-how is strongly related to these domains, so the fact that this item shifted was unexpected, yet plausible.

The fact that factors emerged and fell apart led to the updated version of the conceptual model found in Figure 7:
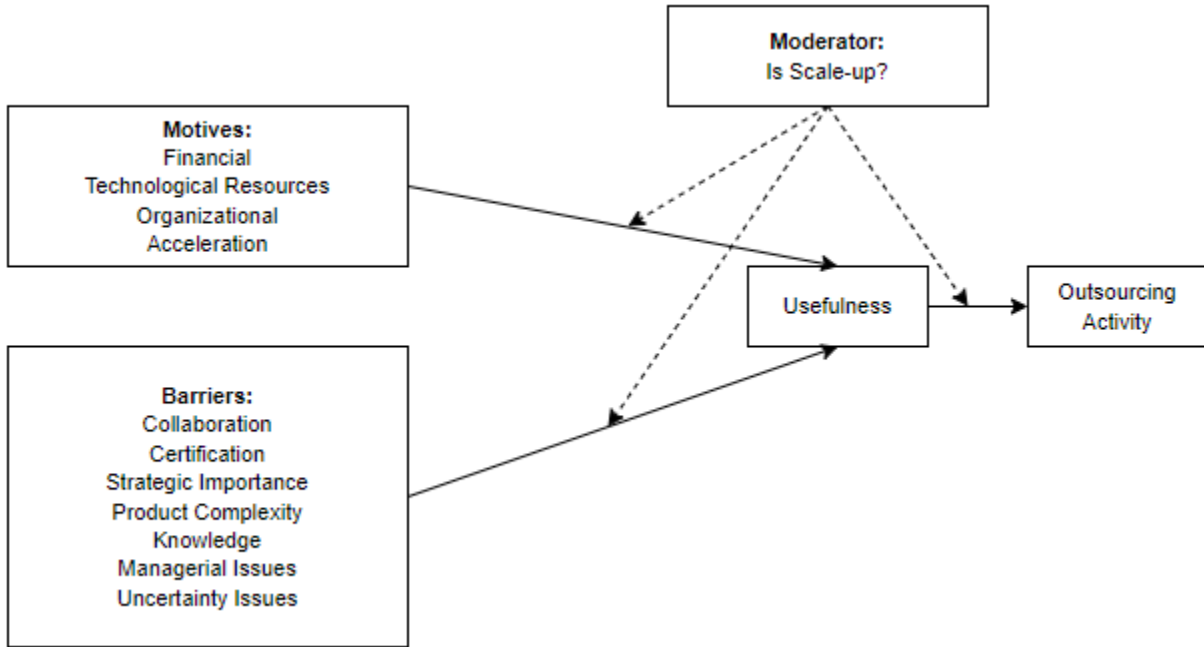


Figure 7: Updated Conceptual Model

### 5.2.3   Values

Given the set of factors and their respective items, the mean and standard deviation for each motive and barrier can be calculated. These results can then be used to answer the first two sub-questions. To come to an actual value for each of the factors, equal weights were used for each items when calculating the value of the factor. This was recommended by the analysis program for analysis with smaller sample sizes, as is the case in this research.

Table 9: Descriptives Motives

| Motive | $\mu$ | $\sigma$ |
|---|---|---|
| Knowledge | 3.80 | 0.94 |
| Acceleration | 3.83 | 0.82 |
| Organizational | 3.91 | 0.90 |
| Finance | 3.08 | 0.80 |

Table 10: Descriptives Barriers

| Barrier | $\mu$ | $\sigma$ |
|---|---|---|
| Collaboration | 3.45 | 0.73 |
| Certification | 3.54 | 0.92 |
| Strategic Importance | 3.16 | 0.87 |
| Product Complexity | 3.42 | 0.82 |
| Knowledge | 3.15 | 0.90 |
| Managerial Issues | 3.23 | 0.87 |
| Uncertainty Issues | 3.15 | 0.84 |

## 5.3 Welch's T-Tests Juxtaposing Scale-ups and Non-Scale-ups

The Exploratory Factor Analysis revealed which motives and barriers MedTech companies experience during their R&D outsourcing process. To answer the second research question, the total sample was split into a group of scale-ups and a group of non-scale-ups. A respondent was considered a scale-up if it adhered to the criteria set out by the Eurostat-OECD (2005) (at least 10 employees and revenue growth of at least 20% for three consecutive years). Using these criteria, a total of 16 scale-ups were identified in the sample, and a total of 54 non-scale-ups.

To compare the means of the two groups, a T-Test was used. A Welch's T-Test is best suited in this instance, as it corrects for skewed sample sizes (as is the case in this research) (Ruxton, 2006). The results of the Welch's T-Tests can be found in Tables 11 and 12.

Note that for all analyses (including the regressions later in this chapter), anything with a p value lower than 0.1 was considered significant. Selection of significance levels is inherently arbitrary and prone to influencing research results with only slight changes (Gelman & Stern, 2006). As such, given the low sample size and exploratory nature of this research, the author believes the circumstance substantiate this decision.

Table 11: Welch's T-Tests Motives

| | Scale-ups (n=16) | | Non Scale-ups (n=54) | | |
|---|---|---|---|---|---|
| **Motive** | $\mu$ | $\sigma$ | $\mu$ | $\sigma$ | $\Delta$ |
| Knowledge | 4.020 | 0.649 | 3.741 | 1.007 | 0.2790 |
| Acceleration | 4.038 | 0.622 | 3.774 | 0.868 | 0.2640 |
| Organizational | 4.375 | 0.687 | 3.772 | 0.913 | 0.6030*** |
| Finance | 3.140 | 0.979 | 3.063 | 0.755 | 0.0770 |

*: p<0.1 **: p<0.05 ***: p<0.01

Table 12: Welch's T-Tests Barriers

| | Scale-ups (n=16) | | Non Scale-ups (n=54) | | |
|---|---|---|---|---|---|
| **Barrier** | $\mu$ | $\sigma$ | $\mu$ | $\sigma$ | $\Delta$ |
| Collaboration | 3.840 | 0.526 | 3.335 | 0.7395 | 0.5050*** |
| Certification | 3.844 | 0.491 | 3.454 | 0.997 | 0.3900** |
| Strategic Importance | 3.172 | 1.063 | 3.159 | 0.820 | 0.013 |
| Product Complexity | 3.500 | 0.6325 | 3.395 | 0.867 | 0.105 |
| Knowledge | 3.271 | 0.983 | 3.116 | 0.880 | 0.1550 |
| Managerial Issues | 3.594 | 0.712 | 3.120 | 0.885 | 0.4740** |
| Uncertainty Issues | 3.281 | 0.966 | 3.111 | 0.815 | 0.170 |

*: p<0.1 **: p<0.05 ***: p<0.01

## 5.4 Regression Results

Before running the regressions, several tests were used to determine whether the data was suitable for a regression analysis. The results of these tests can be found in the table below:

Table 13: Tests for Regression

| Criterion | Test (if applicable) | Value | Value |
|---|---|---|---|
| Heteroskedastisicy | Breusch-Pagan | p = 0.544 | Passed |
| Autocorrelation of residuals | Ljung-Box | p = 0.308 | Passed |
| Residual means equal zero | - | -1.0248e-16 | Passed |

All tests were passed, and therefore, the regressions could commence.

To answer research question four, the motives and barriers identified earlier were checked on their relationships with how useful respondents perceived outsourcing to be. For each of these relations, it was checked whether being a scale-up was a moderator for the relation.

Running a regression analysis yielded the results for motives, displayed in Table 14 (only significant moderation effects were included in the table):

Table 14: Regression Results Motives

| Variable | Beta Coefficient | Standard Deviation | P Value |
|---|---|---|---|
| Organizational | 0.055 | 0.149 | 0.711 |
| Knowledge | 0.227 | 0.113 | 0.046** |
| Finance | 0.054 | 0.099 | 0.587 |
| Acceleration | 0.313 | 0.126 | 0.013** |
| Moderator Scale-Up on Acceleration | -0.255 | 0.133 | 0.056* |

*: p<0.1 **: p<0.05 ***: p<0.01

The same was done for each of the barriers, once again with Usefulness as dependent variable. The results are displayed in 15

Table 15: Regression Results Barriers

| Variable | Beta Coefficient | Standard Deviation | P Value |
|---|---|---|---|
| Collaboration | 0.207 | 0.125 | 0.100* |
| Certification | 0.071 | 0.129 | 0.564 |
| Strategic Importance | -0.246 | 0.118 | 0.037** |
| Product Complexity | -0.043 | 0.139 | 0.756 |
| Knowledge | 0.121 | 0.150 | 0.422 |
| Managerial Issues | -0.251 | 0.143 | 0.079* |
| Moderator Scale-Up on Strat. Imp. | 0.197 | 0.086 | 0.022** |

*: p<0.1 **: p<0.05 ***: p<0.01

As can be seen, not all motives and barriers significantly influence respondents' opinion regarding the usefulness of outsourcing in general. Of those variables that do significantly influence usefulness, only Acceleration and Strategic Importance are moderated by whether the focal company is a scale-up or not.

The final two regressions uncover the relationship between Usefulness and outsourcing activities in the past and future, and how these relationships are influenced by whether a company is a scale-up.

Table 16: Regression Results Outsourcing History

| Variable | Beta Coefficient | Standard Deviation | P Value |
|---|---|---|---|
| Usefulness | 0.353 | 0.106 | 0.001*** |
| Moderator Scale-Up | -0.271 | 0.144 | 0.06* |

*: p<0.1 **: p<0.05 ***: p<0.01

The results of the first analysis, displayed in Table 16 shows that there is indeed a relationship between how useful a company perceives outsourcing to be, and whether the company outsourced in the past 3 years. Being a scale-up seems to negatively moderate this relationship. When taking a closer look at the scale-ups in the sample, this makes sense: 12 out of 14 scale-ups outsourced, indicating that scale-ups are very likely to outsource regardless of circumstances. However, as there were only 2 companies that belonged to the category of Non-Outsourcing Scale-up, this skews the data. This means that while we can conclude there is a relationship between outsourcing history and usefulness, this analysis does not provide proof that being a scale-up influences said relationship.

For the second analysis, respondents were asked whether they would continue their outsourcing activities in the next 12 months. The answers were divided into respondents answering "Very likely" and those who answered anything else. These sub-samples in turn were divided into scale-ups and non-scale ups, resulting in the following categories (note: the sample size is 69 instead of 70 due to one respondent answering "I don't know").

Table 17: Scale-ups and Future Outsourcing

| | Scale-up | Non Scale-up | Total |
|---|---|---|---|
| **Very likely increasing** | 9 | 28 | 37 |
| **Not very likely increasing** | 6 | 26 | 32 |
| **Total** | 15 | 54 | 69 |

The categorization in this case is better distributed, as can be seen in Table 17 and scale-ups are present with more than n=6 in both the "Very likely to increase" and "Not very likely to increase" categories. This means that whether a company is a scale-up can be used as a moderator in the next analysis without running into the same problem again.

Table 18: Regression Results Future Outsourcing

| Variable | Beta Coefficient | Standard Deviation | P Value |
|---|---|---|---|
| Usefulness | 0.513 | 0.115 | 0.001*** |
| Moderator Scale-Up | -0.116 | 0.153 | 0.279 |

*: p<0.1 **: p<0.05 ***: p<0.01

The results of the final regression are displayed in 18. The regression yields a strong and very significant relationship between the perceived usefulness of outsourcing, and whether a company will be outsourcing in the future. However, the moderating effect of whether a company is a scale-up is not significant.

# 6    Conclusion

This section focuses on interpreting the results provided in Chapter 5, and answers the sub- and main-research questions stated in Chapter 1.5.

## 6.1    Factors playing a role in the sample

The first two research question tried to uncover what motives and barriers to outsourcing played a role in the sample, to in turn provide input for further analysis regarding how scale-ups differ from other companies. The conclusions drawn in this section are based on the results of the Exploratory Factor Analysis, found in Chapter 5.2.

The motives found in Varajão et al. (2017) did indeed prove to be a good basis, but the factor analysis suggested splitting up the items related to the factor Finance into two factors. These two factors were named Acceleration (related to wanting to grow the business and accelerate market opportunities) and Finance (just like in the original research). This split turned out to be a good one, as there was a significant difference in how important the sample considered these two factors. Finance was considered less important as a motive, while Acceleration ranked only behind Organizational in terms of importance. The remaining two factors, Organizational and Knowledge, were considered more or less equally important compared to Acceleration. In general, we can conclude that all factors played an important role as motives (all averaged close to 4 on a 5 point Likert scale), except for Finance, which was considered neutral.

The barriers that were expected to be found based on the pre-study and Bigliardi and Galati (2016), overlap strongly with the actual results, with some notable exceptions which are detailed in Chapter 5.2.2. This insights of the pre-study, which were confirmed by the analysis, make an interesting addition to Bigliardi and Galati (2016). Three of their four initial factors still hold, although Collaboration in this research includes a set of about 4 items are specifically important for scale-ups that in not included in their own research. The additional factors that came out of the analysis with sufficient Cronbach's Alphas (Certification, Strategic Importance, Product Complexity and Managerial Issues) are novel in the way that they either apply to scale-ups or specifically to scale-ups in a MedTech setting.

The results reveal that when comparing the barriers in the general sample, the range in which their means fall is relatively small. The lowest mean is 3.15 (close to neutral on the 5-point Likert scale), while the highest is 3.54 (between neutral and important on the 5-point Likert scale). When divided into two groups, Uncertainty Issues, Managerial Issues, Knowledge and Strategic Importance seem to be less important for the sample as a whole (maximum mean of 3.23) and Collaboration, Certification and Product Complexity seem to be slightly more important (minimum mean of 3.42).

It is interesting to note that these findings strongly overlap with the earlier findings of Van de Vrande et al. (2009) in terms of barriers. Organizational and Quality of Partners (which overlap in definition with Collaboration in this research) were ranked as the two most important barriers. The third most important barrier in the research of Van de Vrande et al. (2009), Administration, showed strong similarities with the Certification barrier in this research.

## 6.2    Difference between Scale-ups and Non-Scale-ups

This section aims to answer the third research question. Using the input from the previous two questions, the sample was split in two: scale-ups and non-scale-ups (in accordance with the definition of the OECD (Eurostat-OECD , 2005)).

When examining the means and standard deviations of each of the sub-samples in Table 11, two noteworthy things were found:

1. The means for all of the four motives is higher for scale-ups than non-scale-ups. This means that scale-ups are generally more inclined to outsource compared to their counterparts. This supports the fact that 14 out of 16 scale-ups participated in outsourcing activities (87.5%), while only 40 out of 54 non-scale-ups did so (74%).

2. There is a big difference in standard deviation between the scale-ups and non-scale-ups in Knowledge, Acceleration and Organizational (so all factors except Finance). For these three factors, the Scale-ups have way lower standard deviations compared to the non-scale ups (0.649 vs. 1.007, 0.622 vs. 0.868, 0.687 vs. 0.913). This suggests that the sub-sample of scale-ups is way more homogeneous than the sub-sample containing all non-scale-ups. This makes sense, as the criteria for being a scale-ups are quite narrow, so one would expect this sub-sample to only contain the best performing companies. The other sub-sample contains all companies ranging from companies that performed only slightly worse in terms of growth than scale-ups to companies that are shrinking, and companies ranging from small start-ups with a handful of employees to companies with up to 500 employees. It makes sense that the second sub-sample has a higher standard deviation in their motives, simply because they differ so much in conditions and characteristics.

In three of the four motives a distinction between how scale-ups and non-scale-ups rated them was found. Knowledge and Acceleration are rated 0.279 and 0.264 higher by scale-ups respectively. The Organizational motive was rated 0.603 higher on average. This means that Scale-ups rated Organizational motives on average with a 4.375 on a 5-point Likert scale, so ranging between important and very important.

The fact that means differ by a certain amount does not mean conclusions can be drawn from that difference. Depending on the sample size and standard deviation, T-Test can determine if the probability that these differences are a result of random chance are within acceptable boundaries. Given the small sample size and large standard deviation within the non-scale-up sub-sample, this proved to be fairly difficult. As can be seen in Table 11, only the difference in the Organizational motive was significant (strongly significant even, with p<0.01).

It can be concluded from this that scale-ups and non-scale-ups do not differ strongly in why they outsource, except that scale-ups have a way stronger need for Organizational support, which they hope to find by outsourcing. The Organizational Motive consists of the following items:

- Obtaining resources not available internally

- Prevent having to make major organizational or structural changes

- Compensate for our lack of capacity in this domain

Domain experts and people who participated in the pre-study stated that scale-ups put more emphasis on Knowledge Motive related things (specifically requiring specific technical knowledge to turn their often radical innovation into a product). It turns out that they actually put more emphasis on acquiring resources and capacity. For example, a scale-up might want to start producing their products on a larger scale well before they actually built or own a factory to actually do so.

When examining the barriers, the same pattern is observed as with the motives: all means were higher for scale-ups than for non-scale-ups. A logical explanation for this that scale-ups in the

sample outsource more often (87.5% for scale-ups vs. 74% for non-scale-ups), and therefore they are more consciously aware of what their motives and barriers are.

The Welch's T-Tests revealed that for three barriers there was a significant difference between the scale-ups and non-scale-ups:

- Collaboration (difference of 0.505)

- Certification (difference of 0.390)

- Managerial Issues (difference 0.474)

The fact that Collaboration came out as one of the highest rated factors was not surprising (as it also did in (Bigliardi & Galati, 2016) and Van de Vrande et al. (2009)), but it is interesting to see that is affects scale-ups even more severely. This is in line with some remarks made by participants in the pre-study: they expressed that it was very difficult to find a partner that was willing to invest time and effort in a smaller scale-up, when it could also do business with larger companies. This decision mostly arose from risk aversion (for example, scale-ups are more prone to market disruption or economic downturns than larger companies). This was mentioned often and in multiple forms: the source of the reluctance to work together could arise from small volumes, but also the fact that other customer received more priority due to the size of their projects.

Certification was a barrier that was added solely based on the pre-study. Certification, regulations and legislation are an inherent characteristic of medical markets (Maresova, Hajek, Krejcar, Storek, & Kuca, 2020; Guerra-Bretaña & Flórez-Rendón, 2018), but the results of the pre-study insinuated that this obstacle was even larger for scale-ups. For example, every company that wants to operate in a medical market has to deal with certification, but if you are a fast growing company that wants to get a product to market as quickly as possible, the slow process of obtaining the right certification will cost more opportunity costs. As getting to market quickly is an important thing in the turbulent MedTech market (as indicated by the high rating the Acceleration motive received), everything that stands in the way of (fast) market entry is a big hindrance.

The final barrier that was experienced significantly stronger by scale-ups than by non-scale-ups was Managerial Issues. This barrier was not initially present in the conceptual model, but arose from the Exploratory Factor Analysis. Even though it was not part of the conceptual model, it could have been anticipated that a factor containing these items would arise: Van de Vrande et al. (2009) had also found that the organization of the innovative activities to be performed was among the highest rated barriers in their research. Managerial Issues is as barrier closely related to the Collaboration barrier in the sense that Collaboration focuses on the problems the scale-up perceives in their relation with an outsourcing partner due to the actions of the partner. On the other side, Managerial Issues focuses on problems in managing the relationship that arise from the scale-ups own inability to manage said relationship. This also creates opportunities for outsourcing partners: scale-ups clearly struggle with the managerial and organizational side of managing the outsourcing relationship.

In conclusion, three barriers were experienced to a stronger degree by scale-ups: Collaboration, Certification and Managerial Issues. Collaboration and Managerial Issues mostly involve the fact that outsourcing partners do not prioritize scale-ups enough and scale-ups not having the competences in-house to manage an outsourcing relation, respectively. Certification is related to specific obstacles in the MedTech Industry that affect scale-ups even harder than regular companies.

## 6.3 The relation between the factors, usefulness and the role of scale-ups

This section aims to answer the fourth research question. Some motives and barrier had been experienced more severely or more frequently than others, but that does not mean that these motives or barriers influence how useful companies perceive outsourcing to be. Even if a company experiences a barrier very strongly, this does not have to translate into them changing their opinion on outsourcing in general. In this section, the relationship between the factors and usefulness is examined, and whether being a scale-up influences this relationship.

Of the four motives discovered in the Exploratory Factor Analysis, two have a statistically significant: Knowledge and Acceleration. Companies that stated that they were motivated in their outsourcing decisions by these two motives tended to view outsourcing as more useful. It is interesting to note that the Organizational motive, which was rated as both the most important motive by the general sample and by the scale-up sub-sample, does not influence how useful companies perceive outsourcing to be. It could be the case that companies view outsourcing simply as a source of capacity to begin with, so in that case, whether they experience this motive or not does not change their general view on outsourcing.

Of these two relationships, only Acceleration is moderated by whether the focal company is a scale-up or not. Interestingly, this relationship is negatively moderated, meaning that for a scale-up, the relationship between Acceleration and Usefulness is weaker. This could arise from the fact that scale-ups are already so involved with growth and the fact that outsourcing contributes to this, that for them wanting to grow and outsourcing are inherently connected anyway. For non-scale-ups, the usefulness of outsourcing only becomes apparent once they decide that they want to take their business to the next level, while for scale-ups this is the baseline.

In total, three of the barriers had a significant effect on Usefulness. If companies had experienced Collaboration as a barrier they would, on average, view outsourcing in a more favourable light. The items of the Collaboration factor explain why this is the case: most of these items were related to having a relationship that worked, but could be improved. This means that companies that rated this barrier's items as high in the survey probably had an outsourcing history which they saw as useful, but still with room for improvement.

Managerial Issues was also a barrier found to have a significant effect on Usefulness. The relationship was negative, meaning that if a company encountered managerial issues, they would tend to view outsourcing as less useful. This is an interesting conclusion when combined with the relationship between Collaboration and Usefulness: it seems that when a company wants to outsource and their partner leaves room for improvement, it increases the usefulness of outsourcing, while if the outsourcing company leaves room for improvement (in terms of not managing the relationship well), it decreases the usefulness of outsourcing. This is closely related to the Dunning-Kruger effect, in which people tend to believe they are more capable than they really are (Dunning, 2011). This would mean that if someone else fails in their part of the relationship, the company thinks their is room for improvement. However, if the company itself fails, they think outsourcing just doesn't work as well as they thought, instead of attributing this to their own inability to manage the relationship. It is interesting that the companies are aware that the failure of their outsourcing activities might come for their own mismanagement (respondents were pretty open about this), but that this reflective behaviour does not translate into the relationship with usefulness.

The final barrier that has an effect on Usefulness, which is also moderated by whether a company is a scale-up, is Strategic Importance. If a company had problems in the past with the fact that certain activities or modules of a product were to strategically important for their competitive position,

they generally view outsourcing as less useful. Two of the three companies that participated in the pre-study experienced this barrier:

- One company stated that they simply did not want to outsource certain parts of their R&D and engineering activities, simply because that was what made their company so competitive. They preferred to outsource the design and manufacturing of parts and sub-modules, but the total design (and the technological knowledge on how to make that design work) should always remain in the company to remain competitive. For that reason, it would simply not be in the company's strategic interest to outsource such activities.

- Another company stated that they were more than eager to outsource certain peripherals of their products, but the core-module (which was a radical innovation) was the heart and soul of their business. Outsourcing that would make little sense, mostly because they had the right knowledge about the application domain that an outsourcing partner probably would not have.

Whether the responding company is a scale-up has an effect on this relationship: it strengthens the existing negative relationship between Strategic Importance. This makes sense, as the companies in the pre-study also mentioned this factor a lot, and specifically said that they thought fast growing companies were even more aware of what their competitive edge was. In general, a scale-up will be even more reluctant to outsource their strategically important activities or sub-modules. Based on these findings, we can conclude that the motive Acceleration influences how useful companies perceive outsourcing to be, and so do the barriers Collaboration, Managerial Issues and Strategic Importance. Being a scale-up makes the positive relationship between Acceleration and Usefulness weaker, and strengthens the negative relationship between Strategic Importance and Usefulness.

## 6.4 The relation between usefulness, outsourcing and the role of scale-ups

The final analysis was meant to uncover whether being a scale-up influenced the relationship between perceived usefulness on one hand, and past and future outsourcing activity on the other. It makes sense that if a company claims they think outsourcing is useful, they are likely to have engaged in outsourcing activities. This section explores to what degree this relationship is different for scale-ups.

The first regression's results, shown in Table 16, prove that there is indeed a very strongly significant relationship between whether a company outsourced in the past and their judgement on outsourcing's usefulness. There was also a negatively moderating effect, meaning that Scale-ups had outsourced in the past even if they perceived outsourcing as being less useful. However, as explained in Chapter 5.4, this conclusion is rather misleading if it is taken into account that there were only 2 non-outsourcing scale-ups in the entire sample. Because of this, a second analysis was also performed, looking at whether the perceived usefulness of outsourcing contributed to companies stating that they were very likely to outsource in the next 12 months. This result was once again very highly significant, and was also stronger than with past outsourcing. This was, once again, to be expected: if a company deems an activity some useful, it would be strange if they indicated that they would refrain from performing said activity in the future. However, the moderating effect that was observed earlier for past outsourcing was not significant in this case, meaning that a strong relationship exists between perceived usefulness of outsourcing and future outsourcing activity, and that this relationship is the same for both scale-ups and non-scale-ups alike.

## 6.5 General conclusion

Based on all the analyses performed, the main research question can be answered. This research has proven that scale-ups in the do indeed differ when it comes to their perceptions of outsourcing compared to their slower growing counterparts. The Exploratory Factor Analysis and subsequent Welch's T-Tests proved that scale-up are more strongly driven by Organizational motives, and more strongly obstructed by the barriers Collaboration, Certification and Managerial Issues compared to the rest of the sample. The subsequent regression analyses showed that for scale-ups the proven positive relationship between Acceleration and Usefulness is weaker, while the proven negative relationship between Strategic Importance and Usefulness is stronger. The final analysis showed that there was a strong relationship between Usefulness and outsourcing activities, both past and future, but that this relationship was the same for scale-ups and non-scale-ups.

# 7 Limitations and Implications

## 7.1 Limitations

One of the things that was overlooked in designing the survey is that many companies have multiple R&D partners. Upon creating the survey, it was assumed that companies indeed had multiple suppliers, but that there would be only one significant R&D partner. One respondent noted that they actually had several R&D partners that played a more or less equivalent role in their outsourcing process. The respondent noted that they filled out the survey with one of those specific partners in mind, so in the end the results would not have been impacted by this design-flaw, but for future research it is advisable to keep this in mind.

Another limitation was caused by the fact that convenience sampling was used for the interviews. As mentioned in Chapter 3, this probably created bias in the respondents: customers that want to participate in such an interview tend to be customer's that have favorable views towards NTS. All interviewees indeed expressed they were satisfied with the relationship they had with NTS. They could recall some negative experiences with other suppliers, but the possibility exists that more barriers would have been uncovered if unsatisfied customers would have been interviewed. No further barriers were mentioned by respondents of the survey when they were asked if they had anything to add to the barriers presented to them, but that does not rule out that more undiscovered outsourcing barriers exist.

A total of between 500 and 700 MedTech companies exist in the Netherlands, but contact information of only 405 companies could be found. This resulted in a total of only 70 valid replies. This is not bad for an online survey, but a higher response rate would have contributed to the results of this research. There are some differences between scale-ups and non-scale-ups that turned out to be insignificant, but that could be actual differences that simply did not make it through the T-Tests due to the small sample size. The amount of scale-ups in the sample was relatively high: 16 out of 69 companies in the sample, so 23.2%, which is a lot higher than the approximation of 5% that was made by (PricewaterhouseCoopers, 2018) and ScaleUp Institute (2020). However, 16 is still rather small in absolute terms.

A final limitation, and also input for future research, is the fact that several separate regressions were used in the two final research questions, instead of using a path analysis. The latter is recommended to examine complex situations with indirect effects (as in the case in this research) (Streiner, 2005). It also allows for the comparison of multiple models, something which was not done in this research.

## 7.2 Implications

This research has several implications, which will be elaborated upon in this section.

### 7.2.1 General Managerial Implications

First, general implications for any company that wishes to engage with scale-ups (whether it be in MedTech or another high-tech industry) in the field of R&D outsourcing will be discussed. Based on the motive and the three barriers in which scale-ups differ, the implications per factor are the following:

- Motive Organizational: this research uncovered that the Organizational motive is the biggest driver for scale-ups to look outside their organizational boundaries for a R&D outsourcing partner. Even though knowledge and the fact that scale-ups want to accelerate their time-to-market play an important role in wanting to outsource, it seems that problems related

to capacity (like simply not having enough people to perform a certain activity) and not wanting to make structural changes (like buying a factory themselves when they could also outsource such an activity) are the main drivers. Knowing that this is the main reason scale-ups seek help, organizations facilitate the pooling certain resources to drive down costs of utilization of said resources. A good example of this is Pivot Park in Oss, where companies in the pharmaceutical and biotech industries can share laboratories and expensive equipment they would otherwise not have access to (Pivot Park, 2022). Apart from business, the Dutch government can also help by guiding these efforts. The Dutch government stated it wanted to create a better environment for start-ups and scale-ups (Ministerie van Economische Zaken en Klimaat, 2019), and therefore, funding places like Pivot Park where resources can be shared and organizational challenges can be tackled would be advisable. The existing findings in more general populations of SMEs (instead of scale-ups), do not echo these findings. For example, Van de Vrande et al. (2009) found that SMEs in general are more concerned with sourcing knowledge than with sourcing capacity. However, the researches were performed roughly 13 years apart, and in different settings, so the fact that motives differ is not very surprising.

- Barrier Collaboration: it might seem obvious that Collaboration is an important factor in outsourcing, but especially the items in this factor that were added based on the pre-study have implications for outsourcing partners. Many of the added items related to scale-ups feeling like they were under-prioritized and did not receive the attention they needed from partners, solely because of their size and production volume. Scale-ups are indeed an investment for outsourcing partners, as their initial production volume is small and a partnership with them bears more risk than with a larger, more established company. However, with this risk also comes an opportunity: scale-ups have a lot of potential for further growth, and becoming their main partner early in the growth process means less effort has to be spend to retain this position later on. Therefore, outsourcing partners should focus on communicating that they are not afraid to work with smaller companies that have the majority of their growth still ahead of them. In the existing literature, this barrier has not been addressed yet. There is evidence that smaller firms generally have a harder time finding R&D partners than larger firms, even though they would benefit most from such a partnership due to limited resources (Badillo, Galera, & Serrano, 2017), which is also something that can be concluded from the survey results. However, differences in size (and thus the resulting lack of prioritization) have not yet been researched in this context. There are some other publications that seem to briefly mention or hint at the relationship between project priority and company size in partnerships (Bresman, Birkinshaw, & Nobel, 1999; Cummings & Teng, 2003), but none of them explicitly test this in the relevant context.

- Barrier Certification: scale-ups want to grow fast, and complex legislation and obtaining the correct certification can impede this process. If a scale-up has to find its own way through this complex legal landscape, it will not only take a lot of time (thus increasing time-to-market), but also requires the scale-up to invest in a legal department (which goes against the Organizational motive). Outsourcing partners should make sure they have the correct certification, and are well-aware of current and future changes in the legislative landscape, as to unburden the scale-up as much as possible. For scale-ups, finding a good outsourcing partner is hard as it is, so being upfront on what medical experience an outsourcing partner has can save both the scale-up and the partner a lot of time. One interviewee explicitly stated that this was one of the first things he informed about when talking to an outsourcing partner. The reason for this was, he stated, because incorrect certification is a deal-breaker, and even

if the outsourcing partner checked every other box, would probably mean no outsourcing relationship was possible. Past researches agrees with this finding. A good example is a case study of Kumar, Deivasigamani, and Omer (2010), in which they examine a medical device company that wishes to outsource parts of its design processes to another company. The medical device company explicitly states that they only wish to outsource to companies that are ISO 13485 compliant (an important certification to operate in medical markets). However, the article does not state whether the company is a scale-up, and thus does not say anything about whether this would be more applicable to scale-ups. A recent interview with the CEO of Aidience, a Dutch MedTech scale-up, sheds some light on the issue: he claims regulations and certification are slowing down companies, and particularly Dutch scale-ups in their growth (whicn are generally dependent on quick product introductions) (VNO-NCW, 2022). Participants in the pre-study said these difficulties translated in scale-ups having a very strong preference for outsourcing partners that had the right certification, simply because if they did not, it would amount to extremely much more work on the scale-up's side. Regulations change quickly in the MedTech market, and not having a partner that can guide a scale-up through that landscape will mean a scale-up will either have to invest in a strong legal department themselves (which goes against the Organizational motive discussed earlier), or accept that go-to-market time will decrease significantly.

- Barrier Managerial Issues: scale-ups have difficulties managing outsourcing relationships, because of the managerial complexities that arise from these relationships, and the fact that scale-ups do not always have the necessary managerial competences to deal with them. Outsourcing partners often have the competences in-house to aid with things like project management, which would allow the scale-up to focus more on the management of the relation with the outsourcing partner. In general, scale-ups have a lot of potential and want to grow, but simply do not posses the managerial competences to manage multiple complex outsourcing relationships. This creates an opportunity for other companies that have a long history in providing managerial assistance to take up the role of lead-partner, which could manage other sub-contracting relationships for the scale-up. Respondents stated that a pro-active attitude in this matter was something they appreciated greatly in outsourcing partners. There is also literary support for this barrier's existence. Du and Temouri (2015) found that companies that experience periods of strong growth will often run into managerial problems, and consequentially this ends the period of growth. This is based on an older theory, called the Penrose effect (Penrose, 1960), which stated that the most limiting factor in a company's growth would be the existing management ineptitude to deal with the novel situation they find themselves in. This is also what happens in scale-ups: senior managers are usually founders with technical background who have to deal with managerial challenges they can not handle effectively. The R&D outsourcing process, in all its complexity, is such a managerial challenge.

### 7.2.2 Managerial Implications for NTS

This research is particularly useful for companies, like NTS-Group, that function as outsourcing partner for R&D, engineering and manufacturing. The results of this research reveal what these companies should focus on if they want to catch the high potential scale-ups in high-tech markets like MedTech. In their marketing material, they should focus on the factors that are experienced more severely by scale-ups than by non-scale-ups: the Organizational motive, and the barriers Collaboration, Certification and Managerial Issues.

The fact that the Organizational motive is the most important one, means that NTS should try to address this in their communication towards the market: they bring value to the table in the

form of extra capacity and make sure scale-ups do not have to make structural changes in their organization to keep up their rate of growth.

The three barriers which are experienced more severely by scale-ups than by non-scale-ups (Collaboration, Certification and Managerial Issues) also lead to implications for NTS. The Eindhoven region contains a number of large technology firms. This is exactly what some scale-ups in the pre-study saw as a potential obstacle: who will guarantee NTS has enough priority for them when they are also trying to serve these way larger (and probably more stable and profitable) large tech companies? For NTS, it is important to ensure that they take away this fear in potential customers.

The next barrier, Certification, also has practical implications for NTS: understand certification and regulations very well before ramping up operations in the MedTech market. NTS already has some experience in MedTech, and is already aware of the importance of certification, but this research confirms that Certification weighs very heavily in scale-ups' decision to outsource. During this research, a trip was made to the Medica 2021 conference in Dusseldorf (one of the largest MedTech conferences in the world) by the author, and this trip revealed how important certification was in MedTech. Outsourcing partners of all sorts, ranging from contract manufacturers to R&D service suppliers, presented all their certifications very prominently on their stands. A good example is ISO 13485, which is a standard on documentation and Quality Management Systems (QMS). Some of NTS' sites are currently certified in this standard, and this is something the company should definitely signal to the market.

At this moment in time, NTS is not involved in many MedTech projects that require the involvement of multiple sites and departments. However, with the shift in the company's focus, this is likely to change in the future. Being certified in a standard like ISO 13485 also means you need people in your project team that truly understand these standards. Based on the results of this research and conversations the author had with people involved in maintaining the QMS and people from NTS' Compliance Team, it was determined that for most projects a dedicated person would be needed for this role. This so-called "Quality Manager" would serve as a lieutenant to the Project Manager, and advise him or her on any matters that were related to certification or compliance. Over time, Project Managers would get more familiar with these activities themselves, and the Quality Manager role could be scaled down again. There are some specific NTS-sites that have people that could fulfill this role because they have a lot of knowledge on certification while also having a history in medical projects. The first step for NTS in this process would be to identify the people that fit this description and make sure that every MedTech Project Manager gets one assigned one.

Finally, the last barrier indicates that scale-ups have a hard time managing the complexity that arises from outsourcing. For NTS, this creates an opportunity to take even more work out of the hands of the scale-up. This would mean that NTS does not only offer services in terms of engineering or manufacturing, but also helps with project management. One interviewee said during the pre-study that they would prefer to have one central outsourcing partner that could manage all the other outsourcing relations, simply because they lacked the competences to do so. This is exactly a role that NTS could take on as large, coordinating partner, to unburden smaller scale-ups.

### 7.2.3 Academic Implications

This is the first research to examine scale-ups in this setting. Earlier work by Achiche et al. (2012) and McCormack et al. (2015), based on Van de Vrande et al. (2009), had researched the same context (outsourcing in MedTech), but without making a distinction between scale-ups and non-scale-ups. Furthermore, this research also adds to these earlier findings by having a more robust

and verified data collection method: this research used 5 point Likert-scales (Achiche et al. (2012), McCormack et al. (2015) and Van de Vrande et al. (2009) used binary yes/no questions) which were proven to be valid by Bigliardi and Galati (2016) and Varajão et al. (2017)).

Looking at the sample that was used in this research, the amount of R&D outsourcing that takes place is in line with some publications, but in contradiction with others. A publication that strongly contradicts with the findings of this research is Priyadarshini et al. (2021). Their research claimed that in 2008, in most European countries, between 30% and 45% of companies participated in some form of R&D outsourcing, only slightly below amount found by Van de Vrande et al. (2009). However, they also claimed that this percentage had dropped to less than 10% in most European countries by 2018. This is in strong contrast with the results of the survey, which indicated that more than 77% of the responding companies participated in R&D outsourcing, and for scale-ups this number was as high as 87.5%. Priyadarshini et al. (2021) do not state how they define R&D outsourcing, and they probably had a more narrow view on which activities are considered as R%D outsourcing compared to the definition used in this research. Nonetheless, the difference between their findings and the findings of this research are noteworthy.

The high degree of outsourcing in the sample was to be expected when taking into account the model by (Cantone et al., 2019) (also presented in Figure 3). As explained in Chapter 2.1, most high-tech industries end up in quadrants of Cantone's model that favour outsourcing. The higher degree of outsourcing among scale-ups compared to the rest of the sample is also supported by literature discussed earlier:

- According to Diaz-Mora and Triguero-Cano (2012), companies that find themselves in volatile and turbulent environments (which is usually the case with scale-ups), are more likely to outsource. The reason that Diaz-Mora and Triguero-Cano (2012) give for the increased likelihood of outsourcing is that these companies want to be as flexible as possible in relation to their environments. This research confirms that reasoning: scale-ups experienced the Organizational motive way stronger than non-scale-ups, which related to quickly obtaining capacity without making any large re-organizations themselves. As such, the results of this research support the statements made in (Diaz-Mora & Triguero-Cano, 2012).

- Lin and Tsai (2007) also found that companies in volatile conditions were more likely to outsource, but for a different reason: they preferred to focus on their core-activities and core-technologies, and outsource most other activities. In the interviews of the pre-study, Company B stated exactly this motivation to outsource. With the limited resources they had, they deemed it the best strategy to focus on the technologies that really set their innovation apart, and let other companies like NTS take care of the peripheral technologies.

This research proves that there are indeed differences in how scale-ups and non-scales-ups perceive outsourcing: they are driven and obstructed by the same motives and barriers, but to different degrees. However, not all motives and barriers contribute to how useful outsourcing is perceived to be, and being a scale-up only plays a role in two of these relationships (Acceleration and Strategic Importance). Research has been performed to determine the relationship between firm-level characteristics and outsourcing (Tomiura, 2005), and between industry-level characteristics and outsourcing in high-tech settings (Qu, Pinsoneault, & Oh, 2011). However, linking motives and barriers to perceived usefulness and outsourcing activity seems to be novel. Because of this, it would be interesting to dive deeper into these relationships, and uncover why some of them do have a strong influence on perceived usefulness, and why some do not.

Interestingly enough, while there are significant differences in how scale-ups and non-scale-ups

experience certain factors, the relationship between usefulness and actual outsourcing activity seems to be the same for both. This leads to the notion that scale-ups indeed perceive matters differently, but some relationship simply stay the same regardless of company growth.

## 7.3   Further Research

Based on this research, quite a lot of topics for future research arise. The most important one would be to replicate this research with a larger sample. Some of the differences that were found between scale-ups and non-scale-ups were ruled as non-significant, but increasing the sample size can determine if this is actually the case or just a result of the small sample size. Data collection from external companies is a time-consuming process, but would definitely give rise to additional insights.

For this research R&D, engineering activities and manufacturing were all considered "R&D Outsourcing", because even the 'simpler' activities like manufacturing often involve large knowledge flows between partners. This also helped in keeping the survey from getting to large, and thus deterring potential respondents. However, as one respondent also commented, the motives and barriers experienced when outsourcing R&D and manufacturing might be very different from one another. For example, the Knowledge motive will probably play a bigger role for the outsourcing of R&D, while the Organizational motive is probably more important for the outsourcing of Manufacturing. Deeper exploration into how these different types of 'R&D Outsourcing' give rise to different motives and barriers in scale-ups would be an interesting addition to this research.

Furthermore, it would be interesting to replicate this research on a European level, to see whether significant differences can be found between scale-ups in different countries. For example, the Certification barrier arises mostly from European-wide legislation, but local regulations could also impact how this barrier is experienced by scale-ups. Furthermore, as national culture impacts how business is done (Hofstede, 2011), barriers like Collaboration could also play a different role in different countries.

Finally, an interesting research topic is the moderation of being a scale-up on the relation between the Acceleration motive and Usefulness. It was initially expected that there would either be no moderation or a positive one, so it is interesting to see a negative one was found. As stated in Chapter 6, this could have been the case because scale-ups are in a 'growth mindset' to begin with, meaning the relationship is weaker for them because they see outsourcing as useful regardless of whether they experienced Acceleration as a motive. However, this is not a very logical nor a watertight explanation, so more research on that particular relationship would be interesting.

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# A Appendix A

Table 19: Codification of Motive Items

| Code | Corresponding question |
|---|---|
| Knowledge1 | Getting access to world-class capabilities |
| Knowledge2 | Getting access to cutting-edge technologies |
| Knowledge3 | Getting access to technical proficiency and specialized human resources |
| Acceleration1 | Increasing our business' flexibility |
| Acceleration2 | Possibility to redirect existing resources |
| Acceleration3 | Accelerate our go to market |
| Acceleration4 | Increase the chance of capturing our market opportunity |
| Organizational1 | Obtaining resources not available internally |
| Organizational2 | Prevent having to make major organizational or structural changes |
| Organizational3 | Compensate for our lack of capacity in this domain |
| Finance1 | Reducing costs |
| Finance2 | Controlling costs |
| Finance3 | Improving our accounting balance sheet |

# B   Appendix B

Table 20: Codification of Barrier Items

| Code | Corresponding question |
|------|------------------------|
| Collaboration1 | Lack of partners willing to prioritize our projects (as they rather focus on larger customers) |
| Collaboration2 | Finding a partner that was willing to work with a company of our size |
| Collaboration3 | (Potential) partners did not prioritize our projects in times of need |
| Collaboration4 | Fear of opportunistic behavior of (potential) partners |
| Collaboration5 | Lack of partners willing to deal with our current low volumes |
| Collaboration6 | Difficulties in finding the right partners |
| Certification1 | (Potential) partners' lack of proper certification for our industry |
| Certification2 | (Potential) problems with certification due to outsourcing |
| Certification3 | (Potential) partners' lack of knowledge on rules and regulations |
| Certification4 | Administrative and legal burdens that may result from outsourcing |
| Strategic1 | (Potential) loss of our competitive edge |
| Strategic2 | (Potential) loss of core capabilities |
| Strategic3 | (Potential) loss of knowledge on our customer needs |
| Strategic4 | (Potential) loss of know-how |
| Product1 | (Potential) mistakes in design due to partner's lack of knowledge of our customers |
| Product2 | Our product's high technical complexity |
| Product3 | (Potential) loss of synergy in engineering our product |
| Knowledge1 | Problems linked to potential imitation of your innovation |
| Knowledge2 | Potential unclarity of intellectual property rights |
| Knowledge3 | Lack of availability of relevant external knowledge |
| Managerial1 | Managerial complexities of outsourcing |
| Managerial2 | Lack of adequate managerial competences to select and manage outsourcing partners |
| Uncertainty1 | Uncertain costs |
| Uncertainty2 | Fear of granting a technology to others without an understanding of its potential |