MASTER

Understanding the make-or-buy decision in R&D
influences on the make-or-buy decision in the context of R&D, applied to the R&D center of Bosch Sprang

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Understanding the make-or-buy decision in R&D:

Influences on the make-or-buy decision in the context of R&D, applied to the R&D center of Bosch Sprang

By

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in Innovation management

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Subject headings: make-or-buy decision, R&D, outsourcing, transaction cost theory (TCT), SME
Preface

This thesis in front of you is the result of my graduation project and is the final product required to end the master program Innovation Management at the Eindhoven University of Technology. It involves a graduation project conducted at Bosch Sprang BV to investigate what the possibilities are to make their new R&D center more profitable for the short term. Because investigation to the possibilities of profitability improvement was too broad for a master thesis project, the focus of this project is on the make-or-buy decisions of potential customers in the context of R&D.

The master thesis is a product that has not been an individual effort. Therefore, I would like to thank various people for supporting and inspiring me, during the graduation project.

First of all, I would like to thank my supervisor Thijs Peeters. His valuable insights, feedback, guidance and criticism during the thesis project where extremely valuable for me. Secondly, my thanks go to my second supervisor Myriam Cloodt. I really appreciated her valuable input, especially during the project definition. Additionally, my special attention goes to my company supervisor Berry Smeulders. His guidance, motivation and network were vital to the completion of this research. Fourthly, I would like to thank the company Bosch Sprang for giving me the opportunity to do my research. Finally, I want to express my gratitude towards my girlfriend, family and friends for their patience, support and interests during my study and thesis project.

Marius van der Schans
Sprang-Capelle, June 2015
Management summary

The general idea behind this master thesis is to make an own R&D center more financial attractive for SMEs in the short term. Because this subject is too broad to be one master thesis, the focus of this thesis is on the decision variables in the make-or-buy decision in the context of R&D. This decision is important because depending on this decision, the potential customer places an order at the R&D center of the SME or do the task by himself.

Bosch Sprang is an SME that invested in an own R&D center, however their business model is only aimed at the long term. From the literature we know that, to be more profitable in the short term, small or bigger R&D projects for other parties should be performed. However, external parties should outsource their R&D to make that possible. The decision of external parties to outsource their R&D or do it in-house depends on several factors. These factors, and how they can be influenced are interesting both for filling the literature gap and for applying at Bosch Sprang. Therefore the research question is:

How do trust and uncertainty influence the make-or-buy decision in R&D and how can this knowledge be applied to the R&D center of Bosch Sprang?

Method

To answer this research question, the thesis starts with theoretical insights that are gathered by conducting a literature study to the decision variables in the make-or-buy decision in general. The make-or-buy decision is dependent on different factors. In the theory section, these factors are derived from three different fields: the transaction cost theory (TCT) of Coase (1937), the framework of Porter (1980) and from social science (Das en Teng, 2001).

This information is used to create interviews for 6 employees of Bosch Sprang. The main part of these interviews is about the make-or-buy decision factors. Using the theory section and using the results of the internal interviews, the external interviews are built. These external interviews are conducted with 11 different parties in the thermoforming value chain. The interviewees are people who are in the position to decide to perform R&D in the own company or outsource the R&D. Therefore, interviewees are high in their company hierarchy. The interviews are conducted to verify the results from the internal interviews and the literature about the decision factors in the make-or-buy decision, especially in the context of R&D.

Results of the thesis

The results of this master thesis can be divided into three parts. Firstly, the main part about the decision variables in the make-or-buy decision and how these variables could be influenced. After that, a small part about approaching the customers. Finally, a small part about risks and special aspects that deserve extra attention by performing R&D for external parties.

For the R&D center of Bosch Sprang, producers of packaging using thermoform tools are the most attractive potential customers. The R&D center should approach them with pro-active behavior, depending on the existing relation and the existing level of knowledge and quality of the customers company.

Based on literature, internal interviews and external interviews, it can be concluded that the following factors are most important in the make-or-buy decision in the context of R&D:

1. Availability of own resources
2. Trust between partners
3. Cost / benefit ratio
4. Delivery time of the order
5. Task complexity of the transaction
6. Property rights / confidentiality
7. Need for knowledge transfer
8. Uncertainty in the transaction
9. Transaction frequency

In this list, the factors are ranked from highest to lowest importance, from 1 to 9. The factor ‘trust’ also contains ‘competence trust’. This is trust that the external R&D center has the right resources and quality level. The factors from the literature, internal results and external results have a lot of overlap. The decision factors, which are judged on importance with a mark between 1 and 10 by the internal and external interviewees, score almost the same. However, there are several remarkable differences.

The factor confidentiality was not in the literature, but is mentioned as very important, both in the internal and external interviews. The most plausible reason is that this thesis is searching for decision variables of the make-or-buy decision in the context of R&D instead of searching for these variables in the general make-or-buy decision.

The second remarkable difference is that the factor ‘delivery time of the order’ is only once mentioned by the internal interviewees, but is much more cited by the external interviewees. Thus, for Bosch Sprang it is a learning point that ‘delivery time of the order’ is an important variable for the potential customer in the make-or-buy decision.

Based on the internal and external interviews, it can be concluded that the following factors enhance contractual and competence trust during the make-or-buy decision in the context of R&D:

1. Open, pro-active and personal communication
2. Showing how will be dealt with confidential projects
3. Having the right competence and showing that by the right appearance
4. Signing a contract and / or NDA
5. Performing a pilot test
6. A customer visit to the R&D center
7. Showing reference projects
8. Certification

The factors that enhance trust also reduce uncertainty. Besides these factors, from the internal and external results, we know some other factors that specially reduce uncertainty:

1. Having a clear project description or project plan
2. Splitting up the project into different parts (with milestones or ‘go’, ‘no go’ decisions in between)
3. Performing a risk analysis

Most of the factors that enhance trust and reduce uncertainty are mentioned both in the internal and external interviews. Therefore, these factors could be seen as significant contributors to enhance trust in general and to reduce uncertainty. Only a few factors are remarkable. First, the ‘open, pro-active and personal communication’ is several times cited in the external interviews, but not cited in the internal interviews. This means that employees of Bosch Sprang not detect that this is a notable factor in enhancing trust and reducing uncertainty. This could be a
learning point for them. The factor ‘having a clear project description or project plan’ is meaningful to reduce uncertainty according to the external interviewees. Internal interviewees do not mention this factor by uncertainty reducing factors. However, by aspects that deserve extra attention, internal interviewees mention this already.

Both internal and external interviews show that problems with confidentiality is the most cited risk. Because both parties see this risk, this should be taken into consideration carefully when performing R&D for external parties. A second risk that is mentioned by both internal and external interviews is delivering invalid results, for example because the R&D center of Bosch Sprang is quite new and lacks much experience.

Furthermore, both internal and external respondents mention that it is important that the potential customer and the R&D center reach agreement about the project goals, expectations and timeframe to prevent problems between each other.

**Conclusion**
Based on this research can be concluded what the decision variables are in the make-or-buy decision in the context of R&D and how the decision variables ‘trust’ and ‘uncertainty’ can be influenced. This information fills a gap in literature and can be used by the R&D center of Bosch Sprang to receive more orders from external parties for their R&D center. This could be used to make the R&D center of Bosch Sprang financially more attractive in the short term.

Besides, information about approaching customers, potential risks and special aspects that deserve attention in performing R&D for external parties, is gained. This can also be used by the R&D center of Bosch Sprang by performing R&D for external parties and thus to make their R&D center more profitable.

The general limitation for this research is that this research is only conducted in the thermoforming value chain and thus cannot directly be generalized to other value chains.
### List of abbreviations

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<th>Definition</th>
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<tbody>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
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<tr>
<td>CINO</td>
<td>Chief Innovation Officer</td>
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<tr>
<td>CTO</td>
<td>Chief Technical Officer</td>
</tr>
<tr>
<td>NDA</td>
<td>Non-Disclosure Agreement</td>
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<tr>
<td>RC</td>
<td>Relational Contracting</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<td>ROI</td>
<td>Return On Investment</td>
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<td>SME</td>
<td>Small and Medium Enterprise</td>
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1. Introduction

In this introduction, the thesis project is introduced. First, some theoretical background is given about innovation and Small and Medium Enterprises (SMEs). In paragraph two, the empirical context of Bosch Sprang is explained. After that, the problem definition is given. In paragraph four, the research objective is shown. In the last paragraph of the introduction, the structure of the master thesis report is given.

1.1 Theoretical background

Nowadays, the term ‘Innovation’ is intensively used to talk about the strategy for companies to survive in the competitive world. Most large technical companies have their own R&D center to innovate their existing products and markets. For a lot of SMEs, innovation is also important to survive.

A lot of research is done on innovation and R&D in general, financing the investments, ways to collaborate in innovation to leverage the investments and the impact of financial constraints on innovation. This research is done both for SMEs and for big companies. For example Bougrain & Haudeville (2002), Devins & Kimbara (1995), Contractor & Lorange (2002), Dodgson & Rothwell (1989), Narula (2004) and Savignac (2007) write about these topics. In contrast, little is known about ways to make an own R&D center more profitable for SMEs in the short term. Thus, when an SME decides to invest in an own R&D center because of goals in the long term, the question is how to make this decision more attractive for short term. The reason that SMEs need short term gain from their R&D is that, in general, smaller firms have naturally fewer resources than larger firms (Alvarez & Barney, 2001).

To overcome the problem of fewer resources, R&D cooperation has become more important (Becker & Dietz, 2004). Other reasons for the increasing importance of R&D cooperation are the growing complexity and risks of innovation (Coombs, 1996; Hagedoorn, 2002; Nooteboom, 1999). For this R&D cooperation, partner networks, as a component of a business model, deserve attention.

Before the start of this master thesis, a literature study is done. A summary of the results is given in paragraph 2.3, and especially in table 1 of this thesis. From this literature study, we know that the partner networks ‘arm length transactions’ and ‘small relational contracts’ has the biggest potential to make an R&D center financially more attractive for SMEs in the manufacturing business. However, from the literature it is unknown how to implement ‘arm length transactions’ and ‘small relational contracts’ in the context of an R&D center. In this context, ‘arm length transactions’ could be seen as performing a simple R&D project for external parties and ‘small relational contracts’ could be seen as performing a more complex collaborative R&D project for external parties.

By investigating factors that are important by implementing ‘arm length transactions’ and ‘small relational contracts’ it is crucial to know more about the make-or-buy decision in the context of R&D. It is only possible to implement these partner networks if companies like to outsource a part or the whole of their R&D. Therefore it is meaningful to know what decision variables are of importance in this decision and how the R&D center can deal with these variables.

In this master thesis, a framework is built to implement ‘arm length transactions’ and ‘small relational contracts’ in the value chain (see value chain, appendix 1) in the context of an R&D center. This framework, which is verified in the value chain, is mainly focused on the variables in the make-or-buy decision and especially about ‘trust’ and ‘uncertainty’ (see figure 8). The relation with Bosch Sprang will be explained in the following paragraph.
1.2 Empirical context

Bosch Sprang is an SME that develops and produces tools for the thermoforming industry. The company consists of 85 employees in the Netherlands and has service plants in Indonesia and the USA. In the thermoform industry, there will be more and more competitors from Asia and Turkey. They are aimed at delivering the thermoform tooling for the lowest possible price. Bosch Sprang wants to deliver the tooling and knowledge that give its customer the possibility to deliver his customers the products with the best price/quality ratio. So, Bosch Sprang is focused on the final product of its customer instead of only delivering cheap tooling.

To be able to do so, Bosch Sprang invested in an own R&D center. At this moment, the new R&D center with new employees is almost ready to start. The decision of setting up an own R&D center was made to acquire more knowledge for the whole company and to become a better partner for the customers. Besides, Bosch Sprang wants to have the right appearance to customers to acquire projects from reputable companies like Nestlé where the focus is not on cost price but on knowledge and quality.

This investment should be recouped in the long term by obtaining more exclusive projects because of the high-tech appearance of the company and the improved quality. Bosch Sprang is an SME with only 85 employees in the Netherlands. Investing in an own R&D center and running it is a big financial task for such a small company. However, for the short term there is no payback structure.

1.3 Problem definition

In the previous paragraph, it is already mentioned that at this moment only a payback structure for the long term is available at the R&D center of Bosch Sprang. However, from literature we know that in general it is also important to have some short term gains out of the own R&D because smaller firms have naturally fewer resources than larger firms (Alvarez & Barney, 2001). The question is how to get these resources in the short term.

From the literature study, it is known that ‘arm length transactions’ and ‘small relational contracts’ are able to make an R&D center more profitable in the short term. However, from literature it is unknown how to implement ‘arm length transactions’ and ‘small relational contracts’ in the context of an R&D center.

By investigating the factors that are important by implementing ‘arm length transactions’ and ‘small relational contracts’ it is crucial to know more about the make-or-buy decision in the context of R&D. It is only possible to implement these partner networks if companies intend to outsource a part or whole of their R&D. Therefore it is meaningful to know what decision variables are important in this decision and how the R&D center can deal with these variables.

1.4 Research question and relevance

Based on the introduction, empirical context and problem definition, the research question or problem statement is:

How do ‘trust’ and ‘uncertainty’ influence the make-or-buy decision in R&D and how can this knowledge be applied to the R&D center of Bosch Sprang?

1.4.1. Sub questions thesis project

The three sub questions for this master thesis are:

1. What are the make-or-buy decision variables in the context of R&D?
2. How do ‘trust’ and ‘uncertainty’ influence the make-or-buy decision for potential clients of Bosch Sprang and how could these factors be influenced?
3. How can the developed framework and additionally gained knowledge be applied to the potential customers of the R&D center of Bosch Sprang?

1.4.2 Objective
Figure out how ‘trust’ and ‘uncertainty’ influence the make-or-buy decision in R&D and apply the gained knowledge to the R&D center of Bosch Sprang before the date of 3 July 2015.

1.4.3 Relevance
The results of this study are relevant for scientific purposes because they fill a gap in existing literature about ways to deal with ‘trust’ and ‘uncertainty’ to influence the make or buy decision in R&D. This knowledge could be used to make an own R&D center more profitable in the short term, for SMEs in the manufacturing business. It gives information how to deal with several aspects regarding the make-or-buy decision in R&D. A number of notable general points could be easily generalized to other value chains than this research is about.

The answer to the research question is also relevant for Bosch Sprang since it only has a business model for the long term at this moment and it is searching how to make the R&D center more profitable in the short term. It can use this knowledge by trying to influence the make-or-buy decision and get orders from external parties for its new R&D center.

1.5 Structure report
The answer to the research question is structured in line with figure 1. First, the subject of research is introduced. The whole literature study before the master thesis project is not fully used in this thesis. That is because this research was too broad to be one master thesis project. This master thesis project is narrowed to a more specific area: the decision variables ‘trust’ and ‘uncertainty’ in the make or buy decision in the context of R&D. To be more specific, a short further literature study is done on the make-or-buy decision. This is written in chapter 2. In chapter 3, the method of this master thesis is described. The results of the internal and external research are given in chapter 4. Chapter 5 gives the discussion of the results with the theoretical and practical implications. Chapter 6 gives an implementation plan for Bosch Sprang and chapter 7 describes the conclusions of the master thesis project.

![Figure 1 Thesis structure](image-url)
2. Theory section

The literature study project before starting the master thesis was about what partner network, as a component of a business model, should be used to make an R&D center more profitable for SMEs in the short term. In the introduction of this thesis, it becomes clear that ‘arm length transactions’ and ‘small relational contracts’ should be implemented to make the R&D center more profitable. In that case, the make-or-buy decision becomes very important. Therefore, this chapter shortly elaborates on the decision factors in the make-or-buy decision. This chapter is thus the theoretical answer on the first research question. The empirical answer on the first research question can be found in chapter 4 and 5.

The first paragraph of this chapter is about factors in the general make-or-buy decision, derived from different theories. The second paragraph gives some general remarks in determining the make-or-buy decisions. When a company decides to outsource its R&D, different forms are possible. The R&D can be fully outsourced or a more collaborative form can be chosen. The third paragraph gives information about these different forms of collaboration, and especially about ‘arm length transactions’ and ‘small relational contracts’.

2.1 Factors in the make-or-buy decision

Factors in the make-or-buy decision are factors that influence the company decision to perform a task in the own company, or outsource this task. In this theory section, decision factors are derived from the Transaction Cost Theory (TCT) (Coase, 1937), from the strategic framework of Porter (1980), and from social science (Das en Teng, 2001).

2.1.1 Factors in the make-or-buy decision from Transaction Cost Theory

Technology outsourcing may create considerable transaction costs (Veugelers & Cassiman, 1999). Therefore, most factors that are of importance in the make or buy decision are derived from the transaction cost theory. Hence, it is meaningful to know more about this theory.

The traditional economic theory of Adam Smith (1776), uses the principle of the ‘invisible hand’ to describe make-or-buy decisions. By the ‘invisible hand’ Adam Smith meant the market. However, Coase (1937) has an addition to this theory. He was the first who talked about the transaction costs in the market. Because of the transaction costs, costs of products and services are higher than only the costs of creating the product or service itself. Examples of transaction costs are searching costs, information costs and bargaining costs. Coase (1937) developed a theoretical framework to determine when companies perform the task by themselves and when they outsource it (market vs. hierarchy). The TCT is widely known because of the “Transaction cost Economics” of E. Williamson (1987).

The main research question that the transaction cost theory seeks to address is why economic transactions are organized in the way they are in the modern society (Williamson, 1994). Specifically, why are some economic transactions internalized within the boundaries of firms while others are procured to external parties?

The make-or-buy decision is mainly dependent on the economical factor. However, the economical factor could be divided in different aspects. Derived from the TCT, the following factors are important in the make-or-buy decision:

1. Uncertainty in the transaction
2. Transaction size
3. Specificity of the transaction
4. Task complexity of the transaction
5. Transaction frequency

Below, these factors are further explained using literature (Meer-Kooistra & Vosselman, 2005; Dekker, 2005; Williamson, 1985; Milgrom & Roberts, 1992):

1) Uncertainty in the transaction reflects the difficulty to know beforehand what the results on the end of the research will be. That is the uncertainty in the end result. Another point of uncertainty is: is the external R&D center able to provide the right answers to the research question? That is the uncertainty about the capabilities of the external R&D center. A third sort of uncertainty is behavioral uncertainty. That means that it is uncertain how the other party behaves in terms of strategy and possible opportunistic behavior. Based on the distinction of uncertainty by its nature, there are three types of knowledge relationships: Unpredictability, incomplete knowledge, and multiple knowledge frames (Brugnach, Dewulf, Pahl-Wostl, & Taillieu, 2008). In this thesis, the term ‘uncertainty’ is used as: unpredictability and incomplete knowledge.

2) Transaction size is about the financial volume of the project. What are the costs of the R&D project or task? When the customer knows these costs, he can compare this with the costs of doing the R&D project or task in-house and starts the make-or-buy decision.

3) The specificity of the transaction is higher when one of both parties does transaction specific investments in human or physical capital, which have no or only a low value without the transaction. When a company has to decide to do an R&D task or a project by themselves or outsource it, the question is: are there specific investments needed or not.

4) The task complexity of a transaction refers to the complexity of the R&D task or project. The more variables influence the end result, the more complex the transaction is. Besides, the more complex a task is, the more interdependence between the partners and the more coordination are needed at the transaction.

5) The transaction frequency indicates how much transactions will take place between partners in a specific time frame. In general, by transaction frequency similar transactions are meant.

2.1.2 Factors in the make-or-buy decision from Porter (1980)

Besides factors in the make-or-buy decision from the TCT, there are also other potential factors to use in this research. First, based on the 5-forces strategic framework of Porter (1980), and related to the transaction partners, two other possible factors in the make-or-buy decision are:

6. Competitive position of the partner

7. Power imbalance between the partners

The competitive position of the partner means the position of the external company in the market. How many different alternative suppliers of a specific product or service are available? The less suppliers of the same product or service, the stronger the position of the suppliers is. This could also influence the make-or-buy decision.

There is always a power distance in transactional relations (MacNeil, 1980; Yan & Gray, 1994). This power distance is for a part dependent on the competitive position of both parties. Another element of power distance is asymmetrical information. One of the parties has knowledge that the other party lacks.

2.1.3 Factors in the make-or-buy decision from social science

Social factors play an important role in transactional relations (Das en Teng, 2001). Therefore, the last factor in the make-or-buy decision that is used for this master thesis is:

8. Trust
Between transaction costs and trust there is a specific relation. According to Sako (1992), “transaction costs of long term contractual relationships could be decreased through investment in trust”. Sako distinguishes between three sorts of trust (see figure 2):

I. Contractual trust. This has to do with trust based on moral values. One party trusts another party based on generally accepted norms and values of honesty. Reputation and earlier experiences with this party gives guidelines for the level of trust that should be allocated (Meer-Kooistra & Vosselman, 2005)

II. Competence trust. This is based on the expectation that the potential partner has the required technical and managerial capabilities for the relation. Certification of providers is an indication for competence.

III. Goodwill trust. This sort of trust is built up through interaction between the parties. Both parties have 100% commitment and do more than what is formally defined. By doing so, they create goodwill in the relation.

Determinants of trust can be divided into endogenous and exogenous determinants. Factors that affect trust within the inter-firm relation are endogenous determinants and those related to the business environment that influence trust from the outside are called exogenous determinants (Kautonen & Kohtamäki, 2006). Examples of endogenous determinants are internal factors, knowledge, skills, abilities, psychological factors and personal characteristics. Examples of exogenous determinants are environmental influences, conditions and rules and policies and regulations (Chang, Hussain, & Dillon, 2006). This master thesis focusses only on endogenous trust because exogenous trust cannot be influenced by activities of the R&D center and is thus less interesting for this research.

2.2 General remarks in determining make-or-buy decisions

The eight decision factors are derived from several theories to describe the decision factors in the make-or-buy decision in general. However, in this master thesis, the focus is on the make-or-buy decision in the context of R&D. The goal of this research is to figure out what the make-or-buy decisions are in the context of R&D and how some of these factors can be influenced and how can be dealt with them.

Until now the focus is only on make-or-buy decisions. The literature stresses the choice between external sourcing and internal development as substitutes. But, although the availability of external technology may discourage—and hence substitute for- own research investment by the receiver firms, there are also arguments from a resource-based view of the firm, to stress the complementarity between in-house R&D and external know-how, i.e., the make-and-buy decision (Veugelers & Cassiman, 1999).

However, in this master thesis, no differences are made between companies that intend to fully or only partly outsource, i.e., there is no difference between the make-or-buy decision and the make-and-buy decision.

2.3 Different forms of outsourcing/collaboration

When a company decides to outsource its R&D, there are different ways and different parties available. The different ways of outsourcing could also be seen as different ‘partner networks’.
partner network is one component of a business model and portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value. It describes the position of the firm within the value network (Osterwalder, Pigneur, & Tucci, 2005).


The different forms of outsourcing can also be called ‘different forms of collaboration’ because by outsourcing, also collaboration is needed to obtain the desired results. In the different forms of collaboration, there is a linkage between length and intensity of a relationship. This is clearly shown in figure 3. This linkage could not exactly be proposed in units because the linkage is also dependent on other factors like type of business (health care, manufacturing, etc.) and personal relations. Although, figure 3 gives a clear overview of the general linkage without showing exact units.

Figure 3 Relation between different forms partner networks

As already mentioned in the introduction, the initial idea behind the master thesis was to make an R&D center more profitable for an SME in the short term using the right partner network. Therefore, the different partner networks that are shown in figure 3 are judged from the perspective of the R&D center. The question was what partner network has the biggest potential to make an R&D center more profitable for SMEs in the short term. The conclusion from the literature study that is done before this master thesis is shown in the table 1.
<table>
<thead>
<tr>
<th><strong>TYPE OF PARTNER NETWORK</strong></th>
<th><strong>POSITIVE ASPECTS</strong></th>
<th><strong>NEGATIVE ASPECTS</strong></th>
<th><strong>RECOMMENDED PARTNERS</strong></th>
<th><strong>CONCLUSION</strong></th>
</tr>
</thead>
</table>
| **ARM LENGTH TRANSACTION** | Extra short term profit  
Few extra costs (because of sunk costs) | More difficult to deliver added value compared to competitor | Existing suppliers and customers | Good opportunity to gain short-term profit to make an R&D center more profitable. |
| **SMALL RELATIONAL CONTRACTS** | Supplier delivers more added value  
This decrease uncertainty | Less flexible, more formal relationship | Existing and new customers | Attractive opportunity to get revenues in the medium-long term |
| **R&D ALLIANCE** | Higher innovation performance with less costs  
Spread R&D risk over different companies  
Combine complementary technological skills and resources of different firms | High alliance failure rate for several reasons  
Coordination costs are higher than by small collaborations | One or few parties in the own value chain (search for highest complementarity of resources)  
Competitors  
Network or business group in the value chain | Very good opportunity for SMEs to gain advantage in costs, risks and knowledge in the long term. However, all the possible pitfalls should be taken carefully into consideration to prevent collaborations where costs exceed profits. |
| **STRATEGIC PARTNERSHIP** | Better performance of the whole value chain in terms of price, quality, innovation and competitive position  
Better strategic position of the firm which is positive for long-term survival. | Risk of losing competitive advantage  
Termination rate around 50 to 60%  
A lot of partnership experiences and managing competences are needed  
Change of management approaches and tools needed (cost much time, money and personal resources) | Partners in the value chain, alone or as a business network  
Partnership with existing or new suppliers and customers should be made based on Resource Based View (expected gain is higher than expected costs) | Very attractive opportunity for SMEs to get a stronger strategic position in the market but requires a lot of effort because of possible risks  
More possible gains, however also more risks compared to an R&D alliance and therefore it requires more competences of the company. This partnership is more suitable for the long term. |
### MEDIUM TERM CONTRACTUAL RELATIONSHIP (LICENSING)

- Possibilities to gain revenues as return of technology investments
- Possibility to exploit technology assets globally
- Ability to establish standards with associated network effects

<table>
<thead>
<tr>
<th>Possibilities to gain revenues as return of technology investments</th>
<th>Lower price-cost margin</th>
<th>Lower market share (through more competition)</th>
<th>This form of Partnership is a little bit out of scope for this literature study. However, in case something special is invented, licensing is a valuable option for SMEs to gain revenues on their investment</th>
</tr>
</thead>
</table>

### EQUITY JOINT VENTURE AND COMPLETE MERGER OR ACQUISITION

- High possible gains in case of a good operating venture
- These forms of partnership require extreme amount of resources

<table>
<thead>
<tr>
<th>High possible gains in case of a good operating venture</th>
<th>These forms of partnership require extreme amount of resources</th>
<th>These forms of partnership requires far too much resources for SMEs and is therefore not attractive for them</th>
</tr>
</thead>
</table>

Table 1 Summary partner networks in the context of searching for the right partner network to make a own R&D center more profitable for SMEs
For the short term, ‘arm length transactions’ and ‘small relational contracts’ have the highest potential for SMEs in the manufacturing business to make an own R&D center more attractive. These forms of partner network have the lowest additional costs and the lowest additional partnership risks. These forms of partner network are not effective for the long term because it gives no spread of technical risk and no extra strategic opportunities. From a cost perspective, existing customers are the most attractive group to deliver products and services.

For the long term, the more intensive forms of collaboration are most attractive. Especially R&D alliances are an attractive opportunity to spread the technical risks, have lower costs and to improve common knowledge. R&D alliances have a proper balance between extra possibilities and not too many collaboration risks. The more intensive collaboration forms have bigger opportunities in terms of spreading technical risks, money available for research, knowledge building and potential profits. The drawback of more intensive collaboration, like ‘strategic partnership’ however is that such collaborations cost much more in terms of money, management support, organizational capabilities, trust and collaboration-risk analyses. Because much more is invested, the negative effect of a premature termination is much higher. Therefore, partner selection becomes also much more critical. To be successful in collaboration, the most important point is that the perception of potential benefits for the different parties is equal.

In general, partner selection should be done in the value chain because there the additional capabilities of the different partner are the highest.

Licensing could also be a valuable option when a technical breakthrough is created and there are no capabilities to exploit it fully, however in practice, it is not the goal of R&D at Bosch Sprang, and therefore out of scope for this theory section. Besides licensing, ‘Equity joint venture’ and a complete merger or acquisition are also out of scope for this theory section.

Because the focus is on the short term, only ‘arm length transactions’ and ‘small relational contracts’ deserve specific attention in this chapter.

2.3.1 Arm length transactions

An ‘arm length transaction’ is one in which the parties are completely independent of one another so that they act in their personal best interests or to maximize their own wealth. Thus there is no chance of collusion between them (Christensen, Cottrell, & Baker, 2014). The transaction is only based on market price (Hoyt & Huq, 2000). Such a transaction is the easiest one to manage because the only thing to do is delivering a good product or service for a good price. There is only few collaboration between the different parties in a short time frame.

In the context of R&D, an ‘arm length transaction’ should be seen as an order from an customer to an external R&D center to measure for example specific properties of a material. A specific example is a company that asks an external R&D center for the E-modulus and impact strength of a specific plastic. The customer provides his material to the external R&D center. The R&D center measures his sample and delivers the properties asked. By this form of outsourcing, the intensity and duration of the relation are very low.

2.3.2 Small relational contracts

Relational (or relationship) contracting (RC) is based on a recognition of mutual benefits and win-win scenarios through more cooperative relationships between the parties. RC principles embrace and underpin various approaches, such as partnering, alliancing, joint venturing and other collaborative working arrangements, and better risk sharing mechanisms (Rahman & Kumaraswamy, 2002).
However, these more extended approaches fall out of scope because they are more applicable for long-term strategy. Now, the focus is on ‘small relational contracts’, especially in the context of R&D.

‘Small relational contracts’ could be divided in two types. One part is the part where the supplier delivers more and more value. The other part is an increasingly co-operative relationship between the parties. These are both based on a temporary relationship that may last only a couple of years (Contractor & Lorange, 2002). The second part of RC has also some overlap with R&D alliances. However, ‘R&D alliances’ are far more comprehensive than ‘small relational contracts’ and fall therefore out of scope.

An example of a ‘small relational’ contract in the context of R&D where the supplier delivers more and more value is when a thermoforming toolmaker plays a role in advising and testing which sort of raw material its customer should use. Normally, the toolmaker delivers a thermoform tool so that its customer is able to produce products with his own material. A ‘small relational contract’ could be that the customer asks the toolmaker to do research on a set of materials to be able to come up with an advice for the best raw material. Then the supplier of thermoforming tools delivers more and more value because he does not only deliver the tooling but also an advice for the raw material to use.

An example of a ‘small relational contract’ with an increasingly cooperative relationship between the parties is when a thermoforming toolmaker together with its customer develops a specific technique to cut a hole in the product during the thermoforming process. This relation is increasingly cooperative when the toolmaker and his customer discuss about possibilities and do the tests also together. Then, the knowledge of both companies is combined to get an optimal production process.

2.3.3 General remarks collaboration forms

In this thesis, the focus is on the decision variables in the make-or-buy decision in R&D by ‘arm length transactions’ and ‘small relational contracts’. It could be the case that by more extensive forms of collaboration like ‘R&D alliances’ the decision variables are a little bit different of differ on importance. For example, it could be imagined that by more extensive ways of collaboration, the relationship between the parties plays a bigger role than by simple forms of collaboration. However, this is out of scope for this thesis because this thesis focus on the decision variables by ‘arm length transaction’ and ‘small relational contracts. To generalize the findings of this master thesis to more extensive forms of collaboration, further research is needed.
3. Method
In this chapter, the method of the whole master thesis project is described.

3.1 Research methodology
As already mentioned, before starting the master thesis project a literature study is done. There it becomes clear what a business model is and which components it consists of. Besides, from the literature study we know what the best partner network is, to apply to R&D centers of SMEs, to be more profitable in the short term.

After that, further literature study is done on the make-or-buy decision. With use of this information, an interview protocol is built (Appendix 2). This interview is conducted with six different persons of Bosch Sprang: three salesmen, the head of the sales department, the CINO and the CTO.

From the results of these interviews and existing literature, a theoretical framework is developed that gives information how to implement the right partner networks in the context of an R&D center. These results are used, in combination with the literature, to finalize the semi-structured interviews for external parties. The semi-structured interviews for external parties are mainly focused on the make-or-buy decision variables, and especially on the variables ‘trust’ and ‘uncertainty’. These variables are further investigated by verifying them by 11 different parties in the value chain. This gives also information about how these variables could be influenced.

3.2 Method of analysis
In this paragraph, the method of analysis is described. First something about the literature study is explained and after that, the method of analysis for the master thesis is elaborated.

3.2.1 Literature study
In the literature study before executing the master thesis, the business model itself, the business model components, and especially the partner networks as components of a business model are described. The result of the literature study is that it is clear what a business model is, which components it should contain and which partner network should be used to make an own R&D center more profitable for SMEs in the manufacturing business. The right ‘partner networks’ are ‘arm length transactions’ and ‘small relational contracts’. These should be implemented to make the R&D center more profitable in the short term. Before being able to implement these partner networks, the make-or-buy decision of the potential customers becomes very important. Therefore, the theory section in this master thesis elaborates on the make-or-buy decisions. This theory section gives the theoretical answer on sub question 1 and is used by developing the semi-structured interviews to be able to find the empirical answer on sub-question 1.

3.2.2 Qualitative research
The focus of this research is on qualitative data. It is expected that the heterogeneity is high in the different answers and qualitative data gives more room for getting context information behind a question. For example, the interviewer could ask the interviewee why a specific answer is given. To gain good insight into this context, quantitative studies need very much research cases. Because of constraints of time and money, in this research, this is not possible.

The data collection strategy involved two phases, first interviews with different employees of Bosch Sprang BV and subsequently, multiple cases in the value chain are interviewed. Interviews in one company can provide rich insights but should be followed by more in-depth means of data collection like different cases. It has to be emphasized that any resulting conclusions and generalizations will be contingent upon the conditions and context within which the selected organizations operate. Hence, the framework is checked by different parties / cases in the value chain. These companies cover a broad spectrum of commercial activity and hence we feel confident to present this generalized
framework as a guide for action (see figure 8).

According to Yin (2003) a case study is, besides the literature study, a valuable addition to investigate a business problem in its real-life context. Especially the different cases of different companies should give a broad overview of the applicability of the gained knowledge. So, interviews by several cases / different companies in the value chain enhance the external validity. For a good case study it is important to determine the unit of analysis, ways of collecting data and ways of analyzing the data (Aken, Berends, & Bij, 2006; Yin, 2003).

**Unit of analysis:**
The unit of analysis is the major entity that is analyzed in a research. The main entities in this research are the decision variables in the make-or-buy decision in the context of R&D, and especially the variables ‘trust’ and ‘uncertainty’.

**Data collection 1:**
The data collection 1 is data that is collected to be able to build a framework how to implement ‘arm length transactions’ and ‘small relational contracts’, with a special focus on the decision factors in the make-or-buy decision. Besides, this data is collected to be able to develop an interview protocol for the external parties. This data is collected through semi-structured interviews with different employees of Bosch Sprang. First, the plan was to do a focus group discussion. Nevertheless, semi-structured interviews are chosen to collect this data. Between the different employees of Bosch Sprang are too much personal differences for gaining the right information by a focus group discussion. Then, only information from a few faster thinkers is collected. Therefore personal structured interviews are chosen. Table 2 shows the names of the interviewees, sectors, etc.

<table>
<thead>
<tr>
<th>#</th>
<th>Interviewee</th>
<th>Sector</th>
<th>Company</th>
<th>Function</th>
<th>Date</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O. Roubos</td>
<td>Manufacturer Thermoformtools</td>
<td>Bosch Sprang BV</td>
<td>Salesman</td>
<td>01/04/2015</td>
<td>60 min</td>
</tr>
<tr>
<td>2</td>
<td>G. Smeulders</td>
<td>Manufacturer Thermoformtools</td>
<td>Bosch Sprang BV</td>
<td>CINO</td>
<td>02/04/2015</td>
<td>75 min.</td>
</tr>
<tr>
<td>3</td>
<td>A. Bosch</td>
<td>Manufacturer Thermoformtools</td>
<td>Bosch Sprang BV</td>
<td>CTO</td>
<td>03/04/2015</td>
<td>75 min.</td>
</tr>
<tr>
<td>4</td>
<td>M. Haex</td>
<td>Manufacturer Thermoformtools</td>
<td>Bosch Sprang BV</td>
<td>Salesman</td>
<td>03/04/2015</td>
<td>90 min</td>
</tr>
<tr>
<td>5</td>
<td>A. Bogers</td>
<td>Manufacturer Thermoformtools</td>
<td>Bosch Sprang BV</td>
<td>Head sales department</td>
<td>07/04/2015</td>
<td>105 min</td>
</tr>
<tr>
<td>6</td>
<td>P. van Raamsdonk</td>
<td>Manufacturer Thermoformtools</td>
<td>Bosch Sprang BV</td>
<td>Salesman</td>
<td>09/04/2015</td>
<td>75 min.</td>
</tr>
</tbody>
</table>

*Table 2 Interview scheme for intern semi-structured interviews*

After the interviews where worked out, they are communicated with the interviewees to verify whether the interpretation was right and to enhance the internal validity.

**Data collection 2:**
The data collection 2 is data that is collected from other companies in the value chain and is used to verify the make-or-buy decision factors. Furthermore, data collection 2 is especially focused on the variables ‘trust’ and ‘uncertainty’ in the make or buy decision. This data collection is done by semi-structured interviews. There are two reason for choosing semi-structured interviews. First, semi-structured interviews to different companies give the possibility to compare the results in general because the information is structured around the interview questions which in turn are structured around the developed framework. Interviews give the possibility to analyze the data in a more
structured way. Secondly, semi-structured interviews will be used because these are open-ended, what implies that interviewees were allowed to discuss other relevant aspects. Semi-structured interviews combine these two parts, being structured and still give the possibility to discuss other relevant aspects.

An important point of data collection 2 is that all interviewees should be in the position to decide to outsource R&D activities. This thesis is focused on the decision factors in the make-or-buy decision in R&D. The people who know best what role these decision factors play, are the ones who are responsible for this decision. That means that the interviews should be taken with people who are high in the company hierarchy. That becomes clear in table 3, which not only shows the names and sectors of the interviewees but also their function in the company.

<table>
<thead>
<tr>
<th>#</th>
<th>Interviewee</th>
<th>Company</th>
<th>Sector</th>
<th>Function</th>
<th>Date</th>
<th>Duration</th>
<th>Location interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Drs. H. Wieman</td>
<td>Albert Heijn</td>
<td>Retailer</td>
<td>European Sourcing Manager</td>
<td>20/04/2015</td>
<td>75 min.</td>
<td>Zaandam</td>
</tr>
<tr>
<td>2</td>
<td>BSc E. Hodenpijl</td>
<td>Modiform</td>
<td>Producer thermoform products</td>
<td>Leader technical development</td>
<td>20/04/2015</td>
<td>45 min.</td>
<td>Sprang-Capelle</td>
</tr>
<tr>
<td>3</td>
<td>Mr. H. Armbruster</td>
<td>Kuhne Extrusion</td>
<td>Extruder manufacturer</td>
<td>Chief Executive Officer (CEO)</td>
<td>21/04/2015</td>
<td>20 min.</td>
<td>Sprang-Capelle</td>
</tr>
<tr>
<td>4</td>
<td>G. de Kwaasteniet</td>
<td>Desch Plantpak</td>
<td>Producer thermoform products</td>
<td>Plant manager</td>
<td>22/04/2015</td>
<td>75 min.</td>
<td>Waalwijk</td>
</tr>
<tr>
<td>5</td>
<td>Dr. Bernd Stein</td>
<td>Kiefel GmbH</td>
<td>Thermoform machine builder</td>
<td>Chief Operational Officer (COO)</td>
<td>23/04/2015</td>
<td>30 min.</td>
<td>Sprang-Capelle</td>
</tr>
<tr>
<td>6</td>
<td>MSc. J. Tibax</td>
<td>De Ster</td>
<td>Producer thermoform products</td>
<td>Manufacturing Engineer</td>
<td>30/04/2015</td>
<td>90 min.</td>
<td>Hoogstraten (Belgium)</td>
</tr>
<tr>
<td>7</td>
<td>Dr. T. Kirschnick</td>
<td>Fernholz GmbH</td>
<td>Extruder manufacturer</td>
<td>Leiter Technik</td>
<td>04/05/2015</td>
<td>55 min.</td>
<td>Meinerzhagen-Sprang-Capelle</td>
</tr>
<tr>
<td>8</td>
<td>Mr. R. Düchting</td>
<td>Battenfeld-Cincinnati</td>
<td>Extruder manufacturer</td>
<td>Head of processing</td>
<td>05/05/2015</td>
<td>65 min.</td>
<td>Bad Oeynhausen (Germany)</td>
</tr>
<tr>
<td>9</td>
<td>Drs. R. Derks</td>
<td>Silver Plastics GmbH</td>
<td>Producer thermoform products</td>
<td>Technical Manager</td>
<td>06/05/2015</td>
<td>35 min.</td>
<td>Sprang-Capelle</td>
</tr>
<tr>
<td>10</td>
<td>BSc. A. Siebring</td>
<td>RPC</td>
<td>Producer thermoform products</td>
<td>Product and Process Development Engineer</td>
<td>07/05/2015</td>
<td>65 min.</td>
<td>Deventer</td>
</tr>
<tr>
<td>11</td>
<td>MSc V. de Rijk</td>
<td>Surya Indo Plastic (SIP)</td>
<td>Producer thermoform products</td>
<td>Assistant to director</td>
<td>08/05/2015</td>
<td>55 min.</td>
<td>Sprang-Capelle</td>
</tr>
</tbody>
</table>

Table 3 Interview scheme for external semi-structured interviews

After the interviews where worked out, they are communicated with the interviewees to verify whether the interpretation was performed well and to enhance the internal validity.
Data analysis 1:
The data is analyzed by comparing the semi-structured interviews to identify common dilemmas and refine the unique aspects. Tables and graphs are created to facilitate further comparisons. The semi-structured interviews are compared for similarities and differences to develop the emerging constructs and theoretical logic. This is done in an iterative way and with several breaks because this is the best way to do this sort of research, to refresh the way of thinking. By analyzing, coding is used to transform long answers into keywords that could be counted and compared. An example of this coding can be found in appendix 4.

The advantage of doing data collection 1 only at Bosch Sprang is that when knowledge from the interviews will be applied to the R&D center of Bosch Sprang, it fits within the conceptual framework of Bosch Sprang. The drawback is that the knowledge could be focused on the situation at Bosch Sprang too much. That could cause generalization problems for the theoretical implications. To tackle the last problem, the model will be verified through different cases, by different parties in the value chain, using semi-structured interviews. The only problem that remains is that all interviews are performed in the same value chain. Therefore, it could be difficult to generalize the findings to other value chains.

Data analysis 2:
The data of other companies in the value chain is analyzed commonly to get a good overview of the results. This means that within case and cross case analyses are done (Brown & Eisenhardt, 1997). The data is analyzed by comparing the cases with the developed model from data analysis 1. Again, tables and graphs are created to facilitate further comparisons. The analysis of the gathered data gives the answer on sub question 2. From the gathered data is also determined which target market for Bosch Sprang has the biggest potential to have ‘arm length transactions’ or ‘small relational contracts’ with. In chapter 5, all information is used to write theoretical and practical implications.

Content of the internal interviews:
The questions in the internal interviews (see appendix 2) have the following background. First some questions about the need for R&D in the thermoform business are asked to see what the existing opinion at Bosch Sprang is. Because the initial idea was to develop a framework to implement ‘arm length transactions’ and ‘small relational contracts’, the following question was how the different parties in the value chain should be approached.
After that, the focus was more set on the decision factors in the make-or-buy decision. First, the interviewee was asked what the possible decision factors are in the make-or-buy decision. After that, decision factors from the theoretical insights (see chapter 2) are judged on importance with a mark between 1 and 10.

After the first interview and some customer visits in the R&D center of Bosch Sprang, it became clear that there is one important other variable that can influence the make-or-buy decision that should be in the interviews:

a. Property rights

The first decision factors are factors in a general make-or-buy decision. The factor ‘property rights’ is especially a possible factor in this decision in the context of R&D. In this master thesis by ‘property rights’, all aspects about confidentiality, patents and different sorts of rights are meant. In the internal interviews, these factors are judged for the situation of an ‘arm length transaction’ and for a
‘small relational contract’. That is done to see the difference in importance of the different factors, in the different situations.

To be able to develop a framework how to implement ‘arm length transactions’ and ‘small relational contracts’, also some extra questions about aspects that deserve extra attention by performing R&D for other parties, and questions about risks are asked.

To find ways to influence several decision variables, questions about how to reduce uncertainty, enhance trust and make transaction size more attractive, are asked. Besides, the interview goes more in depth regarding the content of a contract in different situations. The last questions in the intern interview are about potential opportunistic behavior of potential customers.

The more in depth question about the content of a contract is based on the contract dimensions of Dekker (2005). He mentions the following contract dimensions: price, product / service description, property rights, after sales service and conflict handling (see figure 4).

The question is to judge these factors how important these will be to have specified in the contract. Besides, the interviewee is asked whether there are other important factors that should be in the contract. These questions should make clear where the focus should be on, by drawing up a contract in the context of performing R&D for external parties.

**Content of the external interviews:**

The objective of the external interviews (see appendix 3) is to gain more knowledge about the decision factors by different parties in the value chain. Besides, another objective is to verify different aspects of the framework that is developed based on the results of the internal interviews. So, the content of the external interviews is based on literature behind the internal interviews and the results from these interviews. The results of the internal interviews are used to adapt and add the questions for the external interview.

The external interviews start with some questions about the general thoughts of searching for more material knowledge and outsourcing R&D. After that, the interview goes more in depth on the decision factors in the make-or-buy decision in the context of R&D, and especially about ‘trust’ and ‘uncertainty’. The decision factors that should be judged by the interviewee are changed compared to the ones asked in the internal interviews based on the results of the internal interviews. The decision variables that are added are the following:

a) Availability of own resources (budget, people, knowledge, time)
b) Need for knowledge transfer

These factors are several times mentioned in the internal interviews and are not fully covered by the existing factors from the theory section. However, there is an overlap between ‘availability of own
resources’ and ‘specificity of the transaction’ because a lack of ‘availability of resources’ implies that specific investments are needed.

The need for knowledge transfer is a new factor that should be incorporated by the possible decision factors in the make-or-buy decision in the context of R&D because this factor is several times cited in the internal interviews. It should be verified in practice whether these factors play a significant role in the make-or-buy decision.

One decision factor was in the internal interviews but is not put into the external interview because the influence of this factor was judged as insufficient (average mark of 4.0) by all internal respondents both in the case of an ‘arm length transaction’ and in the case of a ‘small relational contract’:

- Power imbalance between partners

In the external interviews, there is also the general question what can be done to reduce uncertainty and to enhance trust. Besides that, there are questions to judge the possibilities to reduce uncertainty and to enhance trust. With those questions, the results from the internal interviews are verified by the different parties in the value chain.

Because the way of approaching customers is dependent on their preferences in sort of relations from simple market transaction to complex relationship management (Freytag & Clarke, 2001), there is also a question in the external interview about the market situation of the company and the desired market situation in the context of R&D. That information could be used in the conclusion to know how the customer should be approached.

3.2.3 Quality

By a case study, the quality is of high importance. According to Yin (2003), four tests are important to taken into account: construct validity, internal validity, external validity and reliability. Table 4 shows the definitions of the tests, the advices to improve these validities and the tactics which are used during this thesis project to enhance these validities.

<table>
<thead>
<tr>
<th>Tests</th>
<th>Definition</th>
<th>Advice</th>
<th>Tactic</th>
</tr>
</thead>
</table>
| Construct validity | Establishing correct operational measures for the concepts being studied. | - Use multiple sources of evidence  
- Establish chain of evidence  
- Have key informants  
- Review draft case  
- Study report | - Use of multiple sources of evidence, such as interviewees and literature.  
- Key informants are used: interviewees are all of high level and are responsible for the make-or-buy decision in context of R&D |
| Internal validity     | Establishing a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships. | - Do pattern-matching  
- Do explanation-building  
- Address rival explanations  
- Use logic models | - Clear research framework based on literature and internal interviews  
- Interviews from different companies are compared to be able to do pattern matching. |
| External validity   | Establish the domain to which a                                             | - Use theory in single-case studies          | - Theory is used to determine questions in interviews. |
study’s findings can be generalized.

Besides, a literature study is done beforehand.

| Reliability | Demonstrating that the operations of a study can be repeated, with the same results | - Use case study protocol
- Develop case study database | - Semi-structured interviews are used
- A specific folder contains all the used data (internal and external interviews) |

*Table 4 Quality improvement case study (Yin, 2003)*
4. Results

In this chapter, the results of the internal and external semi-structured interviews are discussed. The aim of this chapter is to answer the empirical part of research sub question 1 and answer research sub question 2. These research questions are formulated as follows:

(1) **What are the make-or-buy decision variables in the context of R&D?**
(2) **How do trust and uncertainty influence the make or buy decisions for potential clients of Bosch Sprang and how could these factors be influenced?**

This chapter is divided in two parts. The first part is about the results of the internal interviews at Bosch Sprang. The second part is about the results of the external interviews by different parties in the thermoforming value chain.

4.1 Internal results

In this paragraph, the internal results from the interviews at Bosch Sprang are given. The conclusions in this paragraph are based on these results and could not be generalized directly. First, the results should be checked by different parties in the value chain to see whether these could be generalized to other situations. The internal results could be divided into four different parts:

**Figure 5 Structure of paragraph internal results**

The first part is about the decision variables in the make-or-buy decision, especially focused on ‘trust’, ‘transaction size’ and ‘uncertainty. This is to know which questions to ask in the external interviews and to have internal input about importance of different factors. The second part is about general thoughts about R&D in thermoforming business. This is to determine general thoughts at Bosch Sprang about R&D. The third point is how to approach potential customers. This is done to be able to build a framework that could be used by Bosch Sprang in the end. The last part is about risks and special aspects that deserve attention by performing R&D for other parties. This is also to be able to build a framework that could be used by Bosch Sprang.

Several times, the term ‘framework’ is used in this thesis. This framework is built to give insights for Bosch Sprang in the four different parts that are mentioned already. The final special focus of this master thesis is on one aspect of this framework: the make-or-buy decision variables in the context of R&D, and especially the variables ‘trust’ and ‘uncertainty’.

In this analysis, no difference is made between answers of interviewees with a technical background and with a sales background. Reason for that is that all salespeople did a technical study, so their background is not only sales. Besides, too few interviews are conducted to draw conclusions based on differences in background.

4.1.1 Decision variables in the make-or-buy decision in R&D

The interviewees at Bosch Sprang are asked what the decision variables are for parties in the value chain to decide to outsource R&D or to do R&D by themselves. The answers are grouped in a one
sentence code and shown in table 5, together with information how many interviewees mention this factor.

<table>
<thead>
<tr>
<th>Decision factors in the make-or-buy decision</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowhow of materials and applications at external R&amp;D center</td>
<td>4x</td>
</tr>
<tr>
<td>Costs of the order compared to doing the job by themselves</td>
<td>3x</td>
</tr>
<tr>
<td>Need for information exchange</td>
<td>3x</td>
</tr>
<tr>
<td>Availability of resources in terms of material, people, knowledge and budget</td>
<td>3x</td>
</tr>
<tr>
<td>Reliability of R&amp;D center Bosch Sprang</td>
<td>2x</td>
</tr>
<tr>
<td>Capacity of doing the job by themselves</td>
<td>2x</td>
</tr>
<tr>
<td>Protection of knowhow</td>
<td>2x</td>
</tr>
<tr>
<td>Geographical distance to the customer</td>
<td>2x</td>
</tr>
<tr>
<td>When people like to build a network</td>
<td>1x</td>
</tr>
<tr>
<td>Cost-benefit analysis</td>
<td>1x</td>
</tr>
<tr>
<td>Trust</td>
<td>1x</td>
</tr>
<tr>
<td>Does investment in this direction fit the strategy of the company</td>
<td>1x</td>
</tr>
<tr>
<td>Size of the company. Big companies have more budget and higher quality standards and are therefore more likely to do the R&amp;D by themselves</td>
<td>1x</td>
</tr>
<tr>
<td>Delivery time of the order</td>
<td>1x</td>
</tr>
<tr>
<td>Goodwill</td>
<td>1x</td>
</tr>
</tbody>
</table>

Table 5 Factors that influence the make-or-buy decision according to employees of Bosch Sprang

These factors have a lot of overlap with the decision factors from the theory section. For example ‘knowhow of material and applications at external R&D center’ belongs to the factor ‘trust between partners’ because it has to do with trust that the external party has enough knowledge to obtain reliable results. This is also called: competence trust. Besides, this example belongs to ‘uncertainty in the transaction’ because it has to do with the uncertainty that the external R&D center is able to solve the question of the customer.

As already mentioned, two factors that are several times mentioned by interviewees and that are not in the theory section are:

1. Need for knowledge exchange
2. Availability of resources in terms of material, people, knowledge and budget

These two factors are therefore added to the external interviews to see whether they are really important in the make-or-buy decision.

The make-or-buy decision factors from the theory section, are judged on importance by the different interviewees of Bosch Sprang in two different situations: ‘arm length transactions’ and ‘small relational contracts’. The results of these judgments are shown in table 6.

<table>
<thead>
<tr>
<th>Importance of decision variables in make or buy decisions</th>
<th>Arm length transaction</th>
<th>Small relational contract</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specificity of the transaction</td>
<td>8.5</td>
<td>7.9</td>
<td>8.2</td>
</tr>
<tr>
<td>Trust between the partners</td>
<td>7.8</td>
<td>8.5</td>
<td>8.2</td>
</tr>
<tr>
<td>Task complexity of the transaction</td>
<td>7.7</td>
<td>7.5</td>
<td>7.6</td>
</tr>
<tr>
<td>Property rights</td>
<td>6.6</td>
<td>8.3</td>
<td>7.5</td>
</tr>
<tr>
<td>Transaction frequency</td>
<td>7.3</td>
<td>7.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Transaction size</td>
<td>6.2</td>
<td>7.6</td>
<td>6.9</td>
</tr>
<tr>
<td>Competitive position of company X</td>
<td>5.7</td>
<td>5.8</td>
<td>5.8</td>
</tr>
</tbody>
</table>
In general, according to employees of Bosch Sprang the factors ‘Specificity of the transaction’ and ‘trust’ are the most important factors in the make-or-buy decision in the context of R&D. The factor ‘Power imbalance between partners’ scores on average insufficient and is therefore not used in the external interviews.

In table 6, there is a clear difference between the importance of the factors by ‘arm length transactions’ and ‘small relational contracts’. In simple projects, ‘uncertainty’ plays a less important role and ‘Specificity of the transaction’ is most important. In bigger projects, ‘property rights’ and ‘trust’ become more important.

**Influence decision factors in make-or-buy decision**

After asking what the decision variables are, several questions about influencing these factors are asked. According to the interviewees of Bosch Sprang, ‘trust’ could be enhanced by:

1. Showing reference projects
2. Having the right appearance (R&D equipment, accommodation, personnel and report)
3. Showing handling confidential projects

From the data, it is known that having the right appearance is quite broad. For example, the right appearance of personnel means that the employees should have a high willingness to listen, be active, have a proper way of working, have a correct question handling, are reliable in delivering, etc. A right appearance of the report means that the end result should be supported by all graphs and values from the different tests and is eventually elaborated with products that are produced with the test thermoform machine of Bosch Sprang.

A direct relation exists between ‘trust’ and ‘uncertainty’. When a potential customer has more trust in the external R&D center, he has for himself more certainty that the external R&D center come with reliable results. This relation works also the other way around. According to the interviewees of Bosch Sprang, following factors reduce uncertainty and, because of the relation between ‘trust’ and ‘uncertainty’, these factors also enhance trust:

- Signing a contract
- Performing a risk analysis
- Performing a pilot test to determine a trend
- Splitting up the project with milestones and ‘go’, ‘no go’ decisions in between
- A customer visit to the R&D center
- Showing reference projects
- Signing a Non-Disclosure-Agreement (NDA)

According to employees of Bosch Sprang, signing a contract should reduce uncertainty. However, contracts should be not too extensive because creating more extensive contracts costs more in terms of time and money. Therefore, another question in the interview was how important the different factors are to be in the contract. The results are shown in table 7.

<table>
<thead>
<tr>
<th>Importance of contract dimensions of Dekker (2005)</th>
<th>Arm length transaction</th>
<th>Small relational contract</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product / service description</td>
<td>8.8</td>
<td>9.0</td>
<td>8.9</td>
</tr>
</tbody>
</table>

Table 6 Importance of decision variables in make-or-buy decision according to internal interviewees
<table>
<thead>
<tr>
<th>Price</th>
<th>8.5</th>
<th>8.8</th>
<th>8.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property rights</td>
<td>6.7</td>
<td>8.5</td>
<td>7.6</td>
</tr>
<tr>
<td>After sales service</td>
<td>6.7</td>
<td>8.4</td>
<td>7.5</td>
</tr>
<tr>
<td>Conflict handling</td>
<td>5.8</td>
<td>6.8</td>
<td>6.3</td>
</tr>
</tbody>
</table>

*Table 7 Importance of contract dimensions of Dekker (2005) according to internal interviewees*

In general, the description of the R&D project and the price are the most important points to write in the contract. A right product / service description also contains a timeframe with a delivery date. ‘Property rights’, ‘after sales service’ and ‘conflict handling’ becomes only more important in bigger projects. According to the interviewees, an extra factor that could be added to the contract is certain working conditions, for example ‘Metaalunie conditions’.

According to the employees of Bosch Sprang, the transaction size or costs of the R&D could be made more acceptable through: framework agreements, spread of payment, payment only after results (no cure, no pay), price fits into decision budget, pilot test to determine trend, followed by ‘go’ ‘no go’ decision, dividing project in parts with milestones between them and a fixed price for standard research.

One of these factors needs explanation. The factor, ‘price fit into decision budget’ means that the price for the R&D order fits in the decision budget of the responsible person. In some companies, employees have permission to make decisions up to a specific budget. Above this budget, special requests must be submitted. Offering the first project so that it fits in this budget, makes placing the order more acceptable.

4.1.2 General thoughts about R&D in thermoforming business

The interviewees of Bosch Sprang mark the need for material research in the thermoforming business quite high: an 8.8 on a scale from 1 to 10. Besides, it becomes clear that the producers of packaging using thermoform tools are seen as the ones with the highest potential to gain extra profit when they have more material knowledge. To make the R&D center of Bosch Sprang more profitable in the short term, the interviewees see the producers of thermoformed products as the most attractive partners to do research for, based on their existing material knowledge and their possibility to gain extra profit by having more material knowledge.

4.1.3 Approaching potential customers

Different parties in the value chain should be approached in a different manner. The way in which the different parties should be approached is described in the discussion part and further elaborated in appendix 5 because this part belongs not to the core of this master thesis. The way of approaching is also shown in the framework in figure 8.

4.1.4 Risks and special aspects that deserve attention when performing R&D for other parties

The interviewees of Bosch Sprang see the following risks by performing R&D for external parties: damaging existing relations, problems with property rights, invalid results, blaming companies or persons with conclusions, less knowledge transfer through resistance against too much partnerships, other parties see also added value and start to invest in R&D equipment, and being unclear to customers what they could expect. Because these risks belong not to the core of this master thesis, these will be further explained in appendix 6.

Besides risks, the interviewees are also asked for special aspects that deserve extra attention when performing R&D for external parties. They come up with the following aspects: how to deal with
confidentiality, clear project description and timeframe, research following norms and guidelines, clear final result (report), price level should be acceptable in comparison to competitors, independence and objectivity of the R&D center, and potential damage in case something goes wrong. Because these aspects do also not belong to the core of this master thesis, these results are also explained further in appendix 6.
4.2 External results

In this paragraph, the results from the external interviews with different parties in the value chain are given. These results could be divided into three different parts:

- Main part: make-or-buy decision factors
- General thoughts R&D
- Risks and special aspects

![Figure 6 Structure of paragraph external results](image)

This paragraph starts with the main part about the make-or-buy decision factors and is followed by a small part about general thoughts in R&D. This paragraph ends with a small part about risks and special aspects that deserve extra attention by performing R&D for external parties.

4.2.1 Decision variables in the make-or-buy decision in R&D

To verify the developed framework, several questions are asked to determine the decision variables in the make-or-buy decision in R&D. First, in an open question is asked what, for the interviewee, the most important factors are to start or not to start a project with an external R&D center. The results are analyzed using a coding scheme and are shown in table 8.

<table>
<thead>
<tr>
<th>Decision factors in the make-or-buy decision</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost/benefit ratio</td>
<td>8x</td>
</tr>
<tr>
<td>Availability of own resources</td>
<td>6x</td>
</tr>
<tr>
<td>Delivery time of the order (speed of results)</td>
<td>6x</td>
</tr>
<tr>
<td>Resources and quality level of external R&amp;D center</td>
<td>5x</td>
</tr>
<tr>
<td>Confidentiality</td>
<td>4x</td>
</tr>
<tr>
<td>Relation</td>
<td>3x</td>
</tr>
<tr>
<td>Trust</td>
<td>2x</td>
</tr>
<tr>
<td>Transaction frequency</td>
<td>2x</td>
</tr>
<tr>
<td>Independence external R&amp;D center</td>
<td>2x</td>
</tr>
<tr>
<td>Fit with company strategy</td>
<td>2x</td>
</tr>
<tr>
<td>Geographical location</td>
<td>1x</td>
</tr>
<tr>
<td>Safety issues</td>
<td>1x</td>
</tr>
<tr>
<td>Complexity</td>
<td>1x</td>
</tr>
<tr>
<td>Flexibility</td>
<td>1x</td>
</tr>
</tbody>
</table>

*Table 8 Factors in the make-or-buy decision according to external parties in the value chain*

Most of these factors have a lot of overlap with the factors from the theory section. For example the cost/benefit ratio. This is almost the same as the factor ‘transaction size’ because it has to do with costs of performing the R&D by themselves or outsource it.

Another example is ‘Resources and quality level of external R&D center’. This factor has a lot of overlap with ‘trust’ because this factor is the same as trust that the external R&D center has the right ‘technical and managerial resources’. This overlaps with ‘competence trust’. According to the theory section, competence trust is ‘trust that the external R&D center have the required technical and managerial capabilities’ (Sako, 1992).
There are three factors that are mentioned several times in the external interviews, which are not in the theory section:

1. Delivery time of the order (speed of results)
2. Independence external R&D center
3. R&D investment corresponds with company strategy

Especially how quick the customer gets his results is very important for a lot of potential customers by deciding to do the R&D by themselves or to outsource it.

The make-or-buy decision factors that are in the theory section, and two factors from the internal interviews, are judged on importance in the make-or-buy decision with a mark between 1 and 10. The results are shown in table 9. The marks of the different parties in the value chain have a specific color to make it easier to determine specific relations. The value chain is explained in appendix 1.

<table>
<thead>
<tr>
<th>Decision factors</th>
<th>Extruder manufacturer</th>
<th>Machine manufacturer</th>
<th>Producers of thermoform products</th>
<th>Retailer</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability of own resources (budget, people, knowledge, time)</td>
<td>7 9 10</td>
<td>9</td>
<td>8 9 8 10</td>
<td>9 7 7 7 7</td>
<td>8.5</td>
</tr>
<tr>
<td>Trust between partners</td>
<td>7 10 4</td>
<td>10</td>
<td>8 6 8 9 10 8</td>
<td>8 8 8 8 8</td>
<td>8.0</td>
</tr>
<tr>
<td>Task complexity of the transaction</td>
<td>8 9 7</td>
<td>7</td>
<td>8 9 7 7 10 9</td>
<td>6 6 6 6 6</td>
<td>7.9</td>
</tr>
<tr>
<td>Specificity of the transaction (specific investments needed or not)</td>
<td>4 9 8</td>
<td>9</td>
<td>7 9 7 X 3 9</td>
<td>8 8 8 8 8</td>
<td>7.3</td>
</tr>
<tr>
<td>Competitive position of partner</td>
<td>4 5 7</td>
<td>10</td>
<td>5 8 9 7 10 6</td>
<td>8 8 8 8 8</td>
<td>7.2</td>
</tr>
<tr>
<td>Property rights</td>
<td>8 9 4</td>
<td>7</td>
<td>5 5.5 9 7 10 5</td>
<td>8.5 8.5 8.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Transaction size (economic size of the order in euros)</td>
<td>5 10 8</td>
<td>5</td>
<td>8 9 7 8 9 6</td>
<td>2.5 2.5 2.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Need for knowledge transfer</td>
<td>6 5 9</td>
<td>8</td>
<td>6 8 6 7 8 6</td>
<td>6 6 6 6 6</td>
<td>6.8</td>
</tr>
<tr>
<td>Uncertainty in the transaction</td>
<td>2 5 4</td>
<td>4</td>
<td>5 4 8 9 10 7</td>
<td>6 6 6 6 6</td>
<td>5.8</td>
</tr>
<tr>
<td>Transaction frequency</td>
<td>3 4 3.5</td>
<td>9</td>
<td>8 7 6 8 5 8</td>
<td>2.5 2.5 2.5</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Table 9 Judgment of decision factors in the make-or-buy decision through different external parties

All variables are on average higher than 5.5 so, according to the interviewees, all variables play a role in the make-or-buy decision. The most important variables in the make-or-buy decision are ‘availability of own resources’, ‘trust between partners’ and ‘task complexity of the transaction’.

When analyzing this overview of marks, some aspects should be taken into consideration. Some respondents find it difficult to determine the importance of ‘specificity of the transaction’ because this is for them dependent on additional factors. One respondent said that it depends on the ROI. “It depends on the ROI. When we see possibilities, specific investments are no problem, otherwise, this factor is very important” (Interviewee: Derks, 2015). Another respondent said “if the specific investment is process related, it is no problem, but when the investment is for R&D only, we do not invest” (Interviewee: Siebring, 2015).

Another point is ‘property rights’. The importance of this factor is also dependent on the sort of project (Interviewee: Duchting, 2015). Some projects are very confidential, some others not.

There exist also a relation between different factors. For example: “when both parties have a long standing relation, uncertainty in the transaction is less important because the customer has enough trust in the R&D center” (Interviewee: Hodenpijl, 2015). Importance of ‘uncertainty in the transaction’ depends also on costs. “With a small chance of success and high uncertainty, we start the project with the external partner only if the costs are accordingly low” (Interviewee: Kirschnick, 2015).
There are not many remarkable differences between the average results of the different parties in the value chain. It should be said that it is hard to draw conclusions when so little cases of every party are available. Only general remarks could be made about the differences. ‘Competitive position of the partner’ scores quite low on importance, by extruder manufacturers. Besides, extruder manufacturers and thermoform machine manufacturers score low on ‘uncertainty’. However, from these remarks, no reliable conclusions could be drawn.

**Trust**

The results of the open question of the external interviews are that trust could be enhanced by the factors that are shown in table 10.

<table>
<thead>
<tr>
<th>Factors that enhance trust in an external R&amp;D center</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open, pro-active, personal communication</td>
<td>4x</td>
</tr>
<tr>
<td>Experience / competence of R&amp;D center and staff</td>
<td>3x</td>
</tr>
<tr>
<td>Showing reference projects</td>
<td>3x</td>
</tr>
<tr>
<td>Giving insight in way of performing R&amp;D</td>
<td>3x</td>
</tr>
<tr>
<td>Trust will be build up in time through experience and relation</td>
<td>2x</td>
</tr>
<tr>
<td>Showing handling confidential projects</td>
<td>2x</td>
</tr>
<tr>
<td>Delivering reliable results</td>
<td>2x</td>
</tr>
<tr>
<td>Signing a contract</td>
<td>1x</td>
</tr>
<tr>
<td>Customer visit to the R&amp;D center</td>
<td>1x</td>
</tr>
<tr>
<td>Having the right appearance</td>
<td>1x</td>
</tr>
<tr>
<td>Certification</td>
<td>1x</td>
</tr>
<tr>
<td>Word of mouth</td>
<td>1x</td>
</tr>
<tr>
<td>Power balance between parties should be equal</td>
<td>1x</td>
</tr>
</tbody>
</table>

Table 10 Factors that enhance trust in an external R&D center according to external interviewees

The most important factor to enhance trust in an external R&D center is that the external R&D center should have an open, pro-active, personal way of communication. “The external R&D center has to take us seriously: being pro-active in communication and giving useful feedback. We should have the feeling that the external party understands our needs” (Interviewee: Siebring, 2015). “It should be clearly communicated what research method is used and why, so that we are able to know the thought pattern. There should be 100% commitment, communication and learning from both sides” (Interviewee: Tibax, 2015). This way of communication enhances all three forms of trust.

Besides communication, experience and competence of the R&D center are important to build up trust. Furthermore, showing reference projects, giving insights in the way of performing R&D and showing how will be dealt with confidential projects is of high importance. Besides, several interviewees mention that trust will be build up in time through experience and relation. So, the external R&D center should do the right things over time. Some factors in table 10 have some overlap, for example ‘delivering reliable results’ depends on the ‘experience / competence of the R&D center. Another example is ‘Giving insights in the way of performing R&D’. That shows also how ‘open and personal’ the way of communication is of the external party.

Besides, the external interviewees judged five factors that enhance trust in an external R&D center. The factors that are judged came from the internal interviews. The results are shown in table 11. The judgments of each party in the value chain has a specific color.
All factors are judged with a mark higher than 5.5. So, the external interviewees see these factors as significant to enhance trust. The biggest contractual trust enhancement is reached when the external R&D center shows how it deals with confidential projects. Having the right appearance in terms of equipment, accommodation, staff and results enhance competence trust also seriously.

One interviewee judges two factors as very low: ‘signing a contract’ and ‘showing how they deal with confidential projects’. This has to do with the company experience and strategy. This interviewee said: “we never had discrepancy in property rights. Our company doesn’t have patents. Being the first for a while is enough for us” (Interviewee: Kirschnick, 2015). For all other parties, confidentiality is quite important.

The marks for ‘performing a pilot test’ and ‘showing reference projects’ are quite different. Some respondents judge these as very high, while others judge these factors as very low. This is also dependent on the relation and experience with the external R&D center: “signing a contract, performing a pilot test and showing reference projects are not so important because of the long standing relation with Bosch Sprang. For other parties, without strong a relation, it is more important” (Interviewee: Hodenpijl, 2015).

The only remarkable difference in table 11 between the different parties in the value chain is, that extruder manufacturers in general think that showing reference projects does not enhance trust, while other parties score above 5.5 averagely.

### Uncertainty

According to the external interviewees, uncertainty could be reduced by the factors shown in table 12.

<table>
<thead>
<tr>
<th>Factors that reduce uncertainty in an external R&amp;D center</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right way of communication</td>
<td>3x</td>
</tr>
<tr>
<td>Clear project description/plan/test procedure and agreement about goal and expectations of the project on beforehand</td>
<td>3x</td>
</tr>
<tr>
<td>Pilot test</td>
<td>2x</td>
</tr>
<tr>
<td>Customer visit</td>
<td>2x</td>
</tr>
<tr>
<td>Result uncertainty is inherent to R&amp;D</td>
<td>2x</td>
</tr>
<tr>
<td>Certification</td>
<td>1x</td>
</tr>
<tr>
<td>Showing reference projects</td>
<td>1x</td>
</tr>
<tr>
<td>Estimation of feasibility of expectations</td>
<td>1x</td>
</tr>
<tr>
<td>Payment only after results (No cure, no pay)</td>
<td>1x</td>
</tr>
<tr>
<td>All same factors as for trust</td>
<td>1x</td>
</tr>
<tr>
<td>Comparing results with other external R&amp;D centers</td>
<td>1x</td>
</tr>
</tbody>
</table>
Having the right appearance (knowledge, size of company, brand name, specialization)

| Insights in way of performing R&D |
|-----------------------------------|---|
| Table 12Factors that reduce uncertainty in an external R&D center |

Again, the ‘right way of communication’ is the most cited factor. This means that the right way of communication is also important to reduce uncertainty in an external R&D center. “Most important thing is communication, especially in the beginning, that you see that the project needs some corrective action, or not, before you burn a lot of money” (Interviewee: Kirschnick, 2015). Another factor that reduces the uncertainty is a clear project description with the goal of the project, expectations of the results, reason behind the project and eventually, a test procedure. Besides, several factors that enhance trust are also mentioned as factors that reduce uncertainty. One remarkable point is that two interviewees mention that result uncertainty is inherent to R&D and thus not so much can be done to reduce this.

Besides an open question about factors to reduce uncertainty, the interviewees also judge seven uncertainty reducing factors with a mark between 1 and 10. The results are in table 13.

<table>
<thead>
<tr>
<th>Factors that reduce uncertainty</th>
<th>Judgement mark</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extruder manufacturers</td>
<td>Machine manufacturer</td>
<td>Producers of thermoform products</td>
</tr>
<tr>
<td>Performing a pilot test</td>
<td>2 10 10</td>
<td>10</td>
</tr>
<tr>
<td>Signing a contract</td>
<td>7 10 3</td>
<td>10</td>
</tr>
<tr>
<td>Splitting up the project</td>
<td>7 8 8</td>
<td>10</td>
</tr>
<tr>
<td>Signing a NDA</td>
<td>7 10 5</td>
<td>10</td>
</tr>
<tr>
<td>Performing a risk analysis</td>
<td>7 8 3</td>
<td>10</td>
</tr>
<tr>
<td>Customer visit to the R&amp;D center</td>
<td>2 8 7</td>
<td>10</td>
</tr>
<tr>
<td>Showing reference projects</td>
<td>3 6 6</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 13Judgment of factors that reduce uncertainty

On average, all uncertainty reducing factors are approximately of equal importance. Also, between the different parties in the value chain, only small differences exist. One respondent judges ‘sign a contract’ and ‘perform a risk analysis’ as quite low. This is again because of the high level of trust between this company and Bosch Sprang.

The judgments of factors that enhance trust, in table 11, and factors that reduce uncertainty, table 13, have almost the same value. Only ‘showing how they deal with confidential projects’ scores higher.

It could be concluded that in general, the factors that enhance trust, also reduce uncertainty. Comparing the factors in table 10 and 11 about trust, and table 12 and 13 about uncertainty, it could be concluded that very much overlap exist.

Most striking point in the comparison is that the right way of communication is mostly cited in both enhancing trust and reducing uncertainty. This is thus a very important topic when performing R&D for external parties.

**Contractual dimensions**

In order to reduce uncertainty, contracts could be developed between the parties. However, the question is what variables should be in the contract and how extensive these factors should be described because a more extensive contract costs more in terms of time and money (Dekker, 2005).
The interviewees judged the contract factors of Dekker (2005) that are described in the theory section. The result is that all factors score on average higher than 5.5. So, all these factors are important when writing a contract for performing R&D for external parties. The product description is the most important factor that should be in a contract. After that, the most important factor is ‘property rights’.

‘Working conditions’, ‘after sales service’ and ‘conflict handling’ should be in the contract. However, some interviewees mention that specific factors are situation dependent. For example, the importance of ‘property rights’ is dependent on the uniqueness of the project and the importance of ‘conflict handling’ is dependent on the existing relation between both parties.

One extra factor that should be stated in the contract, following the interviewees, is information about how the results will be delivered. This gives the customer more certainty what results he will get. Because the contract factors are not the core of this master thesis, the more detailed analysis of these results can be found in appendix 7.

4.2.2 General thoughts about R&D in their business

All parties in the value chain that are interviewed see advantage of material or product research for their business and the average intention to search for more material knowledge is 8.8 on a scale from 1-10. That means that the intention, in general, is high. Besides, almost all interviewees do already collaborate with other companies or knowledge institutes for material research. Several companies let do their research by universities or suppliers.

The intention to outsource material research is on average a 7.1. That is much lower than the intention to search for more material knowledge (8.8). The reason for that is that two companies scores extreme low, compared to the others. The low scores are because of companies like to search for more material knowledge, but not on their own cost. They like to give their suppliers the order to do so because, that is for them the cheapest way to get the desired information. It becomes clear that in the thermoform value chain, the producers of thermoformed products have the highest willingness to pay for more material knowledge.

4.2.3 Risks and special aspects that deserve extra attention

Parties in the value chain see potential risk in information exchange from the external R&D center to competitors. That is the most cited risk in the external interviews. Another risk, especially for Bosch Sprang is that its R&D center is quite new. They have therefore a lack of experience that could lead to less reliable results. Another risk, also especially for the R&D center of Bosch Sprang, is too much interdependence. When a customer uses knowledge of the R&D center of Bosch Sprang, he is more dependent on Bosch Sprang for a reliable production. Therefore, he is limited in his choice for thermoforming tool supplier.

Besides risks, respondents also give special aspects that deserve extra attention by performing R&D projects with external parties. The most cited aspect that deserves extra attention is an agreement about the project plan. That includes that the objectives, expectations and approach of the project are in line with the requirements of both parties.

Again ‘open communication quick response and right information exchange’ score high. This is the third question where open communication is very important. In general, it can be concluded that an open communication is essential when performing R&D for external parties. Because risks and special aspects are not the core of the master thesis, this factors are more extensively described in appendix 8.
5. Discussion
In chapter 4, the results of the internal and external interviews are given, focused on answering the research question. In this chapter, the focus is broader than only the research question and is also aimed at the differences between the internal and external results and how should be dealt with them. Besides, this discussion is about the differences in the thesis results and existing literature.

5.1 General discussion
In this general discussion, the internal and external results will be discussed, in combination with the knowledge from the theory section.

5.1.1 Make-or-buy decision factors
Based on the literature, internal interviews and external interviews, it can be concluded that the following factors are of major importance in the make-or-buy decision in the context of R&D. The factors are ranked by importance:

1. Availability of own resources
2. Trust between partners
3. Cost / benefit ratio
4. Delivery time of the results
5. Task complexity of the transaction
6. Property rights / confidentiality
7. Need for knowledge transfer
8. Uncertainty in the transaction
9. Transaction frequency

In this list, the factor ‘trust’ also contains the trust that the external R&D center has the right resources and quality level. The ‘cost / benefit’ ratio is the same variable as the factor ‘transaction size’ that is explained in the theory section.

Compared to the existing knowledge from literature, this thesis provide three extra make-or-buy decision factors. The first one is ‘delivery time of the results’. In this thesis it becomes clear that this is also an important variable in the make-or-buy decision. It is remarkable that the factor ‘delivery time of the result’ is only once mentioned by the internal interviewees, but is much more cited by the external interviewees. Thus, for Bosch Sprang it is a learning point that ‘delivery time of the result’ is a meaningful variable for the potential customer in the make-or-buy decision. Further research with cases from other value chains should verify whether this is also an important variable in the make-or-buy decision in other branches. The second extra variable that is not in the literature is ‘confidentiality’. The most plausible reason is that this thesis is searching for decision variables of the make-or-buy decision in the context of R&D instead of only for these variables in general. It is very likely that this is always a decision variable in the context of R&D, however, research in other value chains and with more cases should be performed to verify this. The third extra variable is ‘need for knowledge transfer’. This variable is also likely to be a variable in the context of R&D because in this context ‘knowledge’ plays always an important role. In other contexts, this variable could be of lower importance. However, this should be verified by performing research with this variable, using cases that are not R&D related.

The last remarkable aspect is that ‘investment fits the strategy of the company’ and ‘geographical distance to the customer’ are mentioned by the internal interviews a few times and also by the external interviewees. These could in this context thus also be seen as decision variables, however, with a lower importance. To know whether this is also a significant decision variable in other branches, more different cases in other value chains should be investigated.
Except the three factors that are already mentioned, there is a lot of overlap in the make-or-buy decision factors from the literature, internal results and external results. The decision factors that are judged by the internal and external interviewees score almost the same.

By analyzing the external results, each party in the value chain is investigated separately to identify differences in the value chain. However, no remarkable differences are found between the different parties. It could be the case that no remarkable differences are found because the sample size was too small. Therefore, this research should also be done with more cases of every party in the value chain. It could also be that there is really no difference between the parties. However, that conclusion can only be drawn when enough cases are investigated.

5.1.2 Influencing decision factors in make-or-buy decision

Based on the internal and external interviews, it can be concluded that the following factors, ranked by importance, enhance trust during the make-or-buy decision in the context of R&D:

1. Open, pro-active and personal communication
2. Showing how will be dealt with confidential projects
3. Having the right competence and show that through the right appearance
4. Signing a contract and/or NDA
5. Performing a pilot test
6. A customer visit to the R&D center
7. Showing reference projects
8. Certification

The factors that enhance trust also reduce uncertainty. Besides these factors, from the internal and external results we know some other factors that especially reduce uncertainty:

1. Having a clear project description or project plan
2. Splitting up the R&D project into different parts (with milestones or ‘go’, ‘no go’ decisions in between)
3. Performing a risk analysis

Most of the factors that enhance trust and reduce uncertainty are mentioned both in the internal and external interviews. Therefore, these factors could be seen as significant contributors to enhance general trust and to reduce uncertainty. Only a few factors are remarkable. First, the ‘open, pro-active and personal communication’ is several times cited in the external interviews, but not cited in the internal interviews. This means that employees of Bosch Sprang do not detect that this is a considerably factor in enhancing trust and reducing uncertainty. This could be a learning point for them.

The factor ‘having a clear project description or project plan’ is important to reduce uncertainty according to the external interviewees. Internal interviewees do not mention this factor at ‘uncertainty reducing factors’. However, at ‘aspects that deserve extra attention’, internal interviewees do.

In the context of this research, it became clear how the make-or-buy decision variables in R&D should be influenced. However, in the existing literature, not much is written about this topic. Therefore it is important that future research verify that knowledge from this thesis about influencing the make-or-buy decision factors, is also applicable in other branches.
5.1.3 Approaching customers

The way of acting by approaching customers, according to the internal interviews, is written in appendix 5. In this discussion, the focus is only on the differences and overlaps of the results.

According to the internal interviews, potential customers should be approached in an active way, by the right persons and with an attractive promise of potential profit. This corresponds partly with the input from the external parties. For them, the most cited factor to enhance trust and to reduce uncertainty, is ‘open, pro-active, personal communication’. The match is thus in the pro-active behavior. The difference is that the potential customers talk again and again about ‘communication’ while that is not mentioned by the internal interviewees. So, the main point for them to learn is: communication is very meaningful, also in the make-or-buy decision.

Approaching the customer, depending on the existing relation, and his existing level of quality and knowledge, is also important and is mentioned by both the internal and external interviewees. For example: “signing a contract and NDA and writing about conflict handling in the contract is not so important when both parties already have a good relation” (Interviewee: Hodenpijl, 2015).

It is also important to approach the customer on his field of interest. This is mentioned in the internal interviews, but can also be seen in the external interviews because some parties like simple market transactions more, while other prefer more extensive projects with complex relationship management. Some companies focus mainly on costs while others focus on quality and some companies prefer simple relations while others like more complex relationships in the context of R&D.

Approaching customers is very context specific. However, several aspects like ‘the importance of communication’ and ‘approach on field of interest’ are more general and could probably also be used in other situations. Therefore, a more extensive research in different branches should be performed to determine what variables are context specific and what variables are generally applicable.

5.1.4 Contract dimensions

According to the internal and external results, the factors that should be in the contract are the contract dimensions of Dekker (2005). The weightiest factors that should be in the contract in this context are ‘the product description’ and ‘property rights’ (see appendix 7).

The most cited extra factors that should be in the contract are: how the results will be delivered (part of product / service description), how will be dealt with final results, confidentiality (part of ‘property rights’), and the project plan or project description (also part of product description). So, only the factors of Dekker (2005) are enough because the extra factors are already described in these factors. It could thus be concluded that this thesis verified the contract dimensions from Dekker (2005) and that no extra contract dimensions should be added to the ones that are already known.

5.1.5 Risks and special aspects that deserve extra attention

Both internal and external interviewees see information exchange from the R&D center to competitors of the customer as highest risk. This is the risk of problems about confidentiality. Because both parties mentioned this risk, this is really important and should be taken careful into consideration by performing R&D for external parties. Second risk that is mentioned by both internal
and external interviews is delivering invalid results, for example because of the R&D center of Bosch Sprang is quite new and lacks much experience. Furthermore, both internal and external respondents mention that it is important that the potential customer and the R&D center have an agreement about the project goals, expectations and timeframe to prevent problems between each other. A risk that is only mentioned by external interviewees is that customers become too dependent on Bosch Sprang as supplier of thermoforming tools when they perform R&D projects together. Risks that are only mentioned by internal interviewees are ‘damaging existing relations’, ‘blaming companies or persons with conclusions’ and less knowledge transfer between R&D center and customers because the customers have problems with the fact that Bosch Sprang has a relation with too many partners. The risks and special aspects that deserve extra attention are important for the R&D center of Bosch Sprang. However, the question is whether these factors are also important for an R&D center in other companies or value chains. This should be investigated by performing this research also in other value chains.

5.2 Theoretical implications
This thesis project results in the following theoretical implications. Beforehand, make-or-buy decision factors in general were known from the literature. This master thesis provides, as addition to the literature, factors in the make-or-buy decision in the context of R&D. These factors are already mentioned before: availability of own resources, trust between partners, cost-benefit ratio, delivery time of the results, task complexity of the transaction, property rights / confidentiality, need for knowledge transfer, uncertainty in the transaction and transaction frequency.

From literature, it is already known that ‘trust’ is an important variable in the make-or-buy decision. This master thesis provides, as addition to the literature, information how ‘trust’ and ‘uncertainty’ could be influenced in the context of performing R&D for external parties. From this master thesis, we know that ‘trust’ in an external R&D center could be enhanced by performing the following actions: the R&D center uses open, pro-active and personal communication, the R&D center shows how will be dealt with confidential projects, the R&D center has the right competence and show that through the right appearance, the R&D center signs a contract or NDA, the R&D center performs a pilot test, a customer visits the R&D center, the R&D center shows reference projects and the R&D center is certified.

These factors also reduce the uncertainty for a potential customer. Factors that especially reduce uncertainty of outsourcing R&D are: having a clear project description or plan, splitting up the project into different parts and perform a risk analysis.

5.3 Practical implications
This paragraph provides the results from this master thesis which can be used by SMEs who invest in an own R&D center.

When an SME with an own R&D center likes to perform R&D for external companies to make the R&D center more attractive in the short term, it should work in the following way. The R&D center should approach potential customers in an active way, by the right persons and with an attractive promise of potential profit. It is also important to approach the customer, dependent on the existing relation, the existing level of knowledge and quality, and his field of interest.

From this master thesis, the make-or-buy decision variables in the context of R&D are known. However, not all factors could be influenced by the R&D center. The factors ‘endogenous trust’ and
‘uncertainty’ could be influenced and are therefore further elaborated below. The factor ‘trust’ in general, is one of the most important factors in the make-or-buy decision. The R&D center can enhance ‘trust’ through an open, pro-active and personal communication and by showing customers how will be dealt with confidentiality. Besides, the R&D center can enhance ‘trust’ by having the right competences and show that through the right appearance. Other actions to enhance ‘trust’ are: signing a contract or NDA, performing a pilot test, inviting the customer to visit the R&D center, showing reference projects and have the right certification. Actions that enhance ‘trust’, in general, also reduce ‘uncertainty’.

Other actions that the R&D center should perform to reduce uncertainty are: make a clear project description or project plan, splitting up the R&D project into different parts and perform a risk analysis. The delivery time of the results is also very important for the customer in the make-or-buy decision. Therefore, the R&D center should be able to provide reliable answers quickly.

When the R&D center draws up a contract, it should contain the following factors, ranked from most to least important: product / service description, how the R&D center deals with confidentiality, price and payment terms, working conditions, conflict handling and after sales services.

There are several risks and special aspects that deserve extra attention of the R&D center. Confidentiality of projects should be taken into consideration carefully because it is extremely important for customers. Besides, delivering valid results and reach agreement about the project goals, expectations and timeframe are very meaningful. Finally, the R&D center should be careful with blaming companies or persons with conclusions or damaging existing relations in another way because this is always a risk when performing a new service for existing customers.
6. Implementation plan for Bosch Sprang

This chapter mentions how the knowledge gained through this master thesis project should be implemented to the actual situation at Bosch Sprang. The phases of the implementation plan are chronologically given from starting approaching customers to performing the R&D activities for external parties. This plan can be used by Bosch Sprang to start performing R&D activities for other parties. However, performing R&D for external parties should fit the company strategy of Bosch Sprang.

Paragraph one describes the actual situation at Bosch Sprang. Paragraph two is about what the most attractive potential customers are and how these should be approached at the beginning. When a customer is approached and the customer and the salesman are further in the process of starting an R&D project, other aspects are relevant. These are described in paragraph three. Paragraph four elaborates on what should be done when performing an R&D project.

6.1. Actual situation at Bosch Sprang

Bosch Sprang is an SME that invested in an own R&D center. At this moment, only a payback structure for the long term is available. Bosch Sprang sells thermoforming tools and uses its R&D center to gain knowledge for own use. The investment in the R&D center should, for now, be recouped by selling more thermoforming tools. However, from literature it is known that, in general, it is also important to have some short-term gains out of the own R&D because smaller firms have naturally fewer resources than larger firms (Alvarez & Barney, 2001). From the literature study, performed before starting this master thesis, it is known that performing R&D for external parties is a way to make the own R&D center of Bosch Sprang financially more attractive in the short term. If Bosch Sprang likes to perform R&D for external parties, external parties should outsource their R&D to Bosch Sprang. However, in the past, Bosch Sprang only sells thermoforming tools to the customers and did not perform R&D activities in the field of thermoforming for external parties. Potential customers don’t know that the R&D center of Bosch Sprang, from now, have the possibility to perform R&D activities for them in the field of thermoforming. Therefore, potential customers should be approached by salespeople. To approach potential customers in the right way, it is very important to know when the potential customers decide to outsource their R&D to the R&D center of Bosch Sprang. Therefore, this master thesis is aimed at the decision variables in the make-or-buy decision in the context of R&D and how two of these variables could be influenced. Trust is an important variable in the make-or-buy decision in R&D. That means that, when trust in the R&D center is enhanced, the customers are far more willing to outsource their R&D to Bosch Sprang. Factors that enhance ‘trust’ and reduce ‘uncertainty’ are included in the following paragraphs.

6.2 First approach customer

First, it is important to know which potential customers should be approached by Bosch Sprang. According to internal and external interviewees, the most attractive potential customers are producers of thermoforming products, and especially the ones that already are customer of Bosch Sprang. After that, it is important to know how these potential customers should be approached.

The most essential point in approaching customers and performing R&D for customers is ‘communication’. This is important in all phases of the process. Customers prefer a face to face meeting with a salesman with an open and a proactive way of communication. That way of communication means that the customer should receive quick response on questions, the R&D center should give information about how it performs the research and why it does so, the R&D center or salesman should take the initiative when something has changed or happens and the customer should have the feeling that he is taken seriously. To improve the factor ‘communication’
of their salespeople, it is recommended that the management initialize a communication training. That can make the employees more aware of the importance of communication and provide them tools to improve on this aspect.

When approaching customers, it is very important that Bosch Sprang shows how will be dealt with confidential projects in advance because for customers, confidentiality is crucial in their R&D activities. For example, when a project is confidential, other customers cannot visit the R&D center of Bosch Sprang during tests for this project. The management of Bosch Sprang should write standard procedures how to deal with confidential projects. These procedures should be explained to potential customers.

From the internal interviewees, it is known that the potential customers should be approached based on the existing relation. A good existing relation should be approached by a salesman of Bosch Sprang by calling the responsible person or by making an appointment to communicate face to face about the possibilities of the R&D center. Potential new relations should be reached through networking and mailings. The core aspect is providing information about the research possibilities in an active way.

As already mentioned, it is important that the salesman approaches the potential customer in an active way. That means that he should know the customer’s company, his product range, the materials in use and which person is responsible for the decision to outsource R&D. The salesman should also know the existing level of knowledge and quality, and the focus of the customer. When the salesman knows these aspects, he is able to approach the customer, in an active way, in his field of interest and with an attractive promise of potential profit. For example, the salesman can show a calculation with the potential cost saving on raw material. The salesman should communicate that this cost saving can be reached when the R&D center of Bosch Sprang performs an R&D project to determine the required raw materials. The salesman should also show applicable reference projects to the customer to enhance his competence and trust and to give him an idea of the possible results. Besides, the salesman can invite the potential customer to the R&D center to show where the R&D activities will be performed. This gives the customer a feeling about the capabilities of the R&D center and enhances also his competence trust. The salesman can also communicate that the results from the R&D center could be tested in practice with the own thermoform machine of Bosch Sprang to verify the R&D results in practice. Furthermore, the price level of the R&D center should be acceptable in comparison with competitors. For some customers, it is important that the R&D center of Bosch Sprang has the right certification. Bosch Sprang should investigate whether it is profitable enough to get these certifications.

6.3 Half way through the process
When the customer and the salesman are further in the process, and the customer is willing to place an order, some aspects deserve extra attention. Before starting a project, it is crucial that the customer and Bosch Sprang reach agreement about the project goals, expectations and the time frame of the project. Therefore, a clear project description or project plans should be written beforehand. If possible, a tolerance band of the final results should be set in advance. This is to prevent problems at the end of the project. Writing this clear project description should also be in the already mentioned procedures, that have to be written by the management of Bosch Sprang. Depending on the project size and confidentiality of the project, a contract should be written or an NDA should be signed. The contract should contain the already mentioned factors of Dekker (2005) and eventually also information about how the results will exactly be delivered. How extensively these factors must be worked out is dependent on the project and the wants of the customer. Depending on the size of the project and the uncertainty in the project, the project could be divided
into different parts with ‘go’, ‘no go’ decisions between them. The payment of the project can be linked to these different parts. This reduces the risk and uncertainty of the project and enhances the competence trust in the project. With the link between payment and results, the contractual trust also increases. Eventually, a pilot test can be performed to detect a trend or to check a thought pattern. This enhances the trust in a good final result (competence trust) and also reduces the uncertainty. Dependent on the project, an extensive or small risk analysis can be performed before starting the R&D project. This is also to enhance the competence trust.

6.4 Performing the R&D project

When the R&D center receives an order, the project execution starts. This phase also contains several aspects that deserve extra attention. The staff of the R&D center must be aware that decisions made based on the conclusions from R&D involve much more money than the costs of the research itself. Therefore, the reliability of the results is crucial. The new R&D center of Bosch Sprang should build experience in the field and should be very careful with drawing conclusions from data. It is crucial that measurements are carried out according to the right norms and guidelines to be sure that the results are reliable. Besides, the R&D center should be careful with blaming companies or persons with conclusions because there is a risk of damaging existing relations.

From the external interviewees, it is known that delivery time of the results is very important in the make-or-buy decision in R&D. The R&D center should deliver the reliable results in a short time frame to get more R&D orders. When it is impossible to deliver in time, it should be communicated to the customer as soon as possible. To be able to deliver in the desired time frame, the right equipment should be available at the R&D center. This is the responsibility of the management of Bosch Sprang. Besides, it is recommended that a proper software system is in use that gives insight in the status and planning of a project to be able to steer the activities in such a way that the deadlines will be met. Investment in such systems, and managing them, is also a responsibility of the management of Bosch Sprang.

Besides, it is crucial that the R&D center of Bosch Sprang deals with confidentiality very carefully when performing R&D activities. For example, company X should not see information about a confidential product of company Y when visiting the R&D center.

6.5 Framework with overview of the results

The core of the master thesis is focused on the make-or-buy decision variables in the context of R&D. However, the underlying goal of this thesis is to make an own R&D center more profitable in the short term. Before being able to perform R&D for external parties it is important to know how to approach potential customers. When the knowledge of this master thesis is used to influence the make-or-buy decision, the R&D center gets more orders. By performing the R&D tasks, it is also important to know more about the risks and aspects that deserve extra attention. All useful results from this master thesis are bundled to a theoretical framework that is shown in figure 8. In figure 8, the decision variables and how these should be influenced are ranked by importance with on the top the most important factor and at the bottom the least important factor.
Figure 8. Framework overview results

Approach potential customers:
- Open, pro-active and personal communication
- Give an attractive promise of potential profit
- Use an active approach by the right persons
- Consistent with his existing level of knowledge and quality
- Provide information
- Depending on existing relation
- Figure out the focus of the customer, approach on field of interest
- Market situation of customer: from simple market transaction to complex relationship management

Need for R&D on material side?
Yes
- No arm length transactions
- No small relational contracts
No

Need for R&D in house or extern?
Depends on Main points
Enhanced by

Availability of own resources
Cost / benefit ratio
Delivery time of the results
Task complexity of transaction
Property rights
Uncertainty in the transaction
Transaction frequency

Trust between partners
Permit to the R&D center

Right appearance
Contract / NDA
Customer visit
Reference projects
Certification

Project description
Property rights
Price and payment terms
Working conditions
After sales service
Conflict handling

Arm length transaction
Small relational contracts

Clear project description or project plan
Split the project
Perform a risk analysis

Risks:
- Damaging existing relations
- Problems with property rights
- Invalid results (newness R&D center)
- Blaming companies or persons with conclusions
- Less knowledge transfer through resistance again too much partnerships
- Other parties see also added value and start to invest
- Being unclear to customers what they could expect
- Opportunistic behavior

Special aspects that deserve extra attention:
- Property rights
- Agreement about project plan, project description and timeframe
- Research following norms and guidelines
- Clear end result (report)
- Acceptable price level
- Independence and objectivity
- Potential damage in case something goes wrong
7. Conclusions

This chapter presents the conclusions of the thesis project. The chapter is structured as follows. First the research question and sub-questions are answered. Secondly, limitations of this research and directions for future research are described.

7.1 Answering the research question

This thesis has introduced the decision factors in the make-or-buy decision in the context of R&D. It has also introduced Bosch Sprang and the underlying subject of this thesis: make an own R&D center more profitable in the short term for SMEs in the manufacturing business. The research question that guided this research is:

How do trust and uncertainty influence the make-or-buy decision in R&D and how can this knowledge be applied to the R&D center of Bosch Sprang?

This research question was divided in three sub questions:

1. What are the make-or-buy decision variables in the context of R&D?
2. How do trust and uncertainty influence the make-or-buy decision for potential clients of Bosch Sprang and how could these factors be influenced?
3. How can the developed framework and additionally gained knowledge be applied to the potential customers of the R&D center of Bosch Sprang?

The answer on sub question 1 is that the make-or-buy decision variables in the context of R&D are: availability of own resources, trust between partners, cost-benefit ratio, delivery time of the results, task complexity of the transaction, specificity of the transaction, property rights / confidentiality, need for knowledge transfer, fit with company strategy, uncertainty in the transaction, and transaction frequency.

The answer on sub question 2 is that when a customer has more trust and less uncertainty, he is more intended to outsource his R&D. Trust and uncertainty can be influenced by the external R&D center by different actions. One of the most important factors to enhance trust and reduce uncertainty is an open, pro-active and personal communication with the potential customer. One aspect of this behavior gives insight to the way how R&D will be performed. Another notable point is that the R&D center shows how it deals with confidential projects because that is essential in R&D. The third meaningful aspect is that the external R&D center has the right competences and also has the right appearance so that these competences can be shown to the potential customer. Other factors that enhance trust are signing a contract, perform a pilot test, a customer visit to the R&D center, certification and showing reference projects.

Actions that explicitly reduce uncertainty are: having a clear project description or plan, splitting up the project into different parts and performing a risk analysis. Besides, the factors that enhance trust also reduce uncertainty.

The answer on sub question 3 is that the factors of sub question 2 should be taken into account. So, the R&D center of Bosch Sprang should enhance the general trust of their potential customers by using an open, pro-active and personal communication, showing how they deal with confidentiality, showing reference projects, signing a contract, having a clear project description, and all other factors that are mentioned by the answer on sub question 2.

Besides, the developed framework should be used to approach potential customers. The risks and special aspects in this framework should be used to deal in the right way with potential customers.
So, the most important aspects are dealing with confidentiality, building up experience in the new R&D center, having an agreement about the project plan and expectations and again, an open communication is very important.

By answering these sub questions, the research question or problem statement is also answered. When potential customers have enough ‘trust’ and not too much ‘uncertainty’, they are more likely to outsource their R&D. The factors to enhance ‘trust’ and to reduce ‘uncertainty’, which are derived from this research, should be applied to the potential customers of the R&D center of Bosch Sprang. This is described in more detail in the implementation plan.

7.2 Limitations and future research
This research has several limitations. First, this research is only done in one value chain: the thermoforming value chain. This limits the generalization of the results of this thesis project. It could be the case that in other value chains, other decision variables or factors are of importance. Especially the results from the internal interviews, which are not verified by the external interviewees are not generalizable because these are only based on one case. Another limitation is that only 11 different companies in the value chain are interviewed. No remarkable differences are found between the different parties in the value chain. To find remarkable differences, if they exist, and to generalize these findings, many more interviews should be conducted with different companies from different parties in the value chain. Besides, a more extensive research with a lot of respondents from different value chains should be done. Another aspect is that the semi-structured interviews were conducted by the graduate student. These interviews were structured, however there is still an interpersonal effect which influences the interviewee. The graduate student is seen, by the interviewees, as part of Bosch Sprang. Therefore, sometimes the answers were based on experiences with Bosch Sprang and their place in the value chain. It could be that the focus of the interviewees is more on other subjects when the graduate student has another background. Analyzing the results of the interviews, it became clear that the answers that interviewees gave are also dependent on the existing relation with Bosch Sprang. However, it could be the case that other aspects like company size or company culture also play a role in this field. This is a limitation that only can be solved by doing more research in the future and taking these factors into account. Finally, the last limitation is that the results of this study are based on perceptions. The results are based on what the interviewees think what influence their decisions. Further empirical research is needed to check whether these perceptions really represent reality.

So, the general conclusion is that further analysis is needed to determine the external validity of this research. This could be done by analyzing other and more cases of organizations in different sectors.
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Stein, B. (2015, 04 23). Dr. (J. M. Schans, Interviewer)


Appendix 1 Thermoform process (inclusive thermoform value chain)

A company that produces packaging using thermoform tools needs raw material, an extruder, a thermoform machine and a thermoform tooling. The thermoform tooling is inside the thermoform machine (see pictures below).

So, parties that are involved are:

- Raw material supplier
- Extruder manufacturer
- Thermoform machine builder
- Thermoform tool maker
- Producer of thermoform products
- Retailer
- Product sold by retailer (like AH)
- End consumer
Appendix 2: interview for employees Bosch Sprang

## Structured interview employees Bosch Sprang

<table>
<thead>
<tr>
<th>Interviewee:</th>
<th>Marius van der Schans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function:</td>
<td></td>
</tr>
<tr>
<td>Interviewer:</td>
<td>Marius van der Schans</td>
</tr>
<tr>
<td>Date interview:</td>
<td>XX-XX-2015</td>
</tr>
<tr>
<td>Location:</td>
<td>Bosch Sprang BV. Sprang-Capelle</td>
</tr>
<tr>
<td>Start interview:</td>
<td>XX:XX AM</td>
</tr>
<tr>
<td>End interview:</td>
<td>XX:XX AM</td>
</tr>
</tbody>
</table>

### Introduction:

For my graduating project, I am searching for ways to make an own R&D center more profitable for Small and Medium Enterprises in the short term. From my literature study, I know that the best options to make an R&D center more profitable in the short term is by selling ‘arm length transactions’ and ‘small relational contracts’.

Arm length transactions in this case means performing specific tests and deliver the results of these tests for a fixed price without further collaboration. ‘Small relational contracts’ are collaborative working arrangements and could be divided in two types. One type is the part where the supplier delivers more and more value. The other type is an increasingly co-operative relationship between the company and his customer. An example of a ‘small relational contract’ is when the supplier of tooling and its customer together work on developing a product that enables the customer to produce with the lowest possible material costs. This collaboration should be defined in a contract.

The objective of my master thesis is to set up a framework how to implement ‘arm length transactions’ and ‘small relational contracts’ in the context of an R&D center and implement this framework at the R&D center of Bosch Sprang.

The goal of this interview is to collect data to be able to build a framework that can act as a guideline by implementing ‘arm length transactions’ and ‘small relational contracts’. In this interview I ask you for your opinion about different aspects that came up by performing R&D for other companies. Besides interviews with different people of Bosch Sprang, literature will be used to build this framework. After building the framework, I will come back to the interviewee to confirm the model.

This interview takes approximately 45-60 minutes of your time. Is it OK for you when I use a voice recorder for this interview?

### General thoughts about R&D in their part of business:

1. Do you think there is need for material research in the thermoforming business? Could you give this need a mark between 1 and 10? 1 = no need, 10 = much need

2. What parties in our value chain could gain extra profit when they have more knowledge available about the thermoform materials? Could you give for each party a mark between
1 and 10 to show the potential degree of profit? 1 = No extra profit, 10 = Very much extra profit

3. Besides the parties you mention, there are also the following parties in the value chain. Could you give for each party a mark between 1 and 10 to show the potential degree of profit? 1 = No extra profit, 10 = Very much extra profit

4. Which party (parties) should do the material analysis in your opinion?

**Framework building:**

5. When the focus is to gain more revenues in the short term for our lab, which parties in the value chain are most attractive to do research for?

6. Should the different parties in the value chain be approached in a different manner? If yes, could you give examples?

7. What are decision variables for parties in the value chain to search for more material knowledge?

8. What are decision variables for parties in the value chain to give an order to the R&D center of Bosch Sprang or do the job by themselves?

9. Following the transaction cost theory (Coase, 1937; Meer-Kooistra & Vosselman (2005)), the following decision variables are of importance by make-or-buy decisions:

   **Mark:**

   a) Uncertainty in the transaction (determines the risk in the relation)
   b) Transaction size (economic size of the order in €)
   c) Specificity of the transaction (Specific investments needed or not)
   d) Task complexity of the transaction
   e) Transaction frequency
   f) Competitive position of company X
   g) Power imbalance between partners
   h) Trust between partners
   i) Property rights

That means that these variables are of importance for companies by deciding to place an order by another company or do the job by themselves. Could you judge these factors on importance when the order is only performing and delivering measurements without further collaboration and give them a mark between 1 and 10? 1 = not important, 10 = very important.
10. Following the transaction cost theory (Coase, 1937; Meer-Kooistra & Vosselman (2005)), the following decision variables are of importance by make or buy decisions: 

   Mark:

   a) Uncertainty in the transaction (determines the risk in the relation)
   b) Transaction size (economic size of the order in €)
   c) Specificity of the transaction (Specific investments needed or not)
   d) Task complexity of the transaction
   e) Transaction frequency
   f) Competitive position of company X
   g) Power imbalance between partners
   h) Trust between partners
   i) Property rights

That means that these variables are of importance for companies by deciding to place an order by another company or do the job by themselves. Could you judge these factors on importance, when the order is a project with more intensive collaboration, and give them a mark between 1 and 10? 1 = not important, 10 = very important.

11. Could you give other important factors that influence this decision that are not in this list?

12. Are there special aspects that deserve extra attention by developing ‘small relational contracts’ or doing R&D for other parties? Could you give some examples?

13. What are the most important factors that should be taken into consideration by approaching potential customers?

14. In order to remove a certain degree of uncertainty, contracts could be developed between the parties. From literature we know several factors that could be incorporated:

   Mark:

   a. Price
   b. Product / service description
   c. Property rights
   d. After sales service
   e. Conflict handling

Could you judge these factors on importance when the order is only performing and delivering measurements without further collaboration and give them a mark between 1 and 10? 1 = not important, 10 = very important.

15. In order to remove a certain degree of uncertainty, contracts could be developed between the parties. From literature we know several factors that could be incorporated:

   Mark:

   a. Price
   b. Product / Service description
c. Property rights  
d. After sales service  
e. Conflict handling

Could you judge these factors on importance when the order is a project with more intensive collaboration and give them a mark between 1 and 10? 1 is not important, 10 is very important.

16. Could you give other important factors that should be in the contract, and why?

17. Do you have other suggestions to reduce the uncertainty for both parties?

18. Another important factor in the decision of the customer is transaction size. What could we do to make the transaction size more acceptable for the customer?

19. The task complexity is a decision variable for customers in deciding to do the job by themselves, give an order to an external company to perform the task or do not perform the task at all. How could we deal with the perception of complexity or could the perception not be influenced at all?

20. The transaction frequency has influence on the decision to do the R&D in-house or do it external. Have you suggestions for different price structures for different transaction frequencies? Hour based, analysis based, etc.?

21. Trust is another important decision variable for customers. How could the variable ‘trust’ be positively influenced or could the variable ‘trust’ not be influenced at all?

22. Could you give different sorts of risks by approaching parties in the value chain?

23. Could you give different sort of risks by performing R&D for external parties?

24. Following the transaction cost theory, there is always the risk that a customer show opportunistic behavior. For example the customer does not pay for research because he said that the results are not according to his expectations. Could you judge the likelihood of this risk with a mark between 1 and 10? 1 = not likely, 10 = very likely.

25. Do you have solutions to prevent this sort of behavior?

26. Do you have solutions when the customer shows this behavior?
Finalization:

27. Do you have names of companies and contact persons to approach for doing a structured interview with for this Master Thesis research?

28. Do you know some companies which certainly should not be approached and what is the reason for that?

29. How did you experience the interview? Do you have additional tips?

Thank you very much for participating in this interview! When I worked out this interview, I will communicate it with you to verify if the interpretation is OK. When all in interviews are performed and the theoretical model is made, I want to approach you again to verify the developed model.
Appendix 3: Interview for external parties

<table>
<thead>
<tr>
<th>Structured interview external parties in the value chain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interviewee:</strong> Marius van der Schans</td>
</tr>
<tr>
<td><strong>Function:</strong></td>
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<tr>
<td><strong>Interviewer:</strong> Marius van der Schans</td>
</tr>
<tr>
<td><strong>Date interview:</strong> XX-XX-2015</td>
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<tr>
<td><strong>Location:</strong> X</td>
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<tr>
<td><strong>Start interview:</strong> XX:XX AM</td>
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<tr>
<td><strong>End interview:</strong> XX:XX AM</td>
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</tbody>
</table>

**Introduction:**
I am Marius van der Schans, graduating student Innovation Management at the Technical University of Eindhoven and working as R&D Engineer at Bosch Sprang. At this moment, I am working on my graduation project and do research to variables in the make-or-buy decision in the context of an R&D center.

The objective of my master thesis is to know more about the decision variables in the make-or-buy decision in the context of an R&D center and use this knowledge for the R&D center of Bosch Sprang.

At this moment, a framework is built using literature and a set of interviews with different employees of Bosch Sprang.

The goal of this interview is to collect data to be able to verify the framework that is built. The first part of the interview is to clarify your general thoughts about R&D in your part of business. The second part consist of questions to verify the developed model.

This interview takes approximately 45 minutes of your time.

**General thoughts about R&D in your part of business:**

1. Do you see any advantage of material research for your business?

2. Are you intended to search for more material knowledge in your company? If you search already for more material knowledge, do you have the intention to elaborate on that? Could you give your intention a mark between 1 and 10? 1 = no intention to search for material knowledge, 10 = Full intention to search for material knowledge.

3. Do you already collaborate with other companies or knowledge institutes for material research?

4. Are you intended to let other parties doing material research for your company and connect this information with all days practice? Could you give your intention a mark between 1 and 10? 1 = no intention, 10 = full intention to do that.
Verifying framework:

5. In the case that you want to outsource R&D activities. What are for you the most important factors to start, or not to start a project with an external party that could do material research?

6. The following factors could be of importance by deciding to do the R&D activities in-house or outsource them. Could you judge the following factors and give them a mark between 1 and 10? 1 = not important, 10 = very important. 
Mark:

   a. Trust between partners
   b. Specificity of the transaction (specific investments needed or not)
   c. Task complexity of the transaction
   d. Property rights
   e. Transaction frequency
   f. Transaction size (economic size of the order in €)
   g. Availability of own resources (budget, people, knowledge, time)
   h. Competitive position of partner
   i. Uncertainty in the transaction
   j. Need for knowledge transfer

7. Are there other important factors that influence your decision to do the research in your own company or outsource it?

8. Trust is an important decision variable by outsourcing R&D activities. Could you give factors that enhance your trust in an external R&D center?
Mark:

   a. show reference projects
   b. have the right appearance
      (R&D equipment, accommodation, personnel and results)
   c. show how they deal with confidential projects
   d. sign a contract
   e. perform a pilot test

Could you judge these factors and give them a mark between 1 and 10? 1 = do not enhance trust, 10 = enhance trust significantly.

9. Another important decision variable by outsourcing R&D activities is uncertainty. What is in your opinion the right way to reduce uncertainty in the transaction?

10. The following actions could be done to reduce uncertainty in the transaction: 
Mark:

11. The following actions could be done to reduce uncertainty in the transaction:
a. Sign a contract  
b. Perform a risk analysis  
c. Perform a pilot test  
d. Split up the project  
e. Customer visit to the R&D center  
f. Show reference projects  
g. Sign a NDA

Could you judge these factors and give them a mark between 1 and 10? 1 = do not reduce uncertainty, 10 = reduce uncertainty significantly.

12. In order to reduce uncertainty, contracts could be developed between the parties. The following factors could be incorporated in this contract:

Mark:

a. Price and payment terms  
b. Product description  
c. Property rights  
d. Working conditions  
e. After sales service  
f. Conflict handling

Could you judge these factors and give them a mark between 1 and 10? 1 = not important to note in a contract, 10 = very important to note in a contract.

13. Could you give other important factors that should be in the contract, and why?

14. Are there special aspects that deserve extra attention by performing an R&D project with each other?

15. What do you see as potential risks by performing an R&D project with the R&D center of Bosch Sprang?

16. Companies are in different market situations from simple market transactions at one end and complex relationship management at the other (Freytag & Clarke, 2001). On a scale from 1 -10 where is your company at this moment in general? 1=simple market transactions, 10 = complex relationship management.

17. If you outsource R&D activities, are your preferences more on simple market transactions or more towards complex relationship management?

Finalization:

18. How did you experience this interview?
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19.</td>
<td>Do you have additions, or tips?</td>
</tr>
<tr>
<td>20.</td>
<td>Are you interested in the results of this study?</td>
</tr>
</tbody>
</table>

Thank you very much for participating in this interview! When I worked out this interview, I will communicate it with you to verify if the interpretation is OK.
Appendix 4: Example of coding interviews

This appendix gives an example of coding information from the interviews. This example is about question 5 of the external interviews. First, all answers from the whole interview are written in one spreadsheet. Each respondent has his own color. In figure 9, you can find an example of this.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 5</td>
<td>Example answers</td>
</tr>
</tbody>
</table>

Table 14

<table>
<thead>
<tr>
<th>Decision factors in the make-or-buy decision</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost/benefit ratio</td>
<td>8x</td>
</tr>
<tr>
<td>Availability of own resources</td>
<td>6x</td>
</tr>
<tr>
<td>Time of order</td>
<td>6x</td>
</tr>
<tr>
<td>Resources and quality level of external R&amp;D center</td>
<td>5x</td>
</tr>
<tr>
<td>Confidentiality</td>
<td>4x</td>
</tr>
<tr>
<td>Relation</td>
<td>3x</td>
</tr>
<tr>
<td>Trust</td>
<td>2x</td>
</tr>
<tr>
<td>Transaction frequency</td>
<td>2x</td>
</tr>
<tr>
<td>Reliability external R&amp;D center</td>
<td>2x</td>
</tr>
<tr>
<td>Fit with company strategy</td>
<td>2x</td>
</tr>
<tr>
<td>Geographical location</td>
<td>1x</td>
</tr>
<tr>
<td>Safety issues</td>
<td>1x</td>
</tr>
<tr>
<td>Complexity</td>
<td>2x</td>
</tr>
<tr>
<td>Flexibility</td>
<td>1x</td>
</tr>
</tbody>
</table>

Table 14 Example of analyzed answers

This table could be used in the report to show the results of the interviews and to draw conclusions from. Drawing conclusions is done in an iterative way to gain the best possible analysis.
Appendix 5: Approaching potential customers

The results of the internal interviews is that different parties in the value chain should be approached in a different manner. Based on the internal interviews, it could be said that the following way of acting is important in approaching customers:

- Approach depending on existing relation
- Provide information
- Give an attractive promise of potential profit
- Use an active approach via the right persons
- Approach consistent with the existing level of knowledge and quality
- Find the focus of the customer. Approach on field of interest.
- Know the market situation of customer: simple market transaction < > complex relationship management

These different aspects are derived from the interviews through placing the answers in a coding scheme. The before mentioned way of acting should be a little bit elaborated to be more clear.

The way of approaching is dependent on the existing relation. Good existing relations could be approached by phone or face to face while new relations should be approached by networking, symposia, mailings, specific magazines, etc. The basic thing the R&D center should do is providing information about their research possibilities. In all situations it is important to have an active approach to the customer by giving them information how the capabilities of the R&D center could be used in favor of their company and what the potential profit is for them. If possible, an attractive promise of potential profit could be done, based on a clear calculation of potential gains.

Another important point is that you should know the customer’s company, product range, material in use and the employees who represent the company. First, that is needed to approach the right persons in the company who are able to give an order to the R&D center or can influence this decision. Besides, it is important to know the customer to be able to approach him consistent with the companies’ existing level of knowledge and quality and with the need of the company. When the quality level of a company is high, they should not be approached with basic information but in a more advanced way.

The third point why it is important to know the customer, is to find the focus of the customer. When you know the focus of the customer, you are able to approach him on his field of interest. For example, when the customer is focused on cost savings, you can show examples of R&D projects that have resulted in a cost saving on raw materials. When the customer is more focused on a reliable production or quality enhancement, you can show reference projects in that field and use argumentation that is aimed on this area.

Finally, it is important to know the market situation of the customer. When the customer is more about the simple market transactions, you can come up with possibilities for simple market transactions. When a company likes to be more on the complex relationship management side, they could be approached with more collaborative projects.

As answer on the question about approaching customers, several interviewees ask themselves how the R&D center of Bosch Sprang should present themselves. Should the R&D center be presented as part of Bosch Sprang or should it be an independent separate company? One of the interviewees suggested that the R&D center should have its own sales men that is able to talk about the R&D possibilities in detail. This are aspects that should be discussed by the management of Bosch Sprang.
Appendix 6: Risks and special aspects that deserve attention from internal interviewees

The interviewees of Bosch Sprang see the following risks by performing R&D for external parties:

- Damaging existing relations
- Problems with property rights
- Invalid results
- Blaming companies or persons with conclusions
- Less knowledge transfer through resistance again too much partnerships
- Other parties see also added value and start to invest in R&D equipment
- Being unclear to customers what they could expect

Some of these risks need further explanation. A risk is that a good relation could be damaged through delivering the wrong conclusions or through problems with knowledge transfer to competitors.

Another risk is that companies or persons will be blamed by conclusions of R&D. “It could be that the result of the R&D is that another party in the value chain made a mistake. For example you communicate to a producer of thermoform products that its thermoform machine cause the problems. However, the producer of the thermoform machine is also your customer and could be aggrieved by this conclusion. It is a risk of damaging relations through your conclusions. You should be very careful in blaming companies.” (Interviewees: A. Bosch & A. Bogers, 2015)

By less knowledge transfer through resistance, the interviewee means that some customers don’t like it when you work together with their competitor. They are afraid that you give their information to these competitors. The result is that such customers share less knowledge with your company.

Besides risks, the interviewees are also asked for special aspects that deserve extra attention by performing R&D for external parties. They come up with the following aspects:

- How to deal with confidentiality
- Clear project description and timeframe
- Research following norms and guidelines
- Clear final result (report)
- Price level should be acceptable in comparison with competitors
- Independence and objectivity of the R&D center
- Potential damage in case something goes wrong

The last point needs some explanation. “A lot of the time, the decision that is made based on R&D results is much (order 10.000 times) bigger than costs for this research. Therefore the responsibility of the R&D center is very high. There is a lot of potential damage in case something goes wrong. Results should be very clear communicated to prevent wrong decisions based on the data delivered”. (Interviewee: G. Smeulders, 2015)

The last questions of the internal interviews were about opportunistic behavior of customers, for example a customer of the R&D center does not pay because he said that the results are not according to his expectations. The interviewees of Bosch Sprang judge the likelihood of this risk on average as 3.5, thus very low. The solutions to prevent this sort of behavior given by the interviewees are shown in table 15.
<table>
<thead>
<tr>
<th>Solutions to prevent opportunistic behavior</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make a clear description/agreement/contract of the task that will be done and the results that will be</td>
<td>4x</td>
</tr>
<tr>
<td>delivered</td>
<td></td>
</tr>
<tr>
<td>(By big projects,) customers should pay a part of the invoice in advance.</td>
<td>4x</td>
</tr>
<tr>
<td>Get a purchase order</td>
<td>3x</td>
</tr>
<tr>
<td>Communicate costs for additional work on beforehand</td>
<td>1x</td>
</tr>
<tr>
<td>Determine/estimate on beforehand the range where the results will be. Then the customers know what</td>
<td>1x</td>
</tr>
<tr>
<td>they could expect. Agree upon a range of possible results is always good because there are always factors</td>
<td></td>
</tr>
<tr>
<td>that could not be influenced but have an effect on the results.</td>
<td></td>
</tr>
<tr>
<td>Define clearly what the needs of the customer are</td>
<td>1x</td>
</tr>
</tbody>
</table>

Table 15 Solutions to prevent opportunistic behavior given by interviewees of Bosch Sprang

All internal and external results are bundled in a framework that is shown in Figure 8. This framework gives an overview of the overall results and could be used by implementing ‘arm length transactions’ and ‘small relational contracts’.
Appendix 7: Contract factors

In order to reduce uncertainty, contracts could be developed between the parties. However, the question is what variables should be in the contract and how extensive these factors should be described because a more extensive contract cost more in terms of time and money (Dekker, 2005).

First, the interviewees gave their meaning about the factors that are in a contract following Dekker (2005). These results could be seen in table 16. Different parties in the value chain have a different color.

<table>
<thead>
<tr>
<th>Factors in a contract</th>
<th>Judgment mark</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extruder manufacturers</td>
<td>Machine manufacturer</td>
</tr>
<tr>
<td>Product description</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Property rights</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Price and payment terms</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Working conditions</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Conflict handling</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>After sales service</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 16 Judgment of importance of factors in a contract

In general, all factors from Dekker (2005) scores on average higher than 5.5. So, all these factors are of importance by writing a contract for performing R&D for external parties. The product description is the most important factor that should be in a contract. After that the most important factor, in a contract for performing R&D for external parties, is ‘property rights’. In this master thesis, by ‘property rights’, all aspects about confidentiality are meant.

Some interviewees mention that specific factors are situation dependent. For example, the importance of ‘property rights’ is dependent on the uniqueness of the project and the importance of ‘conflict handling’ is dependent on the existing relation between both parties.

One striking point is that one interviewee scores extreme low for the importance of property rights in the contract. For this company, “property rights are not so important because they had never discrepancies with property rights and being the first for a while is enough” for this company (Interviewee: Kirschnick, 2005).

Between the different parties in the value chain, there is almost no difference in judgment of contract factors.

Besides judgment of known factors, another question was to give other important factors that should be in the contract. The results of this question are shown in table 17.

<table>
<thead>
<tr>
<th>Extra factors that could be in the contract</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>How the results will be delivered (report format, presentation, only results or all info)</td>
<td>5x</td>
</tr>
<tr>
<td>How will be dealt with the end results (confidentiality, sharing, licenses)</td>
<td>4x</td>
</tr>
<tr>
<td>Project plan / project description (scope of project, timeframe, milestones)</td>
<td>4x</td>
</tr>
<tr>
<td>Certification of the results</td>
<td>1x</td>
</tr>
<tr>
<td>What is possible with test results</td>
<td>1x</td>
</tr>
<tr>
<td>Link between payment and results</td>
<td>1x</td>
</tr>
</tbody>
</table>

Table 17 Extra factors that could be in the contract

Most of the factors that are mentioned in table 17 are already in the judged factors from Dekker (2005). Only one factor is several times mentioned and is not in the factors of Dekker (2005). That is information about how the results will be delivered. That could also be incorporated in the contract. This gives the customer more certainty what results he gets.
Appendix 8: Risks and special aspects that deserve extra attention from external interviews

Parties in the value chain see potential risk in information exchange from the external R&D center to competitors. That is the most cited risk in the external interviews. Another risk, especially for Bosch Sprang is that their R&D center is quite new. They have therefore a lack of experience that could lead to less reliable results. Another risk, also especially for the R&D center of Bosch Sprang, is too much interdependence. When a customer uses knowledge of the R&D center of Bosch Sprang, he is more dependent on Bosch Sprang for a reliable production. Therefore, he is limited in his choice for thermoform tool supplier. Besides these risks, table 18 shows also some other less frequent cited risks.

<table>
<thead>
<tr>
<th>Potential risks by performing R&amp;D with external R&amp;D center</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information exchange from external R&amp;D center to competitors / confidentiality</td>
<td>4x</td>
</tr>
<tr>
<td>Newness of R&amp;D center Bosch Sprang -&gt; reliability of results</td>
<td>2x</td>
</tr>
<tr>
<td>Too much interdependence -&gt; limited choice of supplier</td>
<td>2x</td>
</tr>
<tr>
<td>Comparing results from the past impossible through closing R&amp;D center</td>
<td>1x</td>
</tr>
<tr>
<td>Damaging competitive position of customers (when samples lie around in R&amp;D center)</td>
<td>1x</td>
</tr>
<tr>
<td>Opportunistic behavior of one of both parties</td>
<td>1x</td>
</tr>
<tr>
<td>Different perception of project between both parties</td>
<td>1x</td>
</tr>
</tbody>
</table>

*Table 18 Potential risks by performing R&D with external R&D center*

Besides risks, respondents give also special aspects that deserve extra attention by performing R&D projects with external parties (see table 19).

<table>
<thead>
<tr>
<th>Aspects that deserve extra attention by performing R&amp;D project with external R&amp;D center</th>
<th>Times cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement about project plan (objectives, expectations and approach in line)</td>
<td>3x</td>
</tr>
<tr>
<td>Open communication, quick response and right information exchange</td>
<td>2x</td>
</tr>
<tr>
<td>Property rights</td>
<td>2x</td>
</tr>
<tr>
<td>R&amp;D center should be an independent certified body</td>
<td>1x</td>
</tr>
<tr>
<td>R&amp;D center should explain content of their certification</td>
<td>1x</td>
</tr>
<tr>
<td>Customer should have the possibility to adjust the goal of a project</td>
<td>1x</td>
</tr>
<tr>
<td>Potential benefits should be clear of beforehand for both parties</td>
<td>1x</td>
</tr>
</tbody>
</table>

*Table 19 Aspects that deserve extra attention by performing R&D with external R&D center*

The most cited aspect that deserves extra attention is an agreement about the project plan. That includes that the objectives, expectations and approach of the project are in line by both parties. Again ‘open communication quick response and right information exchange’ scores high. This is the third question where open communication is very important. Besides, table 19 shows some other aspects that deserve extra attention.