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MASTER THESIS

Early Supplier Involvement in New Product Development

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MASTER THESIS

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Perspective of a European Trailer Manufacturer

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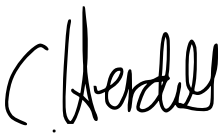

Christian Herdelt

PREFACE

This master thesis has been created within the scope of my Master of Science in Business Administration program at The University of Twente in Enschede (NL) in the period of November 2016 until March 2017.

The topic of early supplier involvement in NPD development has begun to interest me while reading scientific papers in that field. I recognised that most of the companies I have been working or did work for did not consider their behaviour towards suppliers when dealing with new product development projects. The industry was chosen due to personal preferences and former experience in similar industries. There is research available for similar manufacturers but for the trailer industry there appears to be a gap in the literature. This research gives the opportunity for researchers and practitioners to get an overview about strategies and trends in the trailer industry regarding that topic. Furthermore, this research can function as a starting point to extensively research the whole industry instead of only one manufacturer and its environment.

This research offered me the possibility to further explore the field and continue to develop skills and knowledge while dealing with challenges occurring during the making of the thesis. I want to explicitly express a special thanks to Prof. Dr. habil. Holger Schiele and Dr. Matthias de Visser who supported me during the time of executing my research. Furthermore, I want to thank my company supervisors for supporting me within the company and express my gratitude to the firm for giving me the opportunity to conduct the research within their organisation. I would like to thank interviewees for taking the time for an interview during their busy work times. In addition to that, I would like to thank my fellow student Jonas Benen for helping me with conducting the maturity profile of the purchasing department.

EXECUTIVE SUMMARY

This research was conducted in order to determine the role of the overall purchasing function in companies for the topic early supplier involvement in new product development. Nowadays companies focus more on that topic because the markets are highly competitive and technology is changing rapidly. If companies engage in supplier inclusion activities they improve quality and reduce costs.[1] It appears to be important especially for complex products because buyers do not have the know how of products that are highly specialised. For that matter supplier act as experts in the innovation process and help the buyer to innovate as a strong partner.[2] For that purpose a good buyer-supplier relationship is in the interest of the parties that are collaborating.[3]

The inclusion of a supplier early in the process has risks, pitfalls but also benefits that all companies that want to engage in that need to be aware of. As for the risks and pitfalls it can be mentioned that communication with the supplier especially for international projects is important and can cause problems if it is not executed properly. In addition to that there needs to be a high level of trust and commitment between the buyer and the supplier to make the project successful. Otherwise there is a lack of information sharing and assumptions are made. Suppliers need to be chosen carefully and the buyer needs to be aware of their technical capabilities in order to avoid different expectations.[4] Both parties should be aware of power disparity and how it will be handled throughout the collaboration time.[5] Additionally, firms should pay attention to factor market rivalry and scarcity of suppliers. Top-tier suppliers with technical expertise become rare and buyers that want to partner up with certain suppliers need to put extra effort into that.[6] On the other hand side the benefits for early supplier involvement in NPD projects are valuable for companies throughout almost all industries that want to innovate and face the challenge of complexity of products and missing know how. There are short-term benefits namely reduction of development cost and development lead-time and reduction of product cost and gain

[1] See McIvor & Humphreys (2004), p. 180
[2] See Ragatz et al. (2002), p. 392
[3] See McIvor & Humphreys (2004), p. 181 – 182
[4] See Wynstra et al. (1997), p. 159
[5] See Cox et al (2001), p.11
[6] See Capron and Chatain (2008), p. 113

in product value. The long-term benefits are getting access to technological knowledge and development risk sharing between buyer and supplier.[7] The risks and benefits concur with the perception of the firms' employees with the exception of development risk sharing, which was not taken into account.

When the risks and benefits are known, the firms need to plan internally the actions and processes they need to execute. The degree and timing of supplier inclusion depends on the product where the complex product should be included earlier and suppliers get more responsibility within the project.[8] The concurrent engineering approach fits best for incremental innovations and the purchasing department should act as a coordinating function in NPD projects where the supplier is involved, and make sure that the purchasing staff has the right skillset in order to execute that task and make sure cross-functional teams are being set up.[9] Furthermore, a good buyer-supplier relationship should be established. With pro-active actions the buyer has to achieve customer attractiveness, supplier satisfaction and eventually become a preferred customer.[10] While following the literature, there is an exact model developed for the company that was investigated, which can be used to improve their overall early supplier involvement in NPD strategy and process.

Key words: early supplier involvement, open innovation, new product development, buyer-supplier relationship, preferred customer status

[7] See Wnystra et al. (2001), p. 159
[8] See Interview no. 2, Appendix C (2017), p. 85 - 88
[9] See Interview no. 2, Appendix C (2017), p. 85 - 88 ; Valle & Vázquez-Bustelo (2009), p. 145;Mc Donough (2000), p. 226
[10] See Schiele et al. (2012), p. 1180

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LIST OF ABBREVIATIONS

CAD	computer aided design
e.g.	exempli gratia
ERP	enterprise resource planning
etc.	et cetera
et al.	et alia
NDA	non-disclosure agreement
NPD	new product development
SCM	Supply Chain Management
SET	social exchange theory

Table of Contents

1. Introduction: problem & research identification

1.1 Research of the early inclusion of suppliers in a new product development context

1.1.1 Importance of early collaboration with suppliers and problem outline

The master thesis deals with the role of the overall purchasing function in companies in the topic of early supplier involvement in new product development in order to prevent mistakes or realise opportunities in an early stage of the process.

Nowadays companies increasingly outsource activities that belong to new product development, hereafter NPD. Due to that reason it is not a big surprise that there is research that concentrates on collaboration with suppliers when it comes to NPD. In recent literature, researchers focus on the role of the supplier when it comes to NPD, also outsourcing innovation activities and examine the potential relationship between buyer and seller.[11] It is not a secret that today's world is highly competitive and in order to keep up with the markets, one needs to evaluate global trends where the rapid change of technology and the faster development of products play an important role. In order to achieve a competitive advantage, companies for the most part, cannot handle this fast pace of change on their own. Firms want to decrease the development time a certain product needs and at the same time improve quality and reduce costs.[12] Customers expect that the products are up-to-date and have a superior quality and firms want to increase customer value with increasing their own performance. NPD plays a central role in that endeavour. In order to be able to do that it is getting more and more important that firms collaborate with its suppliers and see their own supply chain as a significant part in improving the final product.[13]

Innovation does not only take place in the dark basement of technological companies anymore; it rather involves the supply chain and the firms' suppliers. Due to that matter, the suppliers extended their task spectrum from simply ensuring supply and negotiate the price to being an active member in the NPD and innovation process. For that reason McIvor & Humphreys (2004) stated that the buyer-supplier relationship is highly

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11 See Benton & Maloni (2005), p. 2
12 See McIvor & Humphreys (2004), p. 180
13 See Monczka et al. (2016), p. 126

important. Here it can be said that a confrontational and negative co-operation result in a lower chance of early integration of supplier in the innovation and NPD process. From that, one can conclude that managing the relationship of buyer and supplier is one of the significant tasks in early supplier involvement in NPD.[14]
The question: 'What are the key factors of a good buyer-supplier relationship?' arises because one of the main problems is to determine the quality of the buying and the supplying organisation in terms of transfer of knowledge and NDP performance.[15]
Ragatz et al., (2002) suggests that the involvement of the supplier is important because suppliers are specialised in their own products, which is extremely important especially because products become more and more complex. At the same time, involving a supplier at an early stage can improve the NPD performance and save costs.[16]

1.1.2 Goal of the research

This study will examine how the firm can engage in early supplier involvement and will state why they should do that. In addition risks and benefits will be mentioned and evaluated. It will be analysed what proactive actions need to be taken in order to succeed in collaborating with a supplier when it comes to the NDP process. In this thesis the research model and design is presented. After the problem has been specified and the company participating in the study is known, the precise research questions are evaluated.

1.1.3 Research Focus and development of the research question

Many companies see the early involvement of suppliers and the collaboration in general as a challenging task because it might be the case that they have to share sensible internal information. Technological roadmaps for example should be known by the supplier the firm is collaborating with and on the other hand one should know the level the supplier is on in terms of their products. Due to the fact that it is such a sensitive topic there might be the danger that firms act to slow and miss out great market opportunities because they could not keep up with their competitors or loose their competitive advantage. To ensure

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[14] See McIvor & Humphreys (2004), p. 181-182
[15] See Sjoerdsma & Weele (2015), p. 193
[16] See Ragatz et al. (2002), p. 392

that firms are on the right track from the beginning of their endeavour with including the supplier in their NPD process, the focus on this research is highly connected to this.

Thus, the central research question is:

What can the trailer manufacturer do to include their suppliers in early phases of their new product development process?

New product development here is the creation of a new product with added value that the firm offers to its customers. It is either a completely new product or a modification of an old version of an existing product.

Early involvement of suppliers stands in this context for the involvement in only the new product development. It is limited to co-developments and excludes mergers and acquisitions. For this research the focus is on the external collaboration of the company with a focus on the buyer-supplier relationship.

3.1.3 Sub-questions in alignment with the early supplier involvement

As the central research question was stated in the previous section, this section provides sub-questions with the goal to answer the research question in a more structured way. Important to begin with is to clarify with help of a literature review the concepts of new product development, as well as the existing concepts of early supplier involvement and buyer-supplier relationships with regard to new product development. Since the central research question is meant to support companies with the purpose to include suppliers in an early stage of their NPD, understanding the concepts is necessary to successfully implement a plan. For that reason it is important to evaluate the literature step-by-step from the beginning and planning phase to the execution phase. That results in the first sub-question:

1. ***What are the risks and benefits of early supplier involvement in NPD?***

First, it needs to be examined whether there are more risks or benefits when it comes to early supplier involvement in the whole process of NPD. Firms need to be aware of all the uncertainties and critical points before engaging in this endeavour. Risks and benefits must

be analysed before, to optimise the plan of approach as supplier selection and collaboration plan. However, once the risks and benefits are known and the firm decides to involve their supplier or maybe suppliers, firms need to know how it is done in a successful way and what points of engaging with a supplier are important for the particular company. That point results in the second sub-question:

2. ***How to engage in early supplier involvement in NDP and organise it internally?***

Once the collaboration has started, the critical decisions do not stop. As important as the preparation and execution is that companies maintain their relationship to their suppliers in order to be successful. According to Sjoerdsma & van Weele (2015) the transfer of knowledge is one of the most significant points here.[17] There needs to be mutual trust to ensure a good collaboration between the parties. With the goal of establishing and maintaining that mutual trust companies need to work on the buyer-supplier relationship. That results in the third sub-question:

3. ***What are the main factors in order to maintain a good buyer-supplier relationship while collaborating on an early stage of NPD?***

To answer the central research question in a structured way the sub-questions will be answered along the way. This will lead to an overview of the topic and will support and guide companies that play with the thought to engage in such an endeavour.

1.2 Overview of the trailer manufacturer, its activities and organisation

No public information

1.2.1 Collaboration with a new supplier

When it comes to the product portfolio it can be said that the trailer manufacturer is focused on the commercial transportation of goods, which includes semi-trailers, central axle trailers, drawbar trailers and bodies for trucks.

[17] See Sjoerdsma & Weele (2015), p. 193

In this thesis the running gear of the trailers is one of the focus points of the research, more precise as a practical case to compare the results. In particular there is a development of a second source of supply for hydraulic shock absorber within the pneumatic suspension of an axle. The project is on going and a contract with a Turkish supplier was closed. The first pre-sample is available end of September 2016. The pilot production is planned to start in the beginning of the year 2017, followed by a 6-9 month test phase with an eventual introduction of the product end of 2017 or beginning of 2018.

The Turkish supplier can be of importance for the firm when the project will be a success. The challenge will be to innovate together and include this supplier into the NPD of the running gear of their trailers, in particular the hydraulic shock absorber. There are opportunities seen, also since there is a contract, that the know-how of their area of expertise can be used and combined with firms' research & development activities.

2. Theoretical Framework: Early supplier involvement in new product development

2.1 The concept and steps of the new product development process

The concept of new product development states the creation of a new product or the adjustment of an existing product with creating new value for the customer. The process identifies the market opportunity and shifts it into capitalisation opportunities.[18] That means it is the interface between the customer and the organisation, the customer with their needs, the organisation with its capabilities, in combination with efforts of the firms to create value and deliver it to its customers. Due to globalisation that led to increased competition and more complex technical products that led to difficulties and firms have been in the need to change their NPD process from an exclusively internal to a more open one. Companies measure success of NPD in customer measures (market share, customer satisfaction), financial measures (margin level), firm-level measures (% of sales), and product related measures (performance, speed to market, technical successful).[19] According to Cooper and Kleinschmidt (1986) there are several steps in the NPD process that firms are advised to follow. Their new product process activity model is widely used and quoted by researches in the field, thus used as an example of the steps. Commonly, the whole process starts with an *initial idea* that was market derived, meaning from customers or competitors. Alternatively, it was technology driven by in-house R&D, labs or a supplier source. The process starts with *initial screening* with a go or not to go decision and allocation of funds. After that, a quick *market and technical assessment* is proposed to notice the technical benefits and possible difficulties of the product. Despite the quick market assessment, a *detailed market research* and data collection, is effective to identify customer reactions, followed by a *business and financial analysis* before starting the actual product development. If the outcome of the previous steps was positive the *product development* starts with design, a prototype or sample product, in-house testing and customer testing. Before the *trial production* run it is recommended that a *test market phase* to customers is included in the process. In between the trial production and the start of the *full-scale production*, another business and financial analysis is suggestive to see if there occurred any changes during product development. Lastly, the *market launch* of the

[18] See Krishnan and Ulrich (2001), p. 15.
[19] See Griffin and Page (1993), p. 299

product can be prepared and executed. Successful new product development projects follow for the most part these steps.[20]

2.2 Collaboration with a potential supplier in new product development activities

2.2.1 Challenges and risks of including a supplier into new product development activities

Collaboration with a supplier on a level that extents the regular buying activities, such as including them in your new product development, can have certain challenges, pitfalls and risks. The issues relate to manage the involvement of the supplier in NPD activities and can be associated with the supplier, the manufacturer and the relationship between the two parties. First of all, there may be problems that can be associated to the relationship between the manufacturer and the supplier. A significant harm to the relationship here is the deficiency of trust and commitment, which can affect the collaboration performance negatively in terms of efficiency and effectiveness. Here, both parties detect the relationship as unstable and as a potential risk. In addition to that, communication with the supplier can appear as a problem when the manufacturer fails to clearly communicate what is expected in terms of responsibility sharing in the NPD process. As a result of failed communication the supplier assembles inaccurate assumptions and forms different strategies, which can lead to faulty investments based on these false assumptions. As a more factual example a problem can arise if both parties use different CAD systems that are incompatible or there are language barriers as well as a different interpretations for technical information about the product.[21] Firms often see the risk to share internal information with their suppliers by the cause of data being exposed to competitors. This issue is more critical if the supplier operates as or with a competitor.[22] A problem that originates also on both sides is shown by a case study that notes especially engineers in manufacturing firms are not willing to share their technical data with external suppliers.[23] Although even when the manufacturing firm is willing to share the internal information with their supplier, the problem that the supplier interprets and translates the data correctly remains a risk and challenge here.[24] That problem may explain the resistance of the engineers as well, due to the difficulties of collaboration if data is not being translated in a

[20] See Cooper and Kleinschmidt (1986), p. 74
[21] See Wynstra et al. (2001), p. 159
[22] See Ragatz et al. (1997), p. 199
[23] See Ragatz et al. (2002), p. 391
[24] See Cousins et al. (2011), p. 940

correct way. The supplier needs in-house technical capacities on a similar level than the manufacturer. However, manufacturers may select a supplier that does not have those technical capabilities and only limited or no experience in collaborating due to poor supplier selection criteria, with for example fixation on only the price.[25] Another problem that originates only on the supplier side is limited interest in collaboration. The cause of that may be that the manufacturer is only responsible for a small percentage of the supplier's potential sales. The supplier needs to see clear advantages the manufacturing firm is able offer from a collaboration, especially when other customers of the supplier asking for the same relationship.[26] Moreover, in NPD projects a problem can appear if the parties involved are situated in a power disequilibrium. Research has shown that often the stronger partner force the weaker one to accept challenging points against their will and abuse power in the partnership. That abuse of power triggers mistrust and frustration, thus power disparity needs to be known on both sides before start of the collaboration between the two parties.[27] In certain partnerships with power disparity either the buyer or the supplier can block the stream of value through the supply chain, hence passing value to the end customer will not be successful.[28] Therefore managing power and being aware of unequal distribution of power between buyer and supplier can be seen as obligatory in the beginning of the collaboration process to be successful. Another big challenge for manufacturing firms in the process of building a collaborative relationship with suppliers is factor market rivalry. There is a scarcity of supplier with valuable resources and capabilities that lead to factor market rivalry among buying firms factor markets.[29] Due to that scarcity, buying firms take actions against the competitors resources to gain a competitive advantage and make themselves more attractive to the suppliers.[30] That has implications that it is important for the buying firm to react not only on a collaborative basis to suppliers but also make their firm more attractive and gain a competitive advantage on a resource based view on the factor market to beat your suppliers and pave the way for a potential relationship and collaboration. In order to include a supplier in NPD activities, manufacturers need a clear product development process and strategy to be aware at what point in the process the supplier needs to be included. Additionally, an internal issue is that not only the development engineers created barriers because they are

[25] See Wynstra et al. (2001), p. 159
[26] See Wynstra et al. (2001), p.160
[27] See Zolghadri et al. (2010), p. 312
[28] See Cox et al. (2001), p. 11
[29] See Capron and Chatain (2008), p. 99
[30] See Capron and Chatain (2008), p. 113

afraid their job is in jeopardy but also the purchasers are hesitant in that endeavour because they do not have a finished product to justify their decision. Engineers often join that argument and add that communication with the supplier in the NPD process would add redundant complexity to their work in addition to quality reservations they see between them and the level of the supplier.[31]

2.2.2 Benefits of including a supplier into new product development activities

Despite the challenges and risks of including a supplier into a firm's NPD activities, there are on the other hand side benefits to be mentioned. Research on that topic with in-depth case studies and large-scale surveys have shown evidence that integrating the supplier early in the process leads to a superior product or new product performance in terms of cost, quality and time to market benefits.[32] The lower cost, improved quality and shorter time to the market can be seen as the result of the collaboration and integration. There is a difference regarding the benefits with short-term goals and long-term goals.[33] Firms need to understand the short-term and the long-term benefits at the same time and focus not only on one perspective, in order to implement the process in a successful way.[34]

Short-term goals are linked to specific development projects with two areas namely efficiency and effectiveness. Efficiency of supplier involvement can lead to benefits as reduction of the development costs and reduction of the development lead-time. That can be accomplished by regulating design changes with early communication with the supplier to have the same perception and level at every stage of the process. In addition to that, development tasks of the modules can be separated so that either the manufacturer or the suppliers is in charge of it, depending on who is more competent in executing it. As an alternative both parties can develop the components simultaneously to avoid bottlenecks in the engineering or R&D department. In terms of effectiveness in short-term benefits, evidence suggests that it leads to reduction of the product cost and gain in product value. Those improvements can be achieved with using the supplier's expertise in design, manufacturing, quality and reliability of components, alternative materials and possibilities for component standardisation.[35]

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[31] See Wynstra et al. (2001), p. 160
[32] See Johnsen (2009), p. 193
[33] See Wynstra (2001), p.158
[34] See van Echelt et al. (2008), p. 197
[35] See Wynsta et al. (2001), p. 158

A significant fraction of the product cost is being made at the beginning of the product development phase with mainly technological decisions.[36] The engineering and product design phase generates five to eight percent of the total product development cost, but is responsible for 80% of the total cost of the product (see Appendix F). Thus, early decisions in the process are significant and it becomes more costly and difficult as the process goes on.[37] The decisions from the design process have a significant impact in product quality, cost and cycle time, hence sharing ideas and knowledge with the supplier can lead to considerable cost reductions.[38] Product quality is crucial for all new development products and a way to increase quality is to give suppliers the freedom to share their product concept information in an early stage of the production cycles, and because of that the final product meets the quality criteria.[39] But also cycle time is identified as an important performance indicator for organisations and it improves when suppliers are involved in the process and saving time throughout the collaboration is the result.[40]

For the view in the future there are long-term benefits or also called *"soft-benefits"* that are achieved through integration of the supplier in the NPD process. Due to the fact that it is important only for the long-term success, it often cannot be measured immediately at a new product success point of view.[41] Manufacturers have the interest in getting access to technological knowledge that the supplier has and influence them in technological investments or decisions to adjust the direction of the supplier and the collaboration outlook. Thus, the manufacturing firm and the supplier are able to develop a 'technology roadmap', a plan for technological trends and strategies, together and invest in their collaboration.[42] When including suppliers in project teams, it adds value to the team in terms of new idea generating and technology expertise.[43] As the relationship is closer between the buyer and the supplier, the supplier is more willing to share their technologies so that the buying firm can benefit from it. Hence, building up a long-term relationship is a crucial factor in order to collaborate and share information and technology.[44] This occurs in particular in high technological industries because no firm is able to handle all needed

[36] See Ragatz et al. (2002), p. 398
[37] See Handfield et al. (1999) p. 63
[38] See Ragatz et al. (2002), p. 398
[39] See Ragatz et al. (2002), p. 397
[40] See Ragatz et al. (1997), p. 194; Petersen et al. (2003), p. 291
[41] See Ragatz et al. (1997), p. 194
[42] See Wynstra et al. (2001), p. 159
[43] See Petersen et al. (2003), p. 286
[44] See Handfield et al. (1999), p. 79

technologies perfectly. The capability of a manufacturer to use the knowledge and expertise of the supplier is likely to improve technological decisions and lead to better designs.[45] Another benefit that is connected to the technology factor is risk sharing, because if both parties are involved in the process the supplier takes on some of the risk, thus technological risk sharing between the buying firm and the supplier occurs.[46] Additionally when the two parties share the risk it reduces the need for investments, hence the manufacturer is less dependent on loans or costs specifically for the product development. This means that the product risk for the newly and together developed product is reduced.[47] Research shows that long-term benefits can only be generated when the manufacturing firm can build a working long-term relationship with the supplier.[48]

2.3 Selection of the right supplier, success factors and timing for integration

2.3.1 Degree of supplier involvement & level of responsibility

As elaborated, firms that are technology focused do not develop only internally but rather rely more and more on external sources of technology with consolidation within the supply chain. The challenges and benefits show that firms need to be aware of many different aspects during the process of collaboration. In addition to that, the degree of supplier involvement in NPD activities matters and depends on the division of labour of product architecture and specialisation of engineering tasks between the firm and its suppliers.[49] When including suppliers in the NPD process it is often done with a vertical cooperation, where the degree of the involvement greatly depends on the technological knowledge, the part itself and engineering expertise that is needed by the manufacturer.[50] Petersen et al. (2005) demonstrates a model that shows that the higher the degree of responsibility the stronger the integration of a supplier into the whole NPD process. The model displays the spectrum of supplier involvement using none to black box integration.[51] The model begins with the so-called 'none box', which states that there is no supplier involvement at all. The manufacturer and the potential supplier do not have a relationship that involves NPD activities. The 'none box' approach is the lowest level shown in the model. The next level in the spectrum of integration is the 'white box'. Shown is an informal integration where

[45] See Ragatz et al. (1997), p. 199
[46] See Handfield et al. (1999), p. 79
[47] See Figueiredo et al. (2008), p. 30
[48] See van Echelt et al. (2008), p. 197
[49] See Mikkola et al. (2003), p. 33
[50] See Mikkola, (2003), p. 445
[51] See Petersen et al. (2005), p. 378

the buyer or the manufacturing firm consults the supplier on their design decisions. The collaboration includes discussions and meetings about specifications of the products as well as requirements. Even though the supplier is included in the discussions, the buyer makes all design and specification decision in the end alone. The supplier is not an active party of the actual new product development or design process. The following responsibility level is the 'grey box', where the buyer and the supplier arrange an informal or sometimes even formal joint development project. The buyer and the supplier share technology, both sides include information, they have joint decisions about design and discuss the product specifications together.[52] The grey box level parts are typically classified, especially in the automotive industry, as detail-controlled parts. The buyer is responsible for the functional specification, detailed engineering activities, however there are joint decisions with the supplier about the products to be developed.[53] This method is often used because both parties, the buying and supplying firm, can combine their capabilities. The highest level of the responsibility of the model is 'black box' integration at the end of the spectrum. Black box integration is described as almost complete responsibility of the supplier. The buyer informs the supplier about requirements and specifications for the purchased item and the supplier is responsible to design and develop the parts.[54] In industries or scenarios with technology uncertainty 'black box' integration affects product innovativeness and product speed to market positively in comparison with the other levels of responsibility.[55]

None	White Box	Grey Box	Black Box
No supplier involvement. Supplier "makes to print."	Informal supplier integration. Buyer "consults" with supplier on buyer's design.	Formalised supplier integration. Joint development activity between buyer and supplier.	Design is primarily supplier driven, based on buyers performance specification.

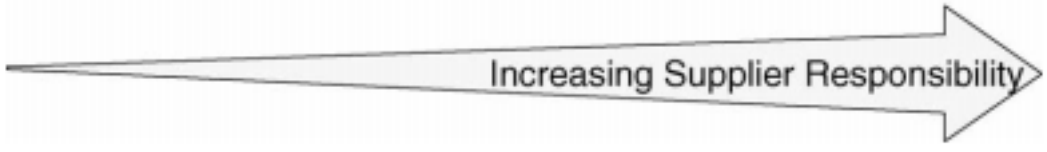

Figure 1: Spectrum of supplier integration

Source: Petersen et al., (2005), p. 378

[52] See Petersen et al. (2005), p. 378-379
[53] See Mikkola et al. (2003), p. 33
[54] See Petersen et al. (2005), p. 378-379
[55] See Zhao et al. (2014), p. 1061-1062

‘Black box’ parts have the advantage for the buyer that the firm can use the suppliers’ expertise and manpower but still maintain control of the design and functions of the system. The higher the technical complexity of a black box part, the more useful is to have a supplier get involved in engineering activities. In addition to that ‘black box’ parts need a high level of integration as shown in the model because information sharing about design and product specifications at an early stage need to be well communicated.[56] ‘Black box’ integration is useful when the supplier has unique expertise in the field and about the product, thus firms assign the tasks to suppliers to improve performance and innovation.[57] Generally, ‘grey box’ and ‘black box’ integration have a positive impact on the success of supplier involvement. When firms select suppliers with a focus on their product development capabilities, it is a strong indicator that either one of those integration levels is chosen.[58] The degree of the relationship has an impact on the involvement of the supplier in NPD activities. The selection of the supplier often plays a significant role that decides the extent of integration. Therefore, identification of suppliers with certain capabilities in the selection process of these suppliers is mandatory.

2.3.2 Identification and selection of innovative suppliers for in the NPD process

As a consequence of the arising importance of outside and external sources of technology, a new task for purchasing arises as well. Firms need to understand which suppliers do have the capabilities to actually contribute to the innovativeness of the firm. Therefore identification of an innovative supplier becomes a new process firms need to be aware of.[59] Innovation in the business context is directed at something new, something advanced, and the question of an innovation approach is who is doing the innovating part. Suppliers need to have certain abilities to innovate and the buyer and the seller need to complement each other in order to be successful.[60]

Schiele (2006) proposed a framework that helps to identify innovative suppliers that are likely to contribute to innovativeness in NPD. The framework consist of three categories of

[56] See Mikkola, (2003), p. 446
[57] See Zhao et al. (2014), p. 1062
[58] See Koufteros et al. (2007), p. 864
[59] See Schiele, (2006), p. 925
[60] See Petersen et al. (2005), p. 385

factors namely (1) the character of the supplying firm, (2) the character of the buyer-supplier relationship and (3) enabling and supporting factors.[61] The three categories include eight propositions that can function as indicators for evaluating the existing portfolio and capabilities of a company.[62] The first factor of the model

(1) Character of the supplying firm in terms of specialisation, development capacity and collaborative mind set

deals with the character of the supplying firms. In comparison, specialised firms are more innovative than de-specialised companies that serve several industries. Those firms often provide complete systems or products that are highly technological with the capability to be innovative.[63] The more specialised a company is, the better is the contribution to innovation when it comes to collaboration in NPD between a buyer and a supplier. From that it can be concluded that companies, which are specialised in an industry and provide complete products should be preferred as a potential partner in an open innovation process.[64] Furthermore, companies that have high own development capability and a certain level of specific knowledge tend to be more innovative and thus are more suited as a partner in NPD activities especially for firms with low development capabilities. Positive indicators are a skilled workforce in the specific field with support of IT systems and NPD process documentation.[65] Firms that have a higher spending in R&D activities contribute more to innovative activities in NPD in a collaborative relationship between buyer and supplier.[66] Research has shown that a certain characteristic of an innovative supplier is that the supplier is simultaneously engaged in several collaborative ventures, hence the previous experience of a supplier can be seen as an indicator of its innovative capability.[67] Firms that have already experience in NPD collaboration show a positive attitude and openness towards joint projects and it displays an organisational culture where the mindset is open as well. That fact and a higher level of professionalism increase the odds to make a better contribution to the relationship in NPD activities.[68] That means while identifying

[61] See Schiele, (2006), p. 929
[62] See Schiele, (2006), p. 932
[63] See Schiele, (2006), p. 928-929
[64] See Pulles et al. (2014), p.411
[65] See Schiele, (2006), p. 929
[66] See Pulles et al. (2014), p.411
[67] See Schiele, (2006), p. 929
[68] See Pulles et al. (2014), p.411

potential suppliers, buyers should have in mind to what extent the supplier is specialised and has a collaborative mindset. The second factor of the model

(2) Character of the buyer – supplier relationship in terms of trust, commitment and supplier development or joint improvement programs

is about the relationship of the buyer and the supplier. The supplier and its characteristics alone does not paint the full picture because innovations are to be co-developed, therefore both parties are of vital concernment.[69] The two parties have to interact on a regular basis and relationships with innovative suppliers should be based on trust and commitment. The quality of the relationship is an important variable for success of NPD projects because all outcomes can most of the time not be written down in a contract. However, both partners need to be confident that it is worth putting effort in it and that a fair distribution will take place. When that confidence on both sides is not given, an open exchange of information and knowledge may be hindered and hence the innovation process harmed. Additionally, trust reduces monitoring costs, is a typical costs that can occur when tasks and responsibilities are given to suppliers.[70] Supplier development can be seen as a joint commitment to improve the suppliers' performance. Suppliers that are participating in a development program are likely to make a greater innovation contribution, thus the buyer – supplier relationship profits from it.[71] Innovative supplier should take part in joint development programs with the buyers. In active supplier development engineers are sent to the partners' production site and personnel is supported in terms of joint programs. Passive supplier development only includes evaluation schemes that are communicated to the supplier for self-improvement purposes. The programs should be done not only in case of a problem but rather to prevent poor performance in the first place.[72] In the process of identifying the potential supplier, a buyer should have the trust and commitment issue in mind and eventually check if there is a willingness to participate in a supplier development program existent. To ease the process in later stages of the collaboration, trust and commitment play an important factor also in setting up development programs. The last factor of the model

[69] See Schiele, (2006), p. 928
[70] See Schiele, (2006), p. 929-930
[71] See Pulles et al. (2014), p. 412
[72] See Schiele, (2006), p. 930

(3) Enabling and supporting factors: geographical proximity, increasing importance of buyer and history of supplier

have an indirect influence, though play a role in the success of the project in terms of innovativeness. Geographical proximity to the buyer can be seen as an enabling and supporting factor for a supplier to successfully collaborate with the buyer in the process of innovation. Due to globalisation and digitalisation it may seem a questionable factor, but research shows the importance of proximity in terms of innovation. Face-to-face innovation meetings should take place frequently and exchange of information to solve problems faster that are not to be solved digitally. Cluster theory suggests that firms within a cluster develop strong local ties that provide them with a competitive advantage in comparison to their isolated counter parts.[73] According to Porter (1990) *"clusters are geographical concentrations of interconnected companies, specialised suppliers (...) firms in related industries, and associated institutions (e.g. universities) (...) in particular fields that compete but also cooperate."*[74] The mutual importance of buyer and seller is characterised as an additional enabling factor. That mutual importance can occur in terms of sales volume and influence towards each other. A power disparity has a negative influence on the buyer – supplier relationship. The final enabling factor is the history of the relationship between the buyer and the supplier. If the relationship is somewhat older and established that means that the partners have been growing together, the relationship is better and collaboration in NPD activities is more likely to be successful.[75] When there is a high consistency with shared attributes as beliefs, values and education between buyer and supplier, the interaction is likely to be better which means as a result a greater innovativeness in NPD collaboration. For dimensions that are important for inter-organisational innovation projects, such as strategic orientation, risk taking and collaboration tendencies, consistency should be given and is seen to be critical in order to be successful.[76] To conclude, buyers should be aware of the suppliers' characteristics, the relationship with the potential partner and also pay attention to enabling factors that play a moderating role in the success of the collaborative project. As for the selection it is important that for selecting the right supplier, relational and operational criteria need to be

[73] See Schiele, (2006), p. 931-932
[74] See Porter, (1990), p.253
[75] See Schiele, (2006), p. 932
[76] See Wagner, (2010), p. 1143-1146

evaluated.[77] For that Hou et al., (2006) identifies a process that consists of four modules. Frist a primary supplier selection should be executed based on the product platform and development strategy. The requirements of a supplier are proposed and through a market survey, supplier web or tender/bidding a supplier is searched. With this step a number of suppliers that are not suitable are already excluded and the next step are made easier. Following that an evaluation system is to be established. The evaluation criteria include: product quality, product cost, technical capability, system support, product standardisation, quantity feasibility, developing capability, function and product modularisation, information exchange, management level, consistency between the partners, collaborative experience, technical risk, power disparity, business credit standing, after service, information service and security. Consequently, the established criteria need to be evaluated. As the last step a supplier assessment is to be done in terms of product collaborative development.[78] The identification and selection of a suitable supplier for collaborative activities in a NPD process is an important step for the procurement department in order to engage in a successful project.

2.3.3 Timing for integrating a supplier in the NPD process

It is no surprise that the timing for integrating a new supplier into NPD activities is of consequence. It is an essential element and success factor in a collaborative project and determines the competitive position in the market by using a "full-service supplier".[79] It is discussed that it may be crucial for firms to include a supplier as early as possible, preferably already in the design process and bring as much technical expertise into the process as possible. As the development of a product continues it becomes more difficult and costly to make changes in case unprecedented issues occur.[80] When it comes to the decision of the right timing, firms need to base their decisions on technical goals rather than joint business goals. For a collaborative project, research found out that a joint setting of business goals has no or little impact on the success of the project and the effectiveness of the team. On the other hand side technical feasibility has an impact on the team effectiveness, thus most likely on the success of the project. This suggests that technical input is more important than business goals.[81] Surprisingly, there is no empirical support

[77] See Croom (2001), p.29
[78] See Hou et al. (2006), p. 6990
[79] See Parker et al. (2008), p. 79
[80] See Ragatz et al. (1997), p. 191
[81] See Handfield & Lawson, (2007), p. 49

that a prior relationship between the buyer and supplier is of relevance for the timing of the integration. However, based on history it is shown that established relationships are an indicator of a successful project and thus also here the timing plays a role in projects with technical complexity and the collaboration should be extended in time, meaning as early as possible.[82] There are many different integration points along the new product development process. The stages of the process are described as independent and often overlapping stages where the idea is specified and evaluated for business goals and technical feasibility.

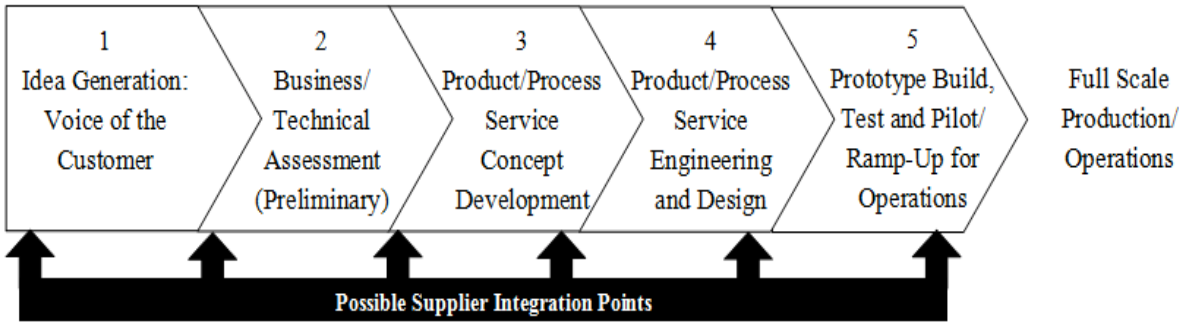

Figure 2: NPD process & integration points
Source: Handfield et al., (1999), p. 62

The first stage (idea generation) is meant for designers and marketers in order to find out the need for a product with help of customer ideas. Existing technologies are evaluated and new technologies of suppliers are assessed. The second stage a business assessment of the product is performed and technical solutions are identified. In the third and fourth stage, the product and process is developed with performance specifications, design and a preliminary prototype. The next stage is the beginning of the development process where suppliers and buyers create blueprints and a working prototype. That prototype can be tested in terms of existing production systems and quality. In case that the new product passes the tests, it enters full-scale production and the suppliers' volumes are ramped up. The earlier the supplier is included in the process, the better the impact in the quality of the product, cycle time and total cost.[83] Most suppliers are implemented in the first three stages. When the technology of the product that should be developed has a high rate of change, the supplier should be included later in the process. However, when the technical expertise of the supplier is high for the certain product, the implementation should be done as early in the process as possible. In terms of timing, the type of the supplier has an

[82] See Parker et al. (2008), p. 74
[83] See Handfield et al. (1999), p. 62-63

influence on implementation at early stages. Suppliers with critical technologies that are not standard commodities are likely to be involved early in the process. Here, there is a need of face-to-face discussions between engineers on a regular basis. Suppliers with non-critical technologies for standard commodities are likely not to be integrated until the final stages of the project.[84]

Earlier Integration	**Later Integration**
Suppliers of complex items	Suppliers of single items
Suppliers of (sub)systems	Suppliers of single components
Suppliers of critical items or technologies	Suppliers of less critical items or technologies
Strategic alliance suppliers	Non-allied suppliers
"Black-box" suppliers	"White-box" suppliers

Table 1: NPD process & integration points

Source: Handfield et al., (1999), p. 78

Evidence suggests that there is a significant relationship between the need of a new technology and the timing of supplier integration. If there is a need of new technology, supplier involvement in NPD is to be made early in order be successful.[85] In their study Watsi and Liker (1999) agree with the overall points and state that the degree of technological uncertainty and the expertise or technical capability of a supplier are predicting points of the timing and the degree of supplier inclusion in a NPD project. After all, there is no "best" timing to integrate suppliers into the NPD project. The type of the project and the product itself has to be evaluated and with reference to that the stage of supplier integration agreed on to achieve good results and team effectiveness.[86]

[84] See Handfield et al. (1999), p. 77
[85] See Parker et al. (2008), p. 79
[86] See Watsi and Liker (1999), p.

2.4 Internal organisation of including a new supplier into new product development activities

2.4.1 Purchasing function involvement in the new product development process

The early integration of a supplier into a firms' NPD process has to be internally integrated and well coordinated. Cross-functional integration of different departments show a positive effect and is a success factor in a NPD process. Historically it is shown that there needs to be effective cooperation between the marketing, sales and the R&D department in order to achieve positive results.[87] On the other hand side research has shown that the involvement of the purchasing department into the process increases the NPD performance and the success of the project.[88] Hence it is important, when establish an internal process and internal organisation of such a project, that the purchasing department is a significant part in cross-functional integration. Despite that importance there has been only little research about the involvement of the purchasing department in NPD or the performance of the purchasing department. However, nowadays it is clear that it is becoming a relevant strategic issue and managerial practice.[89]

When it comes to the NPD process there are two main approaches to distinguish, namely the traditional approach called sequential engineering and an alternative approach called concurrent engineering. In the traditional approach the purchasing department takes the first action after the product was designed and developed with finding materials and parts for the new product. The main task here is searching only for quality or price.[90] In that approach each and every activity of the process is done in isolation and the next step only starts when the previous one is completely done. With sequential engineering there is little communication and the flow of information is only in one direction. That means mistakes and potential problems are mostly detected at the end of the process, which is a huge and costly disadvantage also in terms of quality and time.[91] The alternative approach, namely concurrent engineering, is a process where the activities overlap, cross-functional collaboration takes place and all involved parties collaborate from the beginning of the development process. The goal of that approach is to improve the performance of the NPD process by avoiding the known and above-mentioned issues from the traditional

[87] See Ernst et al. (2010), p. 89
[88] See Johnsen (2009), p. 193
[89] See Spina et al. (2013), p. 1210
[90] See Die Benedetto et al. (2003), p.45
[91] See Valle & Vázquez-Bustelo (2009), p.137-138

approach.[92] Hence, based on research and the aim of concurrent engineering it is fair to conclude that is can be linked with success of certain NPD projects. One main point is, that all parties like the purchasing department can express their demands and worries throughout the entire project, so that issues can be detected along the way. Despite the obvious benefits of concurrent engineering for NPD activities in comparison to the traditional approach, a distinction has to be made between radical or discontinuous and incremental or continuous innovations. Research has shown that for a stable environment with continuous innovations, adapting concurrent engineering obtains positive results as time reduction in the NPD process and higher product quality. However, the discontinuous innovations on the other hand side did not show positive effects with that approach due to limitations when it is applied under uncertainty, which is most of the time the case with radical innovations. Limitations include that under the circumstances of a radical innovation and concurrent engineering, it is hard to control changes in the environment. Additionally, communication issues can occur with many persons from different departments with a consequence of time lost, rework and an overall ineffective process. The time to market is higher and thus the positive effect of lower development cost is surpassed. In general that means it is often risky for companies to use the concurrent engineering approach for radical innovations. Here, firms should not forget about the traditional sequential engineering approach, in order to reach a successful project result.[93]

The purchasing department in general performs various activities in NPD projects. There are several factors that control the involvement of the purchasing department in these activities and define problems and successes in NPD. The factors can be divided into two categories, namely factors that drive the need for purchasing involvement (driving factors) and factors that affect the ability of purchasing involvement (enabling factors).[94] The problems that arise are a sign that the company is not aware of the fact that it needs purchasing involvement in NPD or it is not able to achieve it. The problems might be explained by the driving and enabling factors. Concerning factors that drive the need for purchasing involvement, an exploratory case study identified four factors, namely company size, production type or technology, the overall reliance on suppliers and the

[92] See Valle & Vázquez-Bustelo (2009), p.136
[93] See Valle & Vázquez-Bustelo (2009), p. 145
[94] See Wynstra et at. (2000), p. 130

importance of product development.[95] The *company size* is measured in number of employees and acts as an indicator of organisational complexity. The larger the company, the more important purchasing and supplier involvement becomes. When the organisation is more complex, communication is harder to coordinate and establishing communication guidelines becomes a significant part of successful projects. As for the next factor *production type* or *technology*, products with a high degree of complexity and multiple parts, there is a fair chance that multiple suppliers are involved. The purchasing departments should act as coordinator of development activities between the firm and the suppliers. The *dependence on suppliers* as the next factor is measured by purchasing share in turnover. The more dependent a company is on its suppliers for producing its final product the more dependent it is on its suppliers. The last driving factor is the *importance of product development* in a firm. Here it can be said that if a company has high R&D expenditure, product development is seen as important. The higher the importance of product development the more important is purchasing involvement in the process.[96] Additionally, there are three enabling factors, namely that the internal organisation supports the process of NPD, relevant information of the NPD process are supported by technology and quality of personnel with the right skill set and qualifications.[97] As for the first factor, the organisation of the purchasing department and the organisation of the product development team needs to be distinguished. For the purchasing department the degree of specialisation in the department, meaning the knowledge a purchaser has about suppliers and specific products and the purchaser and engineer should be specialised accordingly, in order to avoid miscommunication. The horizontal complexity of the purchasing department is of importance in terms of the separation of operational purchasing activities and initial product development task because it increases the ability of the department to perform the corresponding tasks. The product development teams need to have a project manager that controls all the activities. Also, the physical location of the teams is important because for the complex communication of the teams it is significant to be physical close to achieve optimal results. As for the second factor it is important to mention that often times product development is a complex and highly information-intensive process. Communication is key and information need to be accessible in time to those that need it, meaning supplier, purchasing and to the engineer.

[95] See Wynstra et al. (2000), p. 130 - 131
[96] See Wynstra et al. (2000), p.131
[97] See Wynstra et al. (2000), p. 132

In order to achieve this, companies need effective technical tools to ensure mutual communication. Popular tools here include a preferred supplier list with information about technical capabilities to support decisions about suppliers, as well as information about availability and costs. Purchasing involvement here takes over the task of information sharing and the availability of up-to-date information. The third enabling factor human resources deals with the set of skills of the responsible employees. Prior research in that area has focused on the attributes of the buying staff when it comes to the enabling factors for purchasing involvement. It is assumed that it makes a larger difference than the skills of development engineers or other staff members in the organisation. The first attribute is *previous experience* of the purchaser within the firm, mainly in a technical function to understand how it is the best way to contribute to product development. Furthermore, the *level of education* of the purchaser seems to be important because purchasing managers with a university degree are more likely to be involved in product development than others. In addition to that, *pro-activeness* of purchasers is found to be important. Purchasers that are willing to participate also in uncertain processes are more likely to be included in new product development tasks. The most important aspect however is, that the purchaser is perceived as competent by others in the organisation. As leader and coordinator of the project, the purchaser needs to have a certain reputation within the company.[98]

Purchasing involvement in an organisation needs to be managed and empirical findings suggest that there are four different management areas to be distinguished. The first area is *development management* where buyers and development engineers discuss design and monitor the progress of a supplier in developing parts for the new product. The second area is *supplier interface management* where purchasing managers and R&D specialists meet on a regular basis with important suppliers to evaluate current projects and discuss potential developments with new technologies. The third area is the *project management* where the purchasing directors establish product development guidelines for their departments. The last area is the *product management* where the general management of the firm considers if research and development activities of a specific technology should be outsourced to a supplier.[99] Wynstra (1999) developed a framework with the four areas on the basis of exploratory case studies. The four areas are complementary to each other and

[98] See Wynstra et al. (2000), p. 132 - 133
[99] See Wynstra et al. (1999), p. 133

may overlap in practice when dealing with a supplier.[100] The following table displays the specific activities for each of the distinguished areas.

Areas	Activity
Development Management	Determining which technologies to keep/develop in-house and which ones to outsource to suppliers
	Formulating policies for the involvement of suppliers
	Formulating policies for purchasing related activities of internal departments
	Communicating policies and procedures internally and externally
Supplier Interface Management	Monitoring supplier markets for technological developments
	Pre-selecting suppliers for product development collaboration
	Motivating supplier to build-up/maintain specific knowledge or develop certain products
	Exploiting the technological capabilities of suppliers
	Evaluating suppliers' development performance
Project Management	*Planning:*
	Determining specific develop-or-buy solutions
	Selecting suppliers for involvement in the development project
	Determining the extent ("workload") of supplier involvement
	Determining the moment of supplier involvement
	Execution:
	Coordinating development activities between suppliers and manufacturer
	Coordinating development activities between different first tier suppliers
	Coordinating development activities between first tier suppliers and second tier suppliers
	Ordering and chasing prototypes
Product Management	*Extending activities:*
	Providing information on new products and technologies being developed or already available in supplier markets
	Suggesting alternative suppliers, product and technologies that can result in a higher quality of the final product

[100] See Wynstra et al. (1999), p. 134

	Restrictive activities:
	Evaluating product design in terms of part availability, manufacturability, lead-time, quality and costs
	Promoting standardisation and simplification of designs and parts

Table 2: Activities for the distinguished management areas

Source: Wynstra et al. (1999), p. 134

Next to the management areas and different activities for the purchasing department, Lakemond et al. (2001) developed a configuration typology for involving purchasing specialists into product development of firms. There are six different configurations:

A. "Engineers contact purchasing specialists external to the project team on an ad hoc basis.
B. Purchasing specialists are integrated into the project team on a part-time basis and work closely with an engineer regarding specific parts/materials/technologies.
C. Purchasing specialists are integrated into the project team on a full-time basis (dedicated) and work closely with engineers regarding specific parts/materials/technologies.
D. A purchasing coordinator is added to the project team and takes care of coordinating purchasers external to the project team.
E. A purchasing coordinator is added to the project team and in combination with purchasing specialists integrated in the project team on a part-time basis.
F. A purchasing coordinator is added to the project team and in combination with purchasing specialists integrated in the project team on a full-time basis."[101]

The configurations A, B and C tend to have more in-depth and dedicated project involvement of purchasing staff (not coordinator) because they are able to focus on that specific project. However, it is more likely to have full-time integration if the degree of collaboration in product development is high. Moreover, the configurations D, E and F stand for a higher degree of coordination and that is needed when a project is more complex, meaning many different components, suppliers and technologies.[102] In order to determine which of the six configurations is the right one for the current situation of the firm, two factors are introduced that helps companies with the decision, namely project

[101] See Lakemond et al., (2001), p. 12-13
[102] See Lakemond et al., (2001), p. 13

size and project complexity. If the project size is large it is likely that there is a more permanent integration of purchasing specialists. If there is a high project complexity it means that there is a need of coordination of the large number of different independent parts to be developed.[103]

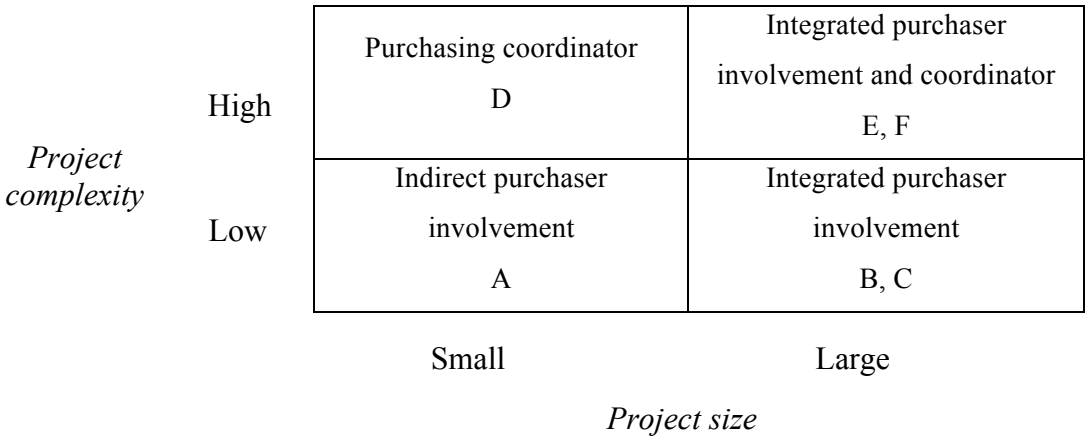

Figure 3: Purchasing involvement configuration for different contingencies
Source: Lakemond et al. (2001), p. 19

The integration of the purchasing department in product development often times distinguishes advanced organisations from less advanced ones and shows a certain level of professionalism.[104] Despite the overall agreement in scholars that integration is one of the key success factors, companies still find it difficult to understand and execute it on a strategic and managerial level.[105] As Schiele (2010) mentioned as a benefit is that the dual role of the purchasing department in the NPD process results in a support of the process of innovation and the protection of cost over the entire product life cycle.[106] To conclude, it can be said that it is highly beneficial to include the purchasing department into NPD activities. However, one needs to be aware of the circumstances the company is in, the challenges the company faces as well as the different ways and opportunities of purchasing integration.

[103] See Lakemond et al. (2001), p. 18 - 19
[104] See Cousins et al. (2006), p. 794
[105] See Ellegaard & Koch, (2012), p. 1
[106] See Schiele (2010), p. 149

2.4.2 Set-up of cross-functional teams in the NPD process

As noted before it is important for the NPD process that is does not happen in isolation of a certain department. Cross-functional integration is the establishment of different mechanisms to enable coordination of activities and task between different departments and functions in a firm and to ensure the achievement of overall business goals.[107] Cross-functional integration is a clear success factor in NPD because the effective usage of all resources is an important factor and achieved through the integration of multidisciplinary teams.[108] It is argued that cross-functional integration has a positive impact on operational performance, thus business performance of a company. Hereby, six dimensions are identified that lead to improved performance of the firm. Manufacturing costs are significantly determined in the product development phase and with effective information sharing it has a positive impact. Next, the conformance quality, the extent to which a product meets its design specifications, is impacted because product development profits from knowledge in market requirements and manufacturing capability. Integration between operations and marketing/sales impacts the design and volume flexibility because issues can be addressed on a regular basis. Finally, if R&D is involved and collaborates with other disciplines the development lead times and product innovativeness is impacted positively because marketing boost creative ideas and operations eliminates issues in time.[109] One important part when setting up cross-functional teams is that the basic characteristic of functional diversity is ensured. That means the teams contain employees from the same hierarchical level but from different disciplines, as purchasing, R&D, marketing/sales, finance, operation, within or between organisations.[110] It is intra-organisational integration when different department in an organisation collaborate and coordinate their activities together to achieve faster and more accurate information transfer across the boundaries of the departments.[111] On the other hand when collaboration between different organisations take place it is called inter-organisational integration. That integration is more strategic and can lead to a competitive advantage of all involved parties.[112] Here, the teams build external networks and communicate externally to share

[107] See Joshi (1998), p. 22
[108] See Kahn (2001), p. 320
[109] See Turkulainen et al., (2012), p. 453 - 454
[110] See Driedonks et al., (2014), p. 289
[111] See Joshi (1998), p. 22
[112] See Joshi (1998), p. 24

knowledge, engage in innovative possibilities and get valuable new information.[113] There is an important aspect to be considered in a cross-functional team namely the effective communication. A leader of the team can undertake the task of being the communicator of the team. In order to be effective the leader should participate all the time and empower and engage all team members to make decisions. This is important so that everyone has the freedom to have and challenge ideas and new technologies. The leader is also responsible to share the outcomes in the organisation so that all parties are properly informed.[114] The team members need to have common goals despite different interests of the various departments or organisations because that promotes a higher level of cross-functional cooperation.[115] If the team dynamic creates an atmosphere that members have a common goal, thus good cooperation, that most likely means that each and every member developed a sense of commitment and is willing to work hard for the team to achieve its goals.[116] However, it is a big challenge for companies to have cross-functional teams because mostly the goals are different, which can lead to negative team dynamic and issues in communication. While setting up teams, firms need to be aware of the fact that creating common goals is necessary.[117] Another important challenge that needs to be controlled is the time allocation diversity. Usually cross-functional teams work on more than one project at a time. That means it might be the case that some dedicate almost all their time to the project and others just a small part. That can lead to issues and fights between the project members, hence it is poison for the team dynamic and effectiveness. Additionally, multiple reporting relationships need to be avoided as well. It is often seen that in cross-functional teams, members experience a conflict caused by reporting relationships to their functional managers and to the leader of the team. Relating issues here can be appraisal, pay raises, expectations and excessive demands.[118] The next challenge is on a more strategic and organisational level. Same as for early supplier involvement, senior management needs to support cross-functional integration. Though it might be the case that the senior management is reluctant to do that because that would mean to delegate responsibility and empower project leaders.[119] When the senior management is on board the organisational setup has to be in line as well, meaning implement a structure with

[113] See Edmondson et al. (2009), p. 126
[114] See McDonough (2000), p. 225
[115] See McDonough (2000), p.223
[116] See Mc Donough (2000), p. 226
[117] See Webber (2002), p. 202
[118] See Webber (2002), p. 203 - 204
[119] See Clark et al. (1992), p.14

sufficient resources for the teams in order to be successful.[120] Human resource practices become important when it comes to supporting cross-functional integration. Traditionally, financial incentives are offered for individual performance. That can be helpful but can also create a competitive climate within the team without any collaboration. In terms of innovation acceleration within the team, HR practices as training and development of the employees instead of financial benefits gives the members the right skill set and motivation and leads to greater innovativeness.[121] Generally, cross-functional collaboration has a positive impact on NPD success[122] and firms are advised to adjust internal procedures accordingly. According to de Visser et al. (2010) the degree of innovativeness and the functional structure play a role in the success of a NPD project. It is argued that for breakthrough innovations, firms with cross-functional teams reach substantially better results compared to the functional structure. Contrary to the above-mentioned benefits of cross-functional teams, for incremental NPD processes, the functional structure seems to achieve better results.[123] Nonetheless, the implementation of a cross-functional team has to be considered when a firm plans a product development process.

[120] See Edmondson (2000), p. 130
[121] See Stock et al. (2014), p. 935
[122] See Kahn (1996), p. 144
[123] See de Visser et al. (2010), p. 295

2.5 Development of a working buyer-supplier relationship

2.5.1 The preferred customer concept, customer attractiveness & supplier satisfaction

The development of a working buyer-supplier relationship becomes important nowadays. Supplier scarcity brings a challenge to buying organisations as world-class suppliers in the field are being poached by potential clients and existing clients who want to increase business with them.[124] Especially, in terms of NPD a good buyer-supplier relationship becomes an important antecedent to achieve better innovation performance.[125] However, in order to increase the innovative performance, the buyer and the supplier have to be willing to put effort in and invest in their relationship and the potential collaboration.[126] It is due to the reason that without having suppliers involved in the innovation process, the potential contributions to innovations are limited.[127] As a result of that buyers seek partners in the limited pool of suitable and highly skilled suppliers. Due to the scarcity of suppliers a preferred treatment by the suppliers is a long-term goal of many buyers that are eager to be an innovative company. There are three constructs that determine if a buyer is awarded privileged treatment, namely customer attractiveness, supplier satisfaction and preferred customer status.[128] Customer attractiveness leads to supplier satisfaction and that may lead to the preferred customer status.[129]

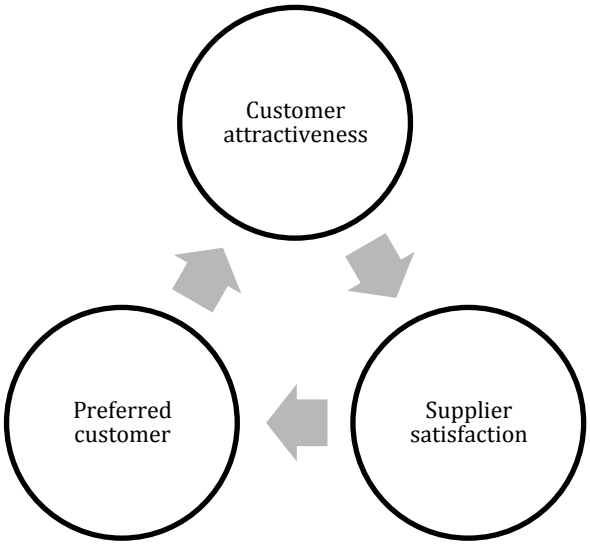

Figure 4: The cycle of preferred customership

Source: Schiele et al., (2012), p. 1180

[124] See Nollet et al. (2012), p. 1186
[125] See Pulles et al. (2014), p.415
[126] See Pulles et al. (2014), p. 412
[127] See Schiele (2006), p. 928
[128] See Schiele et al. (2012), p. 1183
[129] See Schiele et al. (2012), p. 1180

Customer attractiveness here is different from the classical marketing literature, where attractiveness refers to the customer. Here on the other hand side, the attractiveness of a customer towards the supplier in meant and necessary for a supplier to extent a collaborative relationship. Customer attractiveness refers to a positive image of a customer from a supplier's point of view.[130] Factors that make a customer attractive to a supplier are market factors such as size, growth rate and influence in the market. In addition to that the competitive position in the market appears to be important, so suppliers are aware that they are smart and able to compete in the market. Also, the financial and economical situation of a customer is of concern as a sign of being 'healthy'. Furthermore, in combination with new product development, the technological factors as technical skills; patents and copyrights are interesting for suppliers.[131] It is concluded that the principle is based on the social exchange theory (SET) in combination with economics. It implies that suppliers are likely to increase their collaboration with customers that best create value with e.g. increasing rewards and decreasing costs, in combination with serving customers.[132] Following on that, it can be argued that customer attractiveness is based on the view, the supplier has of the customer at the point where the supplier intents to extents the relationship.[133] If the buyer recognises that significance of customer attractiveness too late, one may face the problem that all key suppliers in the industry have already selected a customer that gets special treatment and established close ties to them. In open innovation environments, it is most likely not possible anymore to follow an innovative leadership strategy.[134]

Supplier satisfaction determines the quality of a buyer-supplier relationship in terms of value creation. For partnering efforts buyers should take the satisfaction of suppliers into account because in order to successfully cooperate an honest and whole-hearted support of the supplier is needed.[135] Benton and Maloni (2005) empirically test supplier satisfaction benefits for the buyer and the entire supply chain by improved supplier satisfaction with a relationship driven supply chain strategy.[136] Thus, it is important for buyers to be attractive to suppliers because in oligopolistic and industrial markets they become selective and can

[130] See Hüttinger et al. (2012), p. 1194 -1195
[131] See Hüttinger et al. (2012), p. 1196
[132] See Emerson (1976), p. 350; Hüttinger et al. (2012), p. 1203
[133] See Schiele et al. (2012), p. 1180
[134] See Schiele et al. (2011), p. 18
[135] See Wong (2000), p. 427
[136] See Benton & Maloni (2005), p. 18 - 19

choose customers they want to collaborate with.[137] Firms are just links in a supply chain that delivers value to the end customer. The supply chain is just as strong as their weakest link, meaning without a satisfied supplier, a manufacturer cannot be responsive.[138] However, it appears that supplier satisfaction is not driven by performance but rather by the nature of the buyer-supplier relationship.[139] Important definition of supplier satisfaction is the feeling of equality no matter what power imbalances exist.[140] Essig and Amann (2009) developed a construct with three dimensions of supplier satisfaction as a factor of the quality of a buyer-supplier relationship:

The *first dimension* refers to the strategic level of a buyer-supplier relationship and indicates the intensity of cooperation. Indicators are e.g. willingness to accept suggestions for improvement, intensity of integration and strategic value.

The *second dimension* refers to the operational level and contains indicators of the order process. Indicators are e.g. order process, ordering procedure, billing/delivery and bargaining position.

The *third dimension* is the accompanying level. Here communication (with the indicators politeness, technical/business competence, availability), conflict management (with the indicators quality of reaction and reaction speed) and general view (with the indicators intensity of cooperation, order process and conflict management) are variables that highly influence the buyer-supplier relationship and the supplier satisfaction.[141]

Walter et al., (2003) identifies direct and indirect functions of a relationship with a supplier. The direct functions are: cost reduction, quality, volume and safeguard. A major part of the direct function is achieving cost reduction without making compromises on quality, which is a significant point due to the increasing trend towards outsourcing. The price deduction function is fulfilled when the buyer-supplier relationship provides lower prices. In addition to that, buyers can order higher volumes by reducing the number of suppliers. The indirect functions are: market, scout, innovation development and social

[137] See Schiele et al. (2012), p. 1178 & 1180
[138] See Benton & Maloni (2005), p. 2
[139] See Benton & Maloni (2005), p. 15
[140] See Benton & Maloni (2005), p. 5
[141] See Essig & Amann (2009), p. 105 – 106 & 109; Hüttinger et al. (2012), p. 1200

support. These are long-term functions and especially important for NPD and the early integration with all of the benefits and obligations.[142] The indirect functions are about passing on innovative ideas, social interactions between humans with opportunities to bond and as partners help each other on the market.[143]

To close the cycle, buyers can achieve *preferred customer status* if customer attractiveness and supplier satisfaction is accomplished. That means the buying firm gets a better treatment on all levels than other customers of a particular supplier.[144] There is indeed evidence that suppliers make a difference between their customers and this affects the performance level a customer receives from a particular supplier. Even research on an international and cultural level show gaps, cross-cultural studies suggest it might be easier for firms to become a preferred customer for domestic suppliers instead of international ones. The reason for that may be that suppliers evaluate domestic customers more favourably.[145] Steinle and Schiele (2008) agree with that and conclude that a buyer that is active in the same cluster as the seller has a higher probability of achieving and/or maintaining a preferred customer status with a supplier in comparison to those foreign suppliers who enter the cluster.[146] Only a small group will get special treatment and are awarded with a preferred customer status by a top-tier supplier. Suppliers give the privileged allocation of resources to those who are able to assist with development activities and help to be more competitive in the market. Key selection characteristics include a possible increase in volume, the capacity to develop supplier's image and the know how to create positive network effects.[147]

Nollet et al. (2012) identified a process on what steps a successful preferred customer status is achieved over time and complements the approaches from the main body of the research in the field. The first step is the *"initial attraction"* which happens when a supplier pays attention to a purchaser and goes along with the customer attractiveness point. Step two is *"performance"* of the customer. To become a preferred customer; the buyer needs to understand a suppliers' expectations and perform accordingly. That step

[142] See Walter et al. (2003), p. 160 - 161
[143] See Walter et al. (2003), p. 162
[144] See Nollet et al. (2012), p. 1186
[145] See Schiele et al. (2012), p. 1183
[146] See Steinle & Schiele (2008), p. 5
[147] See Nollet et al. (2012), p. 1187

goes along with supplier satisfaction.[148] The third step in *"engagement"* of the customer. With engagement it is meant that the customer is able to standardise and simplify supply chain practices, find creative solutions for problems and perform on a high level. In order for a supplier to even think about an extensive collaboration, they need to see their own advantages rapidly. The last step *"sustainability"* is a rough point for the customer because firms cannot rest when they achieve a preferred customer status. In order to maintain the status they need to perform activities as joint research, staff exchange, common projects and create value for the supplier.[149]

The following table shows advantages to be a preferred customer from a supplier that awarded you preferential treatment.

Source of value for the buyer	**Suppliers contribution**
Product quality and innovation	Customise product according to customers wishes
	Deliver consistent quality levels
	Suggest or/and initiate quality improvements and innovations for the product required by the customer
	Increased technological capability applied to product sold by the customer
Support	Provide information about the markets and new solution on a timely manner
	Accept to perform steps that are not part of the customers core business
	Be available and responsive
Delivery reliability	Give priority to the customer when overall demand exceeds supply
	Adjust changes in delivery schedules due to peaks in demand or changes in delivery requested
	Take particular care for the order delivered to that customer

[148] See Nollet et al. (2012), p. 1189 - 1190
[149] See Nollet et al. (2012), p. 1190 - 1191

	Be ready to deliver missing components within reasonable time
	Keep safety stocks or locate warehouses close to the customers facilities
Price	Offer one of the lowest prices on the market
	Be more receptive to further price negotiations with the customer
	Contribute to the reduction of the costs incurred to the customer (acquisition & operational costs)

Table 3: Advantages of being a preferred customer

Source: Nollet et al. (2012), p. 1187

Further collaborating on the advantage on the price aspect, research has shown that there is no negative association between the suppler capability and the suppliers benevolent pricing. That is also the fact when preferred customers are in a lock-in situation and are highly dependent on the suppliers' parts. Even in that case, suppliers do not show opportunistic pricing behaviour. That behaviour may be explained by the social exchange theory and suppliers strive for long-term goals and assume that the long-term return is higher. In addition to that, more capable and more innovative suppliers also did not show opportunistic pricing behaviour. Suppliers are not prone to increase the prices because in industrial markets the cost of price adjustments in general is relatively high for the seller. A price adjustment for a selling company means a lot of effort and time in terms of preparation and intensive negotiation.[150] Schiele et al. (2011) clearly shows that when a buying firm becomes the preferred customer of a supplier it benefits the innovation of the buyer and supplier. When there is close collaboration and a long-term partnership with a leading and top-tier supplier, preferred customers have a high chance to gain access to their innovation resources.[151]

Despite the many advantages there are a few challenges and pitfalls that need to be mentioned. A negative effect of the preferred customer concept is that the whole supply chain can become vulnerable because of the concentration of the supplier base. Firms loose

[150] See Schiele et al. (2011), p. 15 - 16
[151] See Schiele et al. (2011), p. 8

the ability to switch to other suppliers in disruptive situations.[152] Also the dependency on one supplier can have the disadvantage that the buyer has the fear of being overpriced as soon as the close collaboration is established.[153] To overcome that fear, a certain trust and commitment, as well as equal power can be a solution of the good, working and successful buyer-supplier relationship.

2.5.2 Trust and power as a determinant of a buyer-supplier relationship

In Supply Chain Management literature, power and trust are often seen as the two main strategies, used by buying firms when it comes to influencing the suppliers.[154] Power can be separated in mediated power and non-mediated power. Mediated power consist of coercive power, which is the ability to punish the partner in case of failing, and reward power, which is the ability to give the partner a reward is case of positive activity.[155] Non-mediated power is not intentional and occurs as normal buyer-supplier business transactions and it is not used to manipulate the target. Mediated power on the other hand wants to trigger a particular response.[156] Research has shown that coercive power shows no sign that suppliers allocate their resources to a partner who threatens to reduce business volume if a partner does not act accordingly. In contrast, reward power shows that suppliers are willing to relocate physical and innovation resources towards the direction of the buyer.[157] Consequently, in terms of collaboration in new product development, the more useful strategy goes with reward power if firms are able to.

For a working buyer-supplier relationship the factor of trust is highly important and influences many decisions that are being made, in relation to that business-to-business relationship. Trust reduces the decision-making uncertainty in a purchase decision and thus the willingness to enter a long-term relationship with the potential collaborative party.[158] Trust separates between goodwill trust and competence trust. Goodwill trust means the degree of trust from a partner to the other party with executing activities that exceed the contractual agreements without asking for that special help. On the other hand competence

[152] See Wagner & Bode (2006), p. 306
[153] See Schiele et al. (2011), p. 3
[154] See Terpend & Ashenbaum (2012), p. 60
[155] See Pulles et al. (2014b), p. 19
[156] See Benton & Maloni (2005), p. 4
[157] See Pulles et al. (2014b), p. 30
[158] Gao et al. (2005), p. 402

trust means the expectation of one partner to the other in terms of technical competence or expertise.[159] Goodwill trust does not have a significant effect on a suppliers' resource allocation towards a buyer. However, when the buyer is responsible for a large share of the suppliers' turnover, goodwill trust has a positive influence on the willingness of the supplier to relocate physical and innovation resources. Competence trust has the same positive effect on the willingness of the supplier to relocate physical and innovation resources despite the share of the turnover.[160]

[159] See Pulles et al. (2014b), p. 19
[160] See Pulles et al. (2014b), p. 30

3. Research Methodology: explorative qualitative research with semi-structured interviews

3.1 Type of explorative research method to gain new insights: Steps of the research

This paragraph shows how the central research question and the sub-questions will be answered. It is meant to guide the reader along the way and displays each step of the research (see Figure 5).

The first step of the research was the *problem identification and definition*. The general problem needs to be discussed with mentioning the situation and complication of the topic and how is the problem related to the real world of business. It shows that the problem is worth to be researched and the research question with sub-questions are stated as well as the research goal is discussed.

Secondly, the *development of the theoretical framework* on early supplier involvement in NPD was elaborated. This was done by a literature review using Scopus, Web of Science and Google Scholar. In addition to that SCM, purchasing, production and logistic journals were checked for recent publications regarding that topic.

In the next step, the *methodology* is defined with the aim to guide the research from the beginning and let the reader know what type of research is done. It shows a connection between the research question and the goal of the research with displaying how the question is answered to reach the goal.

After the current situation and literature is explored, reviewed and a framework is developed *data* from manufacturer is *gathered*. With help of the current theory, interview questions are developed and conducted.

The last part is the *analysis of the results* of the interviews. The gathered data and the theoretical framework are used to answer the research question with its sub-questions.

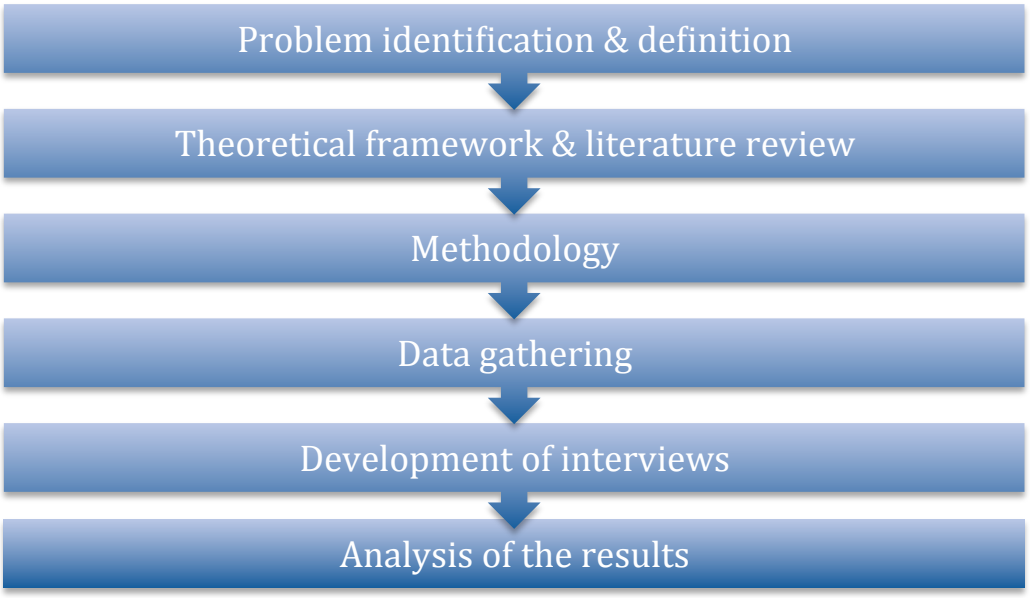

Figure 5: Steps of the research

Source: own elaboration

3.2 Methodology & Methods

3.2.1 Literature exploration from academic journals

The following section discusses the methodology method that is used to conduct the research. Frist of all, qualitative research, used here, will be introduced and reasons mentioning why it is applicable for this particular research. Second, the interviews used to gather data are described and the structure will be shown. At last it will be described how the data is analysed and a structure of the report is shown.

This research is based on the deductive research method, informally known as "top-down" approach. That means a general and established theory is used and tested to see if it can be generalised and applied to more specific situations.[161] Spens and Kovács (2005) display the deductive method as starting with prior theoretical knowledge and scanning the theory. That leads to a theoretical framework from which research questions are derived ex ante and can be tested or applied empirically to confirm the theory. The deductive research method is the predominant method in logistic research.[162]

In this case there is a good theoretical framework needed in order to answer the research questions. Theories are needed to detect company's opportunities and threats when it

[161] See Hyde (2000), p. 83

[162] See Spens and Kovács (2005), p. 376.

comes to that topic. The key words that are repeatedly used and theories that are relevant to this research are the following:

- New product development
- Early supplier involvement
- Collaboration with suppliers
- Buyer-supplier relationships
- Open Innovation
- Preferred customer status

The above-mentioned phrases are parts of theories that were explained in the previous chapter of this report of the research. The literature that is used shows the supplier and the buyer side of a possible collaboration. All literature used is published in leading SCM, logistics, purchasing journals or similar relevant journals.

3.2.2 Application of qualitative research

In order to test the theory and answer the research questions empirically, a qualitative research is conducted. The reasons why a qualitative approach is chosen here, start with that the research is of explorative nature. First, this study intends to explore problems firms are facing with new product development and engaging at the same time in collaboration with their suppliers. Second, the problem in general is complex and a qualitative method can divide it into more manageable parts to lower the complexity. Third, it helps to understand the context of how early supplier involvement is applied in practice and if it is confirmed with the theoretical framework. Fourth, it explains the relation of buyer-supplier relationships and how it needs to function with the answer of a research question. Fifth, the problem here is how it is applicable and realisable for firms. Observing firms with qualitative research methods helps to detect problems and conclude possible solutions[163]. According to Miles and Hubermann (1994) qualitative research can provide meaningful findings that can be translated to this research. For example, with conducting semi-structured interviews in certain firms to empirically test the theory. Furthermore they propose that one gets a holistic view of the context while using that approach.[164] That is

[163] See Miles & Hubermann (1994), p. 429 - 430
[164] See Miles & Hubermann (1994), p. 429

exactly what is needed to answer the research question and support firms that are willing to engage in an early collaboration with their suppliers in the field of NPD. However, one must be careful with conducting the interviews because in addition to expert knowledge the interviewer can get opinions and one needs to distinct it. Nonetheless, semi-structured interviews are used so there is still the opportunity to change certain wording or questions' depending on the company the interview is conducted or the interviewee. The reason for that is to explore attitudes in sensitive areas of the interview.

3.2.3 Set up of expert interviews

The expert interviews are used to gain knowledge from companies and empirically test the theoretical framework. In order to answer the research questions, and questions derived from the theoretical framework. The interview questions (Appendix A) will be semi-structured. The reason for that is to get as much information as possible out of the interviews. As mentioned in the previous section attitudes for sensitive areas can be explored using the semi-structured method. Furthermore, the order of the questions can be changed when the interviews take an unprecedented direction, to gain as much additional information as possible. Additional questions can be included and inappropriate ones left out. The questions for the interviews will be developed as well from the theoretical framework. When developing the questions not only the theory, but also the research question and sub-questions played an important role, together with previous knowledge and expected outcomes. The research question and sub-questions are not asked in a certain sequence because in this case it is not demanded to answer them in a certain order. It rather gets the interviewer most likely more information if the expert starts talking about a certain topic where he or she is passionate about.[165]

The interviews are used as a source of primary data about their own practices and real-life applications as well as behaviours. In addition background information of experts is gathered. The sampling is based on judgment, so manufacturing companies with certain experts are chosen.

The interviews take place at the companies' location in a quiet room to ensure that the interviewee feels comfortable in his or her common environment. It will be a face-to-face setting where the interviewee can speak freely without interruptions. In case of long-

[165] See Sauro (2015), para. 5.

distances, electronic devices such as telephone or computer will be used to communicate. Before the start of the interview the topic will be explained briefly as well as the purpose of the interview. In addition, it will be stated that confidentiality is guaranteed. Interviewees will be asked if they agree that the conversation is recorded, otherwise taking notes will be the focus. They will be asked if names can be used in the final report. A protocol will be stated in the beginning containing introduction, ground rules, questions and next steps.

The interviews are as consistent as possible for semi-structured interviews with the clear goal of answering the research question. The interviewer will ask the questions form a neutral standpoint with no right and wrong answers to ensure research exploration.
The data of the interviews is analysed and compared with the theory. Hereby, it is very important to keep in mind that the expert interviews can contain opinions and attitudes. Based on the interviews and the theory, the central research question and the sub-questions will be answered.

3.2.4 Conceptualisation and operationalization

Conceptualisation is the process that makes notions or concepts that are fuzzy more specific and precise, in other words it specifies the terms that are used in the research.[166] The following table specifies the concepts found in the literature and that are used in the interviews to gather data. There are four topics to be highlighted from the literature in order to create a framework for the development of the interview questions (to be found in Appendix A). The framework consists of the following topics: NPD, challenges & benefits of supplier inclusion, internal organisation and the buyer-supplier relationship.

Concept	Characterisation
New product development	The creation of a completely new product or the adjustment of an existing product. The development of a new product creates value for customers, it identifies new market opportunities and capitalises it.[167]
Supplier integration	Supplier integration is the contribution of the supplier's capabilities, expertise and resources in new product development of the buying company.[168]

[166] See Babbie (2013), p. 118
[167] See Krishnan and Ulrich (2001), p. 15
[168] See van Echelt et al., (2008), p. 182

Open innovation	"Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology."[169]
Purchasing function/department	The function within an organisation that is responsible for buying goods or services and all activities connected to that and to ensure a flawless process.
Cross-functional collaboration	Cross-functional collaboration is the establishment of different mechanisms to enable coordination of activities and task between different departments and functions in a firm and to ensure the achievement of overall business goals.[170]
Buyer-supplier relationship	The relationship between a buying organisation and a supplier that exceeds normal buying and selling activities. Companies that have a good relationship seek a long-term partnership.

Table 4: Conceptualisation of constructs from the theoretical framework

Source: own elaboration

Operationalization on the other hand side is the development of certain and very specific procedures that help during the actual research. The operations and procedures result in empirical observations that connect concepts from the real world and concepts from the literature.[171] This study is of explorative nature, using the semi-structured interview approach where respondents were asked to answer freely with no standardised answer choices. The respondents were encouraged to answer the questions in the way they wanted to and discuss their views in the way they think it is important. However, a catalogue of questions from the literature was developed (to be found in Appendix A) in order to guide the interview. The questions were not asked in a specific way, but rather it was seen where the direction of the interview was going to, in order to ensure the flow of conversation and gain more valuable insights.

[169] See Chesbrough (2003), p. xxiv
[170] See Joshi (1998), p. 22
[171] See Babbie (2013), p. 119

3.2.5 Data analysis

The conducted interviews from industry experts were recorded with an electronic device. With help of the recordings the interviews were transcribed. The transcripts can be found in the Appendix (Appendix C). The interviews were transcribed for later analysis and coded. Here, information of the transcripts are transformed into analysable data with the coding method by putting pieces of data into different categories and sub-categories. For interviews coding can be used to discover patterns in the data that lead to theoretical understandings in social research.[172] While coding, a dated codebook was used to ensure the consistent use of the different codes and make the information later on more assessable. A guideline for the coding process has been developed and shows the categories of the codes, the sub-categories of the codes and to what text passages it refers to. The coding guidelines can be found in Appendix B. The coding was done with help of the computer software 'atlas.ti' and was done to the point where no new insights of the data emerged.

3.2.6 Controllability, reliability and validity of the research

Controllability is the first requirement of research results and a prerequisite for the evaluation of validity and reliability. Researchers need to show how they have executed their study, how they have collected their data, how respondents were selected, what questions were asked, how the study was executed, how the data was analysed and how the conclusions were drawn in order to make their results controllable. If there is a detailed description of the study, others are able to replicate it and see whether their outcomes are the same.[173] In this study all of the above requirements for controlling the study are mentioned, thus this study can be replicated, also reliability and validity can be measured.

The results of the study are reliable when the characteristics are independent and other studies can replace it. There can be biases that might occur because of the researcher, the instrument, the respondents and the circumstances of the research.[174] In this study, the reliability was increased with two people coding the data from the four different interviews. Thus there was a higher reliability achieved. Furthermore, in order to achieve the reliability, the chosen respondents were from different fields, departments and hierarchy levels within the companies in order to gain insights from different perspectives

[172] See Babbie (2013), p. 409
[173] See van Aken et al. (2012), p. 203
[174] See van Aken et al. (2012), p. 207 - 208

until no new information appeared during the interviews.[175] A threat to reliability occurs despite a standardised questionnaire that was used for the interviews, because the researcher was able to influence the results with open questions. In this way the interviewee could be guided to the questions and respond in a way the interviewer wants. In addition to that, it might be possible that there are different experience levels between interviewer and interviewee and that might harm the results. Moreover, the interviews of the study were executed at one period in time, within one week, where the respondents were only interviewed once. Also that is a potential threat to the reliability and might decrease it.

The validity of the research reflects the real meaning of the concept. It is an empirical measurement instrument that measures whether we really measure what we say we measure.[176] There are three different types of validity, namely construct validity, internal validity and external validity. Construct validity refers to the degree inferences can be made from the operationalization and the quality of the theoretical construct.[177] In this study to ensure high construct validity, the theoretical construct covers the whole concept of early supplier involvement, new product development and the combination. Additionally, the interview questions were developed as a combination out of field experts and the literature. The study has a high internal validity because internal validity can be seen when there is an actual real world business problem to be found.[178] The research question faces a real world problem firms' face nowadays. Looking at suppliers and technical trends in industries and collaboration behaviour, it clearly shows that companies need to pay attention to that, which increases the internal validity. The study shows a high external validity when it shows a generalizability of the results. External validity is high when the conclusions that are drawn from the study can be used for other persons, places and times.[179] The external validity here increased with using a number of interviews with different staff members from different areas that can show their perspective from different angles. The research question here was not researched before in that setting as explorative research, thus there are certain risks included due to limited time and only focus on one companies' collaboration projects.

[175] See van Aken et al. (2012), p. 207 - 208
[176] See Babbie (2013), p. 334
[177] See van Aken et al. (2012), p. 209
[178] See van Aken et al. (2012), p. 210
[179] See van Aken et al. (2012), p. 210 - 211

3.3 Empirical findings: Results of the interviews of early supplier involvement in NPD

3.3.1 Case analysis: Staff members being interviewed

Purchasing Manager

For the first case analysis a purchasing manager was interviewed. The position of the manager is "Head of Purchasing – Running Gear" with a focus on coordinating different projects within the "Strategic Procurement" department. Here it was noted that in general the purchasing or R&D department make always first contact with the supplier that could be a potential partner. However, the most important part before collaboration talks is that the supplier has to sign a non-disclosure agreement (NDA). As for the NPD strategy, there is a long-term plan till 2025 where the firm wants to challenge the urbanisation. Due to that trend there is a need of alternative products. In the big picture, NPD becomes definitely more important in the next ten years. In the view of the purchasing manager that will bring challenges that were already noted in previous projects. Internally, different parties have different perceptions to grasp information. There is often a dispute whether a new product or an innovation is needed or not. A solution here could be the coordination of the purchasing department because different departments have different goals and the danger is that certain departments fail to address aspects that are needed to successfully include a supplier. In terms of the NPD projects, top-down approaches are very hard to implement and bottom-up ideas work way faster and better. There are certain challenges and pitfalls of supplier inclusion. The most important one is that the firm communicates openly what they want and let the supplier know what is expected. At the same time trust the supplier with internal data in order make collaboration work. Trust is often the key conflict and that is why NDAs help with that. They are afraid that the supplier might develop their technology without them and the manufacturer will not profit from it. As for the next challenges communication is also a significant part. A few years back the company was not able to operate on an international scale due to language barriers. That has changed over the years because the workforce has become younger. The physical distance is recognisable for countries in the EU. However, when there are different time zones it makes the work more complicated and time consuming.[180] There are also benefits of supplier inclusion in NPD projects. When there is a win-win situation for the supplier and

[180] See interview no. 1, Appendix C (2917), p. 81 - 85

buying firm, both can expand their core competencies. The buying firm benefits from the expertise of the supplier and can introduce new products faster. The firm needs to see short-term benefits most importantly cost reduction in order to engage in such a project. If that is given a closer look at long-term benefits and possible innovation arises. It depends on the product to what degree a supplier is involved in the NPD projects. For simple products, suppliers' just get a drawing and they produce it. For technical more complex products, the help of a supplier is mandatory and they are included as early as possible. There is no problem with identifying innovative suppliers because the manufacturer is the market leader and the supplier wants to collaborate and present their new technology on a regular basis. The purchasing departments' involvement in NPD activities is approx. 80% and it takes over all the coordination of all projects. If another department wants to make contact with a supplier they have to run it by the purchasing department first. The skillset of an employee here should contain, business, administrative and engineering skills to operate from both sides, as well as project management skills in order to be able to lead the team. However, there is no process to what extent the purchasing department is involved. In cross-functional teams there is no project manager so only a coordinator given by the purchasing department. There is one hierarchy level within the teams and the departments purchasing, R&D, quality and logistics are sitting physically close together. At last for the buyer-supplier relationship aspect of the company and especially for collaborative projects, it can be said that the firm does not proactively try to win suppliers over. The trailer manufacturer is attractive to almost all suppliers within the industry because of large volumes and a known brand. Suppliers cannot afford not to work with them. The company does not want to be a preferred customer to any supplier. In case of a bottleneck, the firm wants to have power over a supplier and force them to act accordingly.[181]

Project Manager R&D

The project manager in the R&D department is an engineer and has been for ten years in that position. For the topic supplier inclusion in NPD it can be mentioned that it is the task from purchasing and R&D, where purchasing starts it with sending out NDAs. NPD is a big part for the firm since they benchmark all the products and they need to remain industry standard but also when the market, in form of customers, demand it. An engineers' opinion here is that innovations are needed to survive in the next years. Thus

[181] See interview no. 1, Appendix C (2017), p. 81 – 85

suppliers are needed to help them innovate for products that are technically complex. Steps in the NPD process are first the draft of the idea, then the projects starts with the technical drawings. After that the qualifications of the product is tested, before next production can start. The last one is end of the project and start of regular production. Here issues can be seen in form of missing technical specifications that happen internally and are not communicated to the supplier. But also there are technical issues of the supplier resulting in a delay of the whole project. The lack of communication is a big internal problem, especially when it comes to international projects. There are language barriers and the R&D department is not ready for international projects. There is a translator needed because engineers cannot communicate with their counterparts and that results in information loss and delay. That is the biggest challenge in these projects and does not occur with German partners. Trust here is not a problem because it has not happened that engineers did not want to share any information, but that might be connected to the signed NDAs. Even when there are personal issues where partners dislike each other, both sides act always in a professional manner. As for the benefits of supplier inclusion there is a difference between the R&D and the purchasing department. The R&D department pays attention to long-term benefits namely the innovation and added value to the existing or new product. The purchasing department pays attention to cutting costs and the product comes only second. When collaborating, the degree of supplier inclusion highly depends on the product. It happens for easy and simple products that the supplier just gets the print and makes it. However, for complex products, the supplier is included in the development process and contributes more to the innovation than the manufacturer does because there is the know-how available. Identifying the innovative customers is based on experience and happens on trade fairs or via online searches.[182] The cross-functional teams that are responsible to the collaboration projects are separated in big and small projects. For big projects it might happen that the team is working on the project 100% of the time but mostly and for all medium sized or small projects teams have many different projects at one time. The teams consist of purchasing, R&D and later one quality and logistic. First R&D starts the projects and coordinates it, then comes the purchasing for NDAs and later on when needed quality and logistic. The teams are sitting physically close together for easier meetings and communication exchange. From an engineering point of view there is clearly the trend of scarcity of top-tier suppliers that have superior technical knowledge.

[182] See interview no. 2, Appendix C (2017), p.85 - 88

The manufacturer is naturally attractive to suppliers because of a certain volume but that will change for products where the supplier is not depended on our industry.[183]

Global Sourcing / Supply Chain Manager

The next view comes from a global sourcing and supply chain manager within the strategic procurement department. The general topic of supplier inclusion in NPD is rather difficult because of different interests. The company in general is very fixated on cost reduction when engaging in every project. Thus, sometimes it is hard for the R&D staff to collaborate with the right suppliers because they are simply too expensive. There are technology roadmaps that guide the R&D department to look for supplier that could be interesting to partner up and start a collaboration project. When it comes to challenges of these projects the main one is the coordination. Good or bad coordination makes a project successful or even unsuccessful. A second challenge is the motivation of the team members. They need to be motivated in order to achieve good results. That motivation highly depends on the person that is responsible for the project. Empowerment is the key word here in combination with open communication. Another challenge is especially for international projects. There are language barriers throughout the workforce. Often there are translators needed in order to ensure good communication. That is very time consuming, there are delays the project and information get lost. Team members without language skills need to be supported, which makes it hard to maintain a certain efficiency. Team members generally do not admit that something is unclear, meaning the team manager needs to be aware of that so that no information is wrong or missing because that could be very dangerous. The purchaser often acts as the translator but that is not a good way because engineers can communicate to each other way better and faster. In collaboration projects trust is not a problem due to signed NDAs at the beginning of each project. However, there is always a threat that a competitor receives information but in the trailer industry, suppliers work together with all the big players at the same time. There are also benefits of the collaboration in every project. The main advantage is that the firm can profit from the technical capabilities of the supplier and in most cases they need their expertise. In addition to that, both firms can learn from each other in terms of project management abilities. Last benefit is that buyer and supplier could develop a product that is superior at the market and nobody else is capable of copying it.[184] The inclusion degree

[183] See interview no. 2, Appendix C (2017), p. 85 – 88
[184] See interview no. 3, Appendix C (2017), p. 89 – 93

should be as high as possible and the timing should be as early as possible especially for complex products. For products with commodity character that can be different because the expertise of the supplier is not needed. When the firm looks for innovative suppliers, they do a supplier screening for certain products, to see what the market has to offer. Trade fairs are used to get a look a certain trends and it is made easy for staff members to attend one when some department is in the search of a new innovation. Often though, suppliers come to them to present their innovation. Normally in those projects, purchasing and R&D share the work equally. Mostly, R&D starts it and brings in purchasing shortly after that. Once the purchasing department is brought in, they take over coordination of the entire project and act as project managers. The purchaser needs to do the coordination because once the development is finished the R&D department leaves the project but the project is not done because there are missing steps before start of communication. For that coordination part the purchaser needs to understand the internal processes at the firm. In addition to that, technical knowledge about the product, business, and project management skills are needed. Cross-functional teams are being set up different every time because it depends on the preference of the person that initiates the project. That is a big problem because often people think only within their own department and do no really care if there might a problem later in process. Thus, there will most likely be problems later on in the process and promises made to the supplier cannot be kept. In terms of a buyer-supplier relationship, there are no special actions they take to ensure being attractive to suppliers. Due to the fact that they are the market leader, all the suppliers are coming to the buyer and try to present their innovations.[185]

Engineer R&D

The last view to round up the perspectives comes from an engineer within the R&D department who is working in that position since 2011. The general view is that supplier inclusion for NPD is done for a longer time already. That is especially the case for products that are technically more complex and the firm does not have the expertise to develop it alone.[186] There are many different strategies how they generate new idea. R&D staff follows trends on the market and tries to implement certain new things and start NPD projects out of it. There is no strategy per se when it comes to NPD because most supplier come to them and present their new innovation and ask for a potential partnership that the

[185] See interview no. 3, Appendix C (2017), p. 89 – 93
[186] See interview no. 4, Appendix C (2017), p. 94 – 98

firm is might willing to offer. Challenges and risks in these projects come up when the projects are on an international basis. The challenge here is the language barrier internally as well as for suppliers. There are communication issues that endanger many projects where technical information may get lost. Also, in some countries with a different culture, they do not pay attention to technical requirements. It is way harder to collaborate with those suppliers in comparison to German or EU suppliers. Another challenge belongs also to international projects, namely that the company is internally organised in German. However, technical documents and requirements need to be available in English, which makes it very timely to translate and get other departments to do so as well. A risk for engineers is definitely the sharing of information. It depends on a gut feeling if engineers are confortable sharing information with suppliers. Also here the problems arise with international suppliers with a different attitude towards work and regulations. On the other hand side engineers know that most of the suppliers are also working with competitors and information finds its way there nonetheless. The benefit for the engineering and R&D departments is clearly the technical expertise the supplier has and contributes to the project. Another positive point is that competition between suppliers increases when they see that the company is looking for a partner, which might result in lower cost at the end of the project. They are focused on short-term benefits especially cost reduction. If that is not given there is no way for the R&D department to engage in a new partnership. The degree of supplier inclusion differs from product to product. There is only a high degree of supplier inclusion if the product is very specialised and technically complex. The engineers at the firm identify innovative suppliers mostly through their professional network within the industry. In addition to that trade fairs are used to keep up with innovations and trends in the industry.[187] The cross-functional teams that are needed for the collaboration projects differ most of the time form one another. There is not sufficient staff available to fully equip all teams with the same amount of skilled people. The R&D department takes over the coordination role in the teams and purchasing department joins first. After that quality and logistics if needed. For international projects the global sourcing team is responsible for the coordination. The teams are sitting physically close together so a regular information exchange is ensured and meetings can be set up easily.[188]

[187] See interview no. 4, Appendix C (2017), p. 94 – 98
[188] See interview no. 4, Appendix C (2017), p. 94 – 98

3.3.2 Cross-case analysis: perception of early supplier involvement in NPD

For the empirical research semi-structured interviews were used as qualitative research. The four interview partners came from different functions and hierarchy level within the firm. The results show similarities and differences of the perception about the topic. It can be highlighted that in general the interview partners had common knowledge about the projects and agreed on most of the points. There was a strong agreement seen in the topic of trust. The employees of the trailer manufacturer do not have a trust issue when it comes to sharing data with a supplier. They all are aware of the fact that before the collaboration starts a NDA is signed and that both sides are committed to make the project successful. Only from the engineering part there was a slight concern about that not all suppliers treat the data the same and it might be a problem to share data internationally to "semi-professional" suppliers especially for China. In general the project teams are not afraid to share data because they know that almost all suppliers are working together with competitors also and one cannot prevent that data is shared in some way. All four interview partners agree that the main benefit from collaboration with a supplier and including them early into the NPD process is that the supplier brings technical knowledge into the firm. The more complex the product, the more help does the firm need from the suppliers in order to be successful. The in-house engineers are most of the time no experts in the part but the supplier is. In those cases they should be included as early as possible. The main challenge is seen in international projects rather than national ones. The language barrier appears to be a problem throughout the organisation. Especially, the R&D department faces issues because of that on a regular basis, resulting in information loss and delay of the product. Also the efficiency of the process within the project is not given anymore. In the purchasing department the problem is not 100% or rather not seen as a problem. There is a unanimous agreement in what skills the purchasing staff needs to have for a successful outcome in those projects namely, project management skills, business & administrative skills, knowledge about the internal processes and technical understanding. Another similarity is that every staff member is aware of the fact that most of the time suppliers come with innovations to the firm and there is almost no need to look for it. If proactive actions are taken, trade fairs and professional networks are used to identify innovative suppliers. As for the supplier inclusion it was clear that is should happen as early as possible when technical help is needed. A problem that continuously came up during the interviews was the involvement of top-management and the board of directors in the projects. It might happen that for some projects the board members meet with the

supplier and decide on certain issues without consulting the project team or clearly communicating it to them. That triggers confusion and due to the fact that they are mostly not as involved into the relevant specifications, issues for the later project appear. In the past that resulted in delay of the project and quality issues. All interview partners agree that the bottom-up approach works best here.[189]

The biggest disagreement and an unclear point was the coordination of the NPD project when a supplier is included. The R&D department states that they initiate the project, make contact with the supplier and coordinate the project throughout the time. The purchasing department has the opinion that they are clearly the coordinator of every project and they are needed to initiate projects and also to finish them up, once the development phase is over. For the topic of cross-functional teams there is a little bit of confusion between R&D and purchasing but also within purchasing. There are two perspectives here namely, clear straight forward teams that work together closely and on the other hand side teams that are being set up by personal preferences in a chaotic way where location of the different parties can change. R&D added here that it might be the case that there is a lack of staff members so that missing internal expertise can occur throughout the project. The next dispute appeared with the different perspective of purchasing and R&D about supplier scarcity in the industry. R&D noticed the threat that there are less top-tier supplier with a high level of technical expertise and that even a market leader like the firm has to fight for the good ones that operate over the boundaries of the industry. If the firm does nothing to remain or become attractive to certain suppliers, that might endanger future operations. The purchasing department is not afraid and does not see the trend here. The perspective here is that they are the market leader and suppliers need them in order to stay competitive. There is a disagreement noticed on different levels within the R&D department. On the higher level there is no issue with information sharing to suppliers at all. However, engineers might have a problem with that for international suppliers when they see that the supplier act in a different manner and most likely does not take care about the data and does not operate in a professional way.[190]

The following table summarises the different perceptions of the interview partners and what they have in common.

[189] See Interviews 1-4, Appendix. C (2017), p. 81 – 98
[190] See Interviews 1-4, Appendix. C (2017), p. 81 – 98

Similarities	Differences
No trust issues while collaborating due to NDAs	Sharing data internationally can cause problems.
Data is exposed to competitors but that is the normal dynamic of collaborating	Engineers often do not like to give internal information to Chinese firms.
The main advantage of including a supplier early into NPD activities is the benefit of their technical expertise	Disagreement about the coordinator role of the NPD when a supplier is included
For technical complex products the help of a capable supplier is needed and the supplier should be included as early as possible	Set up in cross-functional teams in terms of organisation, location and timing
For international projects there is a language barrier that causes problems as time delay and missing information	Supplier scarcity of top-tier suppliers, attractiveness of buyer needed in order to stay competitive
Purchasing staff needs the following skills for those projects: project management, business & administrative, internal process knowledge, technical knowledge	
Innovative suppliers come to the firm automatically. Or are found via trade fairs or professional networks	
Top-management involvement harms the project and the bottom-up approach works best	

Table 5: Different perceptions of early supplier involvement in NPD projects
Source: own elaboration

4. Results: comparing theoretical and empirical findings

4.1 Current purchasing department ability & supplier inclusion process

4.1.1 Current innovation process and internal organisation in collaboration with suppliers

The current innovation process within the firm is seen as an important part in the next years. The interviewed project manager from the R&D department stated that *"innovations will be needed to survive in the next ten years"*[191] There is a long-term plan till 2025 that notes that the firm will face a challenge with urbanisation and new innovation will be needed to tackle that. In addition to that, there are technology roadmaps that regularly keep track of technical trends and plan the innovation process somewhat. For innovative supplier identification there are mostly no proactive actions from them because suppliers come forward to present their innovations on a regular basis. The only proactive action is visiting trade fairs fairly regular in order to get in touch with new innovations. Contact to potential suppliers are always made by the purchasing or R&D department and a NDA needs to be signed to begin with the collaboration talks. The degree and timing of supplier inclusion depends on the product. Generally, the more complex the product, the earlier the supplier integration and the higher the degree of supplier integration. As for the process of coordination there is no clear coordinator that is in charge of the project. The planning here depends on the respective project team. That is a big point of confusion between the R&D and purchasing department because it is not clear who takes over the role. The cross-functional teams working together for the project consist often of the same departments but are being set up differently in terms of timing. For big projects the teams spend up to 80% of the time on one project but in general the team members have many projects at the same time. For projects with powerful and big suppliers, it might happen that top management is involved in the projects with taking over negotiation and project planning talks with the top management of the supplier. There are no proactive approaches from the firm to win attractive suppliers or become a preferred customer. The perception here is that as the market leader in Europe, they do not depend on proactive actions because there is a natural attractiveness and top-notch suppliers come automatically. In bottleneck situations it might even happen that they use their size as power and put pressure on suppliers.[192]

[191] See interview no 2, Appendix C (2017), p. 85 – 88
[192] See interview no. 1-4, Appendix C (2017), p. 81 – 98

4.1.2 Purchasing department maturity of the trailer manufacturer

There is a relationship between the maturity level of a purchasing department and its impact on the performance and cost-reduction results within a firm. The more developed a firm is, the larger is the saving potential because there is higher probability that 'best practices' work accordingly.[193] The maturity profile for the purchasing department of the firm was developed by using the purchasing audit tool from Schiele (2007) to assess the maturity level. For that purpose two employees from the strategic purchasing department were interviewed and the tool used to assess the performance of the firm. This assessment can be found in Appendix D. The model includes different areas within the purchasing department. The first function is the procurement planning with several areas as demand planning, pooling planning, environment & scan and innovation planning. The second function is the organisation structure of the purchasing department with structures and mandates and strategic integration. The third function is the process organisation where the behaviour towards supplier, early integration of suppliers and cross-functional behaviour is evaluated. The next function is the HR function where the skills of purchasing staff is analysed. The last management function is the procurement controlling where the controlling system, processes, functions and place, methods and tools that support procurement are evaluated.[194]

The firm scored overall 65% in the maturity profile
12.9 out of 20 points

12.9 out of 20 in Planning ***(65%)***
14 out of 20 in Organisational Structure ***(70%)***
10.6 out of 20 in Process Organisation ***(53%)***
15.1 out of 20 in HR and Leading ***(76%)***
14.1 out of 20 in Controlling ***(71%)***

[193] See Schiele (2007), p. 274
[194] See Schiele (2007), p. 277 - 278

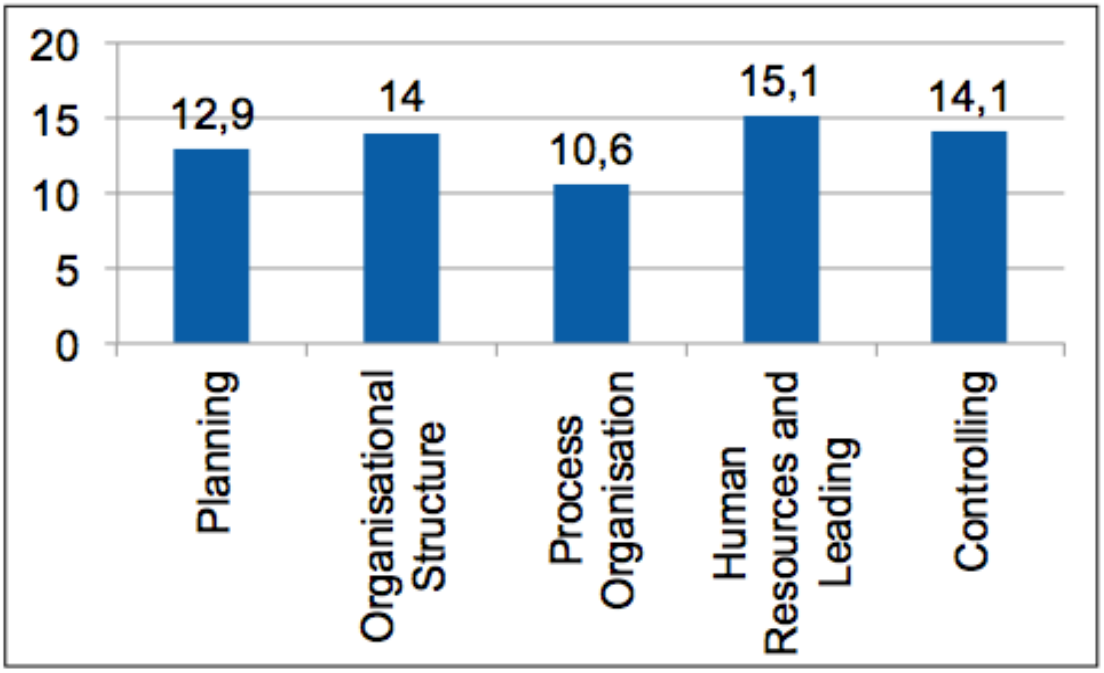

Figure 6: Maturity profile of the trailer manufactuer

Source: Schiele (2007), p. 284-291 + own elaboration, Appendix D (2016), p. 99

The overall assessment has shown that there are no significant weaknesses that need to be addressed immediately. The basic processes are already in place with room for improvement. The planning part showed that the pooling opportunities are regularly analysed in order to be aware of potential cost savings but not documented. It rather happens 'on accident'. Additionally, there is an R&D department working closely together with purchasing to proactively plan innovation activities. However, the responsibilities regarding planning activities are not clearly specified, meaning there can be confusion when it comes to coordination. The organisational structure has clearly defined responsibilities and cross-functional integration happens regularly. For the processes of the firm, there is a weakness seen for the sourcing strategy. It is not defined and every material group has their own, not following a company wide roadmap. The communication with suppliers' process is in general there, but evaluation does not take place because of too little personnel. There are activities for early involvement of suppliers but a process per se cannot be seen. It highly depends on the product and it is done by preference of the responsible project teams. The process is not synchronized with the NPD process, responsibilities are not clearly documented and process targets measured. It depends on the product and team if NPD is compared to industry benchmarks. The human resources area is covered really well and the purchasing staff meets the requirements of the job.

Employees have technical, purchasing and project management knowledge with regular training opportunities. Controlling has no major weaknesses because there is systematic process for controlling activities that measures actions and activities and documents it. On a general basis it needs to mentioned that there was the "global sourcing" department launched in 2013 to ensure working collaborations with international suppliers. Within the company there is no CPO appointed. The head of procurement is not a member of the board and reports directly to the CFO. That is the case despite the fact that approx. 75% of the total cost are spend by the purchasing department.[195]

4.2 Outline of examples for supplier inclusion in NPD

4.2.1 Example of a successful project

For the different product groups there were many supplier inclusion projects over the years. A successful project has been the collaborative development of disc brakes. The inclusion of the supplier took place at the very beginning of the project. As soon as the engineers started to think about how to start the project or even start a drawing, the supplier was already included in the idea generation process. The only fixed parameter at the beginning was that the firm needed one or more new supplier for disc brakes and the purchasing department in cooperation with R&D was able to identify a supplier rather quick and ensured collaboration immediately. The collaboration between the engineers of the two partners has been working without problems. Technical information was shared from the beginning on with communication about drawings and open questions on a regular basis. The engineers are speaking one technical language, have the same values and have the same perspective about work. The similarity of the engineers ensured efficiency in terms of technical development and information exchange. The supplier was very open-minded in working together and was open to share all kind of information the firm needed. The technical tests from the supplier were done before schedule, so that the engineers at the manufacturer could start their own tests. The supplier has shared the data in a timely manner so that a delay was avoided. Due to the fact that disc brakes are highly specialised and a technical complex product, they rely on technical help from the supplier, thus this is the most important factor to ensure efficiency. In case of mistakes that happened, both companies could immediately start working on solving them. In addition to that the purchasing department has done a perfect job in communicating with the supplier and

[195] See Schiele (2007), p. 284 – 291; Appendix D (2016), p. 99

explain what is expected in terms of business activities and the timeline of the project. Even as the project manager on the supplier side has changed, which lead to turbulence for a short period of time, the supplier was so skilled in project management and information exchange that the delay was kept to a minimum. The purchasing department had to intervene by forcing the R&D department to rethink the drawing because the product was overpriced. However, the problem got solved at the end due to communication. The internal coordination and communication was working perfect as well because of a clear set up of a team and known roles in all departments and a known timeline. In addition to that, the engineers were enthusiastic and thus motivated about the project. The most important success factor was the transparency of the supplier in terms of technical information sharing and the ability for them to absorb all the success factors. Furthermore, trust from both sides has been given from the beginning of the collaboration on, which helped a lot with the success and the communication on a personal basis.[196]

4.2.2 Example of an unsuccessful project

There are also unsuccessful projects in NPD when a supplier is included into the process. The collaboration with a supplier for a new generation of pneumatic suspension was a project with many difficulties and seen as not successful. The involved supplier here has been known and is a partner of the manufacturer for approx. 25 years now. In the beginning of the collaboration the supplier was responsible for many different products for them but over the years more projects were taken in-house and away from the supplier. A big problem occurred because the supplier acted arrogant and like they are the only experts. There was almost no communication, no open talks and no advice taken from the manufacturer. It is assumed that the supplier acted that way because they took away many projects from them for the reason to be more independent. In addition to that, there is lack of trust the supplier grants the firm for that project, which causes the missing communication. The R&D department knew very early in the process that they were not satisfied with product at all, caused by poor communication between them and their counterparts at the supplier side. However, the supplier was quite powerful and the engineers did not have the courage to say that the product did not meet their expectations. There was an internal communication problem where the R&D, purchasing and quality department already knew that the project will be unsuccessful or will be delayed. The project started as it did because top management was involved in the communication

[196] See interview no. 4, Appendix C (2017), p. 94 – 98

process with the supplier. The board of directors met with the supplier and decided on points that were internally not realisable. Top management was trying to force the project, but without having all the relevant information, which made everything harder and a lot of problems arose. There was only little exchange between hierarchical levels and projects teams had to work based on already made decisions. [197]

4.2.3 The case: supplier of shock absorber

There is a development of a second source of supply for hydraulic shock absorber within the pneumatic suspension of an axle. The initiation came form the purchasing department and the strategic decision form top management. The purchasing department did a supplier screening and identified five potential suppliers. R&D started with drawings already as the talks with potential suppliers took place. The suppliers had to present their technical capabilities and prices by sending first offers. The project is on-going and a contract with a Turkish supplier was closed successfully. The supplier was chosen because of a cheap price, physical distance, quality of their product and technical knowledge. The purchasing department set up contractual agreement and the project has been officially started. The project is at the point of doing this research on-going; the firm and the supplier do different technical tests for the shock absorber. Communications in detail were started and adjustments are made on a regular basis. Face-to-face meetings took place as well as visit of each other's production facility. A timeline, volume and goals were set with a date for start of production. The project is seen as a success because the supplier delivers what was promised in the beginning. The R&D department relies on their expertise and sees them as highly specialised and experts in their field. The purchasing department sees them as very committed to the project and helpful in every way. Physical distance makes face-to-face meetings easy and there is a need to visit each other's factories and check local processes. Engineers feel confortable working with the supplier in order to solve technical issues. The trailer manufacturer as well as the supplier is able to communicate in English so that there is no delay because of language barriers. There are small problems that arose but have been solved because the supplier is as committed as the firm is to make the project successful. The commitment of the supplier, their technical expertise and the perfect communication can be seen as the success factors. In the case of the shock absorber, the purchasing department has been taken over the role as project coordinator.[198] [199]

[197] See interview no. 4, Appendix C (2017), p. 94 – 98
[198] See interview no. 4, Appendix C (2017), p. 94 – 98
[199] See interview no. 3, Appendix C (2017), p. 89 – 93

4.4 The ideal model for early supplier inclusion in the NPD process for the trailer manufacturer

The firm is aware of the fact that due to globalisation, increased competition and more complex products, there is a need to change their innovation process from an exclusively internal one to a more open one.[200] It is important that this mind set will be continued and that the knowledge of suppliers is used to develop and innovate. The process description is to be found in Appendix G and in the following chapter. Due to the fact that the firm is using incremental or continuous innovation, the concurrent engineering approach is advised to be used, where the activities overlap and cross-functional collaboration is forced from the beginning on. Therefore, NPD performance is likely to be improved and problems can be solved as they occur.[201] Buyers and engineers should meet on a regular basis to discuss *development management* and *supplier interface management*. Purchasing directors need to establish development guidelines for the respective parts. General management need to specify what research and development activities should be outsourced to a supplier. Buyer, engineers, purchasing directors and general management should hereby follow the activities from table. 2 (Chapter 2.4.1).[202] To avoid problems that are connected with the ability from the supplier side the firm is advised to use a process for the identification and selection of a potential supplier. Firms need to understand which suppliers do have capability to contribute to the innovativeness.[203] This can be done with analysing the character of the supplier in terms of specialisation of their products, their development capacity and technical expertise and their collaborative mind set. In addition to that they should pay attention to the character of their buyer-supplier relationship in terms of trust, commitment and joint programs. Furthermore, geographical proximity and the history of the supplier should be taken into account.[204] The process of supplier identification should be done by either the purchasing or the R&D department, depending on who is the initiator of the project. Also, this process should be used on a regular basis during a market screening to notice opportunities to innovate faster. The degree of supplier inclusion is proposed to be made dependent on the product. A small working group consisting purchasing and R&D staff should categorise the project for the certain part into

[200] See Griffin & Page (1993), p. 299
[201] See Valle & Vázquez-Bustelo (2009), p. 137 - 138
[202] See Wynstra et al. (1999), p. 134
[203] See Schiele (2006), p. 925
[204] See Schiele (2006), p. 929

the none box, white box, grey boy or black box category (Chapter 2.3.1).[205] Furthermore, the timing of the integration needs to be determined by the same working group. Hereby, they should focus on the technical feasibility rather than joint business goals. In order to determine the exact timing the working group should follow the NPD stages and its integration points (Chapter 2.3.3). This needs to happen simultaneously to the supplier selection activity to match the supplier in the most useful way. For that kind of projects the purchasing department should clearly take over the role as coordinator and appoint a project manager that is in charge of the entire project. The manufacturer should refrain from using R&D staff as project coordinator because once the development tasks are over, often times R&D looses to motivation and competence to continue the project. At that point the projects are not finalised and it might occur that a successful project turns into an unsuccessful one.[206] In order to be able for the purchasing department to appoint the project manager, the person needs certain skills to be successful. Purchasing staff needs to have previous experience in similar projects, technical experience to understand how to contribute to product management, business and administrative skills, high level of education and pro-activeness, meaning that the purchaser is willing to participate in uncertain processes. If those skills are given, the purchaser needs to be seen as competent throughout the company in order to lead a team.[207] Due to the fact that almost all projects are long-term, there should always be a purchasing coordinator that is in charge over the time. The involvement of other members whether part-time or full-time should be determined for every project separately and according to the size and complexity.[208] The project manager needs to determine at what point which department should be included into the project. However, R&D should be a part from the beginning on as a competent partner for technical questions. When it comes to international projects it is mandatory that all team members are able to understand English documents and communicate in English on their own to avoid delays and information loss. The team-members need to have common goals despite the fact that they are from different departments because that creates commitment, motivation and avoids a negative team dynamic.[209] There cannot be multiple reporting relationships to their functional managers and project manager. For the time of the project that needs to be separated with clear boundaries. On a more strategic level the

[205] See Petersen et al. (2005), p. 378
[206] See interview no. 3 (2017), p.
[207] See Wynstra et al. (2000), p. 132 - 133
[208] See Lakemond et al. (2001), p. 12 – 13
[209] See Webber (2002), p. 202

senior management is supposed to support the projects and delegate responsibility to the project leader. Communication and decisions between the board of directors of the firm and the top management cannot take place without the project manager. Empowerment of the project leader ensures the communication of all relevant points.[210] As a supporting HR practice training and development of the employees regarding the collaboration projects should be offered instead of financial benefits to ensure the right skill set, motivation and avoid a competitive climate that can harm innovation abilities. They should be prepared that the trend of supplier scarcity can reach even the market leaders at some point for certain parts where they cannot attract suppliers with sales volume. Top-tier suppliers with a superior technical expertise might be able to choose their partners across industries. They are advised to stop the fixation on costs for certain parts with top-notch suppliers to avoid missing out on innovative opportunities that can cost market share. The firm should remain attractive to those suppliers, always create a win-win situation and ensure supplier satisfaction along the process. For certain suppliers they should try to reach preferred customer status, thus the firm is the company that will get the offer to innovate together instead of a competitor or buyer from a different industry. Being a preferred customer offers more benefits stated on table 3 (Chapter 2.5.1). In case of bottleneck or lock-in situations, coercive power as punish the supplier, is not advised to use for suppliers that show collaboration potential. If coercive power is used, suppliers show no sign to allocate their resources to such a partner.[211] The company should measure the success of NPD project with supplier involvement in 1) customer measures (market share, customer satisfaction), 2) financial measures (margin-level), 3) firm-level measures (% of sales) and 4) production related measures (performance, speed to market, technical successful).[212] The following graphic shows the advised process for the ideal early supplier involvement model in NPD.

[210] See Clark et al, (1992), p. 14
[211] See Pulles et al. (2014b), p. 30
[212] See Griffin & Page (1993), p. 299

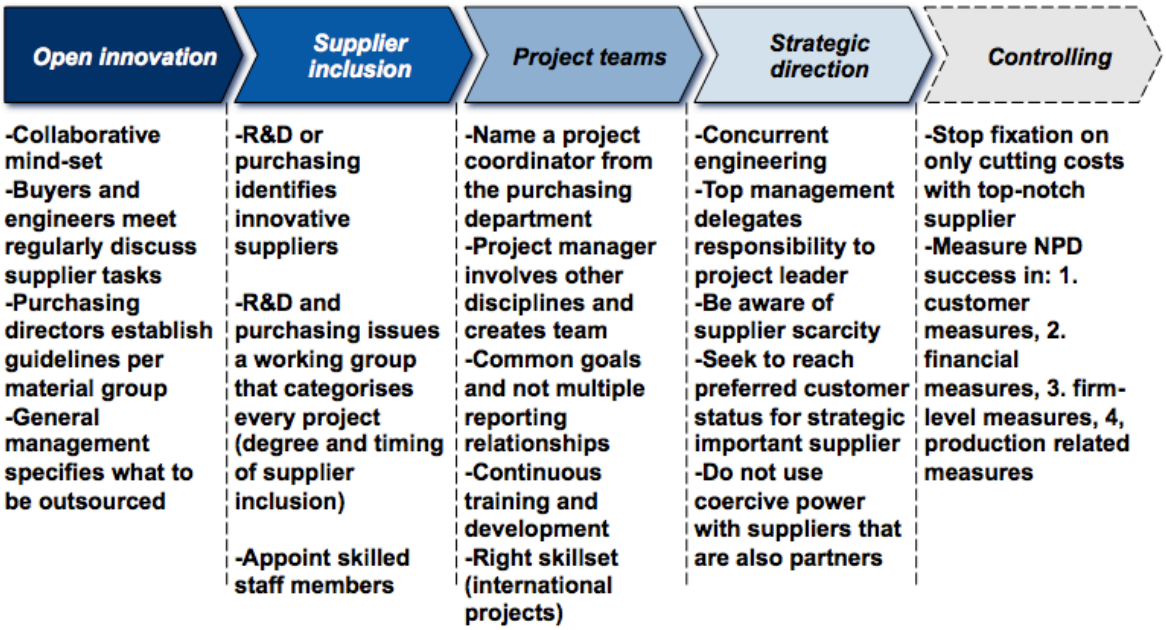

Figure 7: Early supplier inclusion model for the trailer manufacturer

Source: own elaboration

Key points and advice of the early supplier inclusion model for the manufacturer:

- Pursue open innovation
- For incremental innovations use concurrent engineering
- Buyers and engineers meet on a regular basis to discuss development management and supplier interface management
- Purchasing directors establish development guidelines per part or material group
- General management specifies what R&D activities are outsourced
- Continue to use NDA agreements (see Appendix E) to avoid risk, make engineers and purchasing staff feel confortable
- R&D or purchasing develops and executes a process for innovative supplier identification. The process contains: specialisation of products, development capacity, technical expertise, collaborative mindset, trust, commitment, joint programs, geographical proximity and history of supplier.
- Issue a working group (purchasing and R&D) that categorises the project into none box, white box, grey box or black box to determine the degree of supplier inclusion

and determine the timing of integration (see Appendix D, Figure 8 for the degree and Figure 9 for the timing).

- Purchasing department appoints a project manager / coordinator for all projects
- Purchasing staff should have the following skills: previous experience in similar projects, technical expertise, business & administrative skills, high level of education, pro-activeness and a good reputation throughout the firm.
- Project manager determines who needs to be involved depending on the part.
- For international projects all team members need to be able to communicate in English.
- Team member need to have common goals and there cannot be multiple reporting relationships.
- Top management needs to delegate responsibility of the project leader or include that person in all correspondence.
- Offer training and development connected to the projects for team members.
- Be aware of the trend of supplier scarcity of top-tier suppliers with superior technical expertise.
- Stop the fixation on cutting costs with top-notch supplier.
- Seek to reach preferred customer status with strategic important suppliers.
- Do not use coercive power in case of bottleneck or lock-in situations with suppliers that are also partners.
- Measure NPD success in customer measures, financial measures, firm-level measures and production related measures.

After the research and comparing the current projects with the literature in combination with the interviews, the trailer manufacturer is advised to follow this model for successful projects.

5. Conclusion

Nowadays the business world is highly competitive and in order to keep up with the demand from the markets and the rapid change of technology it is mandatory for firms to pay attention to faster development of products, improvement of quality and reduction of costs.[213] The involvement of a supplier is vitally important because especially for complex products the suppliers are specialised in their own products and bring a certain know how can helps the buying firm in understanding the product and increases the chance of an innovation.[214] The purpose of this study was to execute exploratory research in the field of early supplier involvement for new product development projects within companies. While answering the research questions theoretical and empirical analyses are connected, successful and unsuccessful cases are outlined and the ideal model of the firm developed.

In order to be able to assess what the manufacturer can do to include their supplier in early phases of their NPD activities, risks and benefits need to be outlined. Communication with the supplier appears to be a risk including the language barrier especially for international projects. That theoretical observation happened in practice for many different projects within the firm. Surprisingly, there is almost no trust issue the engineers have to share internal data with suppliers, whereas this is seen as a problem in theory. The difference for the firm is that the engineers are aware of the fact that almost all suppliers are also collaborating with competitors and information exchange is seen as something that naturally happens. An issue can arise when suppliers do not have the technical capability that is expected from them.[215] For that reason there is a process proposed to identify innovative customers that are suitable for those projects containing specialisation of products, development capacity, technical expertise, collaborative mind-set, trust, commitment, joint programs, geographical proximity and history of supplier.[216] A power disequilibrium in a collaborative partnership where the stronger partners force the weaker partners to do things against their will results in unsuccessful partnerships.[217] In order to avoid this, they should not use coercive power for partners where they are in a

[213] See McIvor & Humphreys (2004), p. 180
[214] See Ragatz et al. (2002), p. 392
[215] See Wnystra et al. (2001), p. 159
[216] See Schiele (2006), p. 929
[217] See Zolghadri et al. (2010), p. 312; Cox et al. (2011), p. 11

collaborative partnership with.[218] In factor markets supplier scarcity lead to lead to rivalry amongst buyer for the good suppliers and can harm finding suitable innovation partners.[219] The trend of supplier scarcity is only partly seen within the company but could become a problem in the near future for certain parts.[220] In terms of benefits, theory outlines short-term benefits as reduction of development costs and reduction of development lead-time in combination with reduction of product cost and gain of product value.[221] The empirical research confirms that the short-term benefits are accurate for firms' projects. However, the benefit of cutting costs needs to be given.[222] In addition to that, long-term benefits as getting access to technological knowledge is seen as the main reason for engaging into NPD projects with suppliers.[223] Surprisingly, the benefit of risk sharing between buyer and supplier was stated in theory alone and not mentioned in practice.

Additionally, to be able to assess what the firm can do to include their supplier in early phases of their NPD activities, it needs to be analysed how firms can engage in projects like that and organise it internally. The degree and timing of supplier inclusion depends on the product whereas complex product get the most attention and supplier responsibility.[224] The concurrent engineering approach is useful for continuous innovations and therefore useful for them as they are active in that field.[225] The purchasing department should act as the coordinator for all projects and the purchasing personnel needs the right skillset as previous experience, purchasing and technical knowledge, pro-activeness with a resulting good reputation in the firm.[226] Cross-functional teams need to handle the projects because the NPD process does not happen in isolation of one department and should contain team members from different disciplines that have the same hierarchical level.[227] Also, to have a positive atmosphere team members need to have common goals.[228]

Furthermore, to be able to assess what they can do to include their supplier in early phases of their NPD activities, the development of a buyer-supplier relationship becomes

[218] See interview no. 1, Appendix C (2017), p. 81 – 85
[219] See Capron and Chatain (2008), p. 113
[220] See interview no. 2, Appendix C (2017), p. 85 – 88
[221] See Wynstra et al. (2001), p. 158
[222] Interview no. 3, Appendix C (2017), p. 89 – 93
[223] See Wynstra et al. (2001), p. 159; interview no. 4, Appendix C (2017), p. 94 – 98
[224] Interview no. 2, Appendix C (2017), p. 85 – 88
[225] See Valle & Vázquez-Bustelo (2009), p. 145; interview no. 2, Appendix C (2017), p. 85 – 88
[226] See Wynstra et al. (2000), p. 131 - 132
[227] Joshi (1998), p. 22; Driedonks et al. (2014), p. 289
[228] See Mc Donough (2000), p. 226

important and achieves better innovation performance.[229] A good buyer-supplier relationship can be helpful in times of supplier scarcity and achieved with customer attractiveness that leads to supplier satisfaction and that leads to the preferred customer status.[230] The trailer manufacturer states that they are naturally attractive to customers and do not need to take proactive actions to become a preferred customer. The perception is that supplier scarcity does not apply to them because they are the market leader. However, there is disunity whether that is the right direction.[231] There are several benefits of becoming a preferred customer in terms of product quality and innovation, support of the supplier, delivery reliability and price.[232] On the other hand there are pitfalls as well such as a vulnerable supply chain, the ability to quickly switch to other suppliers in disruptive situations, the dependency on one supplier with the fear of being overpriced.[233] To overcome the fear, the buyer and the supplier need to establish a relationship based on trust and commitment.

To conclude it can be said that there are certainly risks of including a supplier early into NPD activities but the benefits predominate if the process is done accordingly. The purchasing department plays a significant role in coordinating those projects and engaging together with R&D personnel to the core of collaboration. To maintain partnerships long-term, companies need to be aware of a good buyer-supplier relationship and proactively work for it.

[229] See Pulles et al. (2014), p. 415
[230] See Schiele et al. (2012), p. 1180
[231] See interview no. 1, Appendix C (2017), p. 81 – 85;interview no. 2, Appendix C (2017), p. 85 - 88
[232] See Nollet et al. (2012), p. 1187
[233] See Wagner & Bode (2006), p. 306; Schiele et al. (2011), p. 3

6. Limitations and further research

This research might be seen as useful for academics and practitioners in companies as it shows the concept and importance of early supplier involvement in product development and highlights its importance in today's highly complex and ever changing world. However, there are some limitations associated with this research.

The main limitation of this thesis is associated with the explorative nature of this research, as this topic has not been studied in detail. Here, four in-depth interviews were executed to verify the theoretical framework proposed by the literature. The conceptual model can be verified with that but an external validity is not assured. In order to assure external validity and generalise it, future research needs to execute that research for more players within the industry as well as across industry boundaries.

Another limitation is that this thesis discusses the topic mainly from the buyers' perspective and therefore not useful for practitioners from the supplier side that are interested in engaging in that topic. Therefore future research should include the supplier side and investigate concepts from the supplier side.

Furthermore, the interviews can be biased due to relationship and personal preferences of the interviewees with the company and the topic itself. The interviews were conducted with staff members from different positions within the company that might have responded in a way that let their area look superior to other areas.

Moreover, the research had a time restriction of 20 weeks, which can be seen as a limitation. Further research could accompany projects from the beginning phase till it is finalised.

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APPENDIX A: Interview questions with motivation from the literature

General Information	**Motivation**
General Information about the purchasing, R&D, sales professionals: Could please explain **your main function in the firm?* **since when are your working for that firm?* **since when are you working in that position?*	-
Could you please give me some general information about your company such as **supplier inclusion in NPD processes* **innovation processes* **importance of collaboration with other parties (departments/suppliers)*	-
New Product Development	**Motivation**
What is your firms' strategy when it comes to NPD?	NPD creates value for customers, identifies market opportunities and shifts it into capitalisation opportunities[234]
What difficulties have you faced regarding NPD projects?	Due to globalisation there is more competition and more technical product that could challenge companies in NPD success.[235]
What are the steps of your firm's NPD process?	There are several steps companies are advised to follow when it comes to NPD processes.[236]
Challenges and risks of including a supplier into your NPD activities	**Motivation**
What challenges have you faced while including a supplier into NPD activities?	Collaboration with a supplier that extends regular buying activities can have certain challenges, risks and pitfalls.[237]
Have you experienced issues regarding trust and commitment?	There may be problems regarding trust and commitment, which affects the collaboration performance.[238]
Have you experienced any communication issues with your supplier?	Communication between buyer and supplier can appear as a problem. [239]

[234] See Krishnan and Ulrich (2001), p. 15
[235] See Griffin & Page (1993), p. 229
[236] See Cooper & Kleinschmidt (1986), p. 74
[237] See Wynstra et al. (2001), p. 159
[238] See Wynstra et al. (2001), p. 159
[239] See Wynstra et al. (2001), p. 159

Are you afraid that when you share internal information that data could be exposed to competitors?	Firms see the risk to share internal information because they are afraid that competitors could receive it.[240]
Benefits of including a supplier into your NPD activities	**Motivation**
Have you experienced benefits from successful projects?	There are benefits in terms of superior product performance, cost, quality and time to market.[241]
Would you separate between short-term and long-term benefits?	Firms need to understand the short-term and long-term benefits at the same time.[242]
Supplier selection & Integration	**Motivation**
How would you describe the degree of supplier involvement?	None: No supplier involvement. Supplier "makes to print". White box: Informal supplier integration. Buyer "consults" with supplier on buyer's design. Grey box: Formalized supplier integration. Joint development activity between buyer and supplier. Black box: Design is primarily supplier driven, based on buyers performance specification.[243]
How do you identify innovative suppliers?	Identification of an innovative supplier becomes a new process firms need to be aware of.[244]
How do you determine at what point in the project you include the supplier?	Timing is important as it becomes costly to make changes within the project as it is on going.[245] The right timing firms need to base the decision on technical rather than business goals.[246]
Internal organisation	**Motivation**
Is the procurement department involved in the NPD process? **if yes to what extent* **if no why not*	The involvement of the purchasing department into the process increases the NPD performance.[247]
What kind of skillset does the purchasing staff have, that is involved in NPD projects?	The degree of specialisation in the purchasing department, meaning knowledge about the supplier, technical expertise and specific product should be there to avoid miscommunication.[248]

[240] See Ragatz et al. (1997), p. 199
[241] See Johnsen (2009), p. 193
[242] See van Echelt at al., (2008), p. 197
[243] See Petersen et al. (2005), p. 378
[244] See Schiele (2006), p. 925
[245] See Ragatz et al. (1997), p. 191
[246] See Handfield & Lawson (2007), p. 49
[247] See Johnsen (2009), p. 193
[248] See Wynstra et al. (2000), p. 132

How is the purchasing involvement in NPD projects managed?	Development management, supplier interface management, project management and product management as distinguished management areas for NPD projects.[249]
How are cross-functional teams being set up in NPD projects?	Cross-functional teams need to have basic characteristics that functional diversity is ensured. Meaning employees form the same hierarchical level and from different disciplines.[250]
Buyer-supplier relationship	**Motivation**
What does your firm do to develop a long-term buyer-supplier relationship? **in terms of being attractive to the supplier* **in terms of supplier satisfaction*	Customer attractiveness leads to supplier satisfaction and that may lead to the preferred customer status.[251]
Does your firm make any effort to get preferential treatment from certain suppliers and achieve a preferred customer status?	The buying firm gets a better treatment on all levels in comparison to other customers of a particular supplier.[252]
Are you aware of power differences in collaboration projects with suppliers and how does it affect the trust towards the supplier?	For a working buyer-supplier relationship the factors of power and trust are highly important and influences many decisions that are being made.[253]
Outline of examples of supplier inclusion in NPD	**Motivation**
Could you give me an example of a successful project?	-
Could you give me an example of a moderately successful project?	-
Could you give me an example of an unsuccessful project?	-
Could you explain the case of the collaboration with a new supplier for shock absorber? **in terms of anatomy of the component* **behaviour of the supplier in the whole collaboration process*	-

[249] See Wnystra et al. (1999), p. 134
[250] See Joshi (1998), p. 22
[251] See Schiele et al. (2012), p. 1180
[252] See Nollet et al. (2012), p. 1186
[253] See Gao et al. (2005), p. 402

APPENDIX B: Coding guidelines

Category	**Sub-Category I**	**Sub-Category II**	**Coding** (refers to all text passages that can be connected to…)
NPD	Strategy		… the strategy or process of the firm for NPD activities.
	Issues		… issues that came up across all previous NPD projects.
Supplier Inclusion	Risk & Challenges	Trust & Commitment	… risks or challenges that arise because of trust or commitment issues
		Communication	… risks or challenges that arise because of communication issues
	Benefits		… short-term and long-term benefits of supplier inclusion.
Supplier integration & selection	Degree of supplier inclusion		…the extent to which a supplier is included in the NPD projects and the differences.
	Integration Point		…how the company decides at what point they include the supplier into the project.
	Identification of innovative suppliers		…actions the company does to identify innovative suppliers.
Internal organisation	Purchasing involvement		… the overall involvement of the purchasing department into NPD project.
	Skills of purchasing staff		… the skills purchasing staff

			members need
	Cross-functional teams		… how are cross-functional teams are being set up for NPD collaboration projects.
Buyer-Supplier relationship	Customer attractiveness		… what is the company doing to be attractive to a supplier.
	Supplier satisfaction		… how dies the company ensure supplier satisfaction when they want to collaborate
	Power differences		…are there power differences known and is it an issue.

APPENDIX C: Interview transcripts

Interview 1

Interviewer: Researcher (Christian Herdelt)

Interviewee: Head of Purchasing Running Gear

No public information

Interview 2

Interviewer: Researcher (Christian Herdelt)

Interviewee: Research & Development Manager Running Gear

No public information

Interview 3

Interviewer: Researcher (Christian Herdelt)

Interviewee: Supply Chain/Global Sourcing Manager

No public information

Interview 4

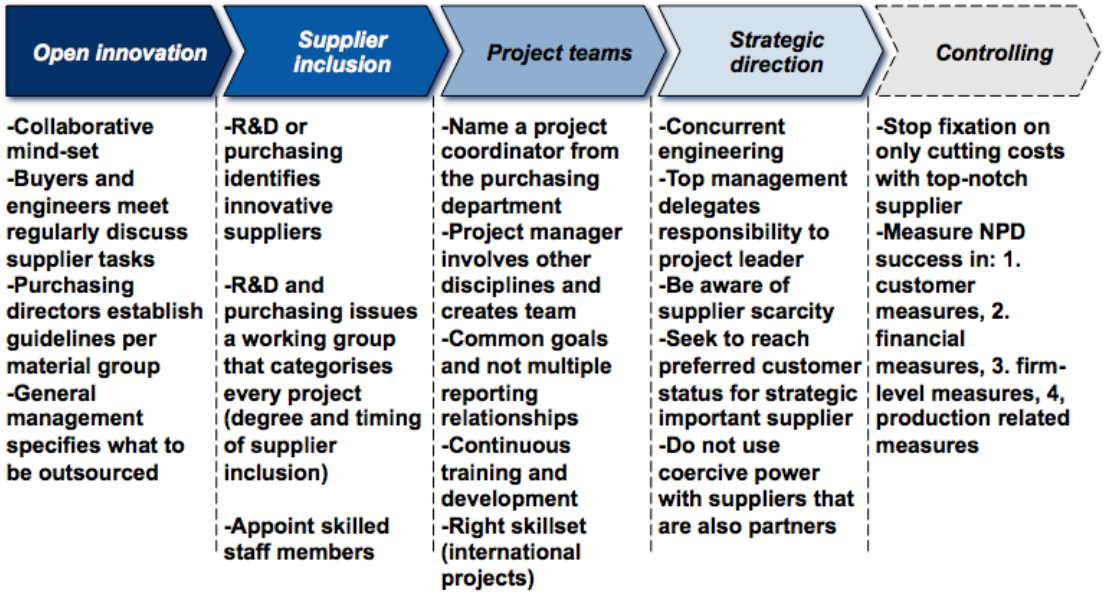
Interviewer: Researcher (Christian Herdelt)

Interviewee: Research & Development Engineer

No public information

APPENDIX D: The ideal model & processes

Process and advise of the ideal model:



Activities during the different degrees of supplier involvement:

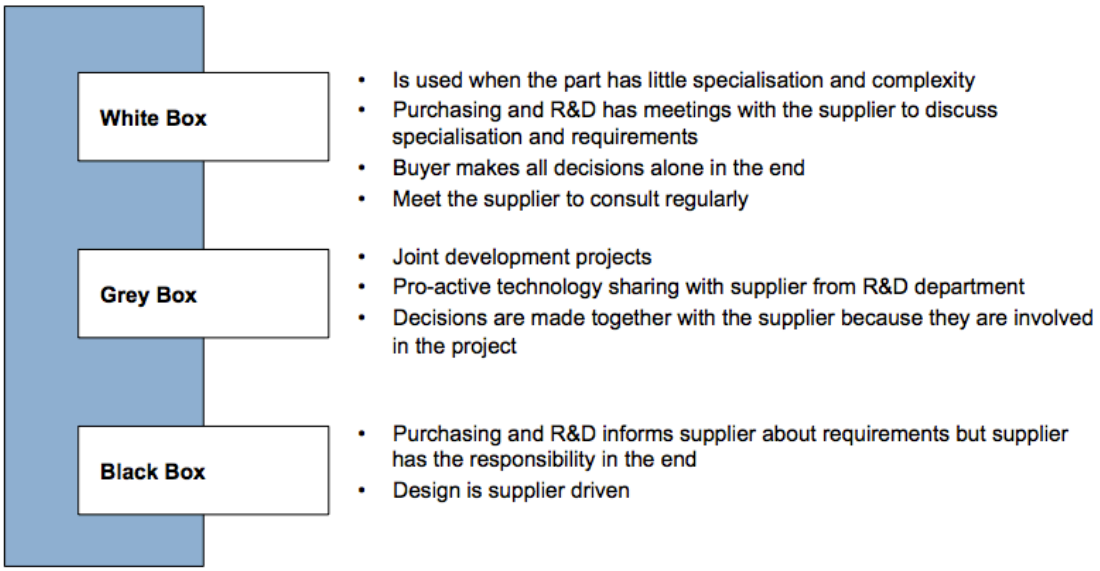


Figure 8: Degree of supplier integration

Source: Petersen et al., (2005), p. 378 + own elaboration

Guideline for the timing of supplier integration

Earlier integration	*Later integration*
• When SCB collaborates with a supplier for complex systems or (sub)systems	• When SCB collaborates with a supplier of only single items
• When the product or part is complex and needs specialised know how from the beginning on	• For suppliers that offer easy technology.
• For all suppliers of critical items or technologies for the trailers	• When the R&D department is able to develop in the beginning on their own without superior special knowledge
• For strategic alliance supplier	• For suppliers with less critical items or technologies for trailers
• For all "Black-box" integration projects	• For non-allied suppliers
• Top-tier suppliers with a superior technological knowledge	• For "White-box" suppliers where the partnership is to a lesser degree

Figure 9: Guideline for the timing of supplier integration

Source: Handfield et al., (1999), p. 78 + own elaboration

APPENDIX E: Non-Disclosure agreement sample

No public information

APPENDIX F: Influence on costs in the NPD process

In early stages of the new product development, firms have biggest influence on the costs. This is evident within the trailer manufacturer in all of their NPD projects also when they collaborated together with suppliers.

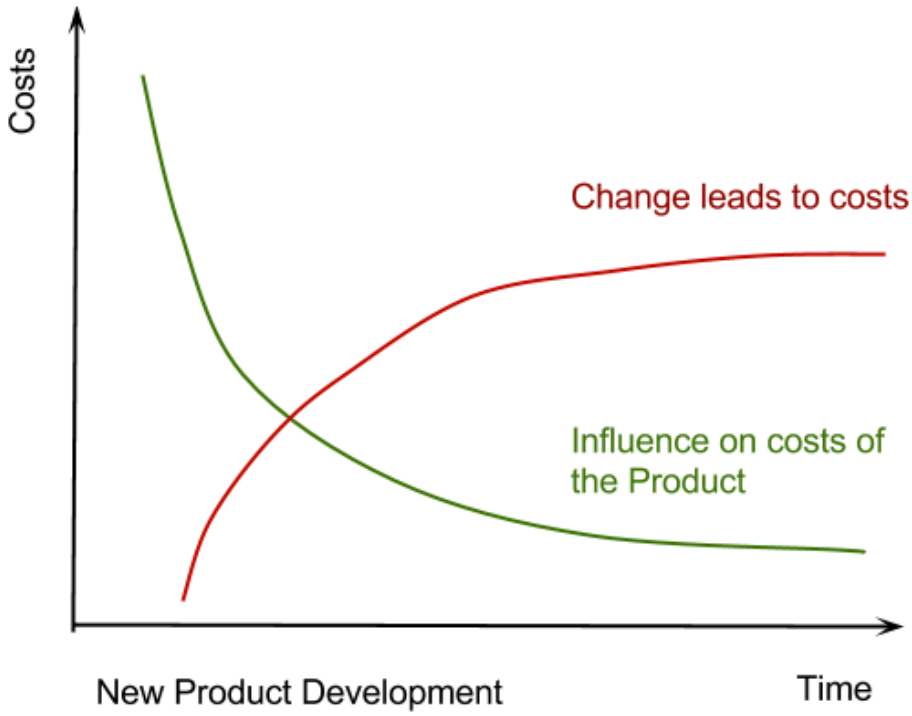
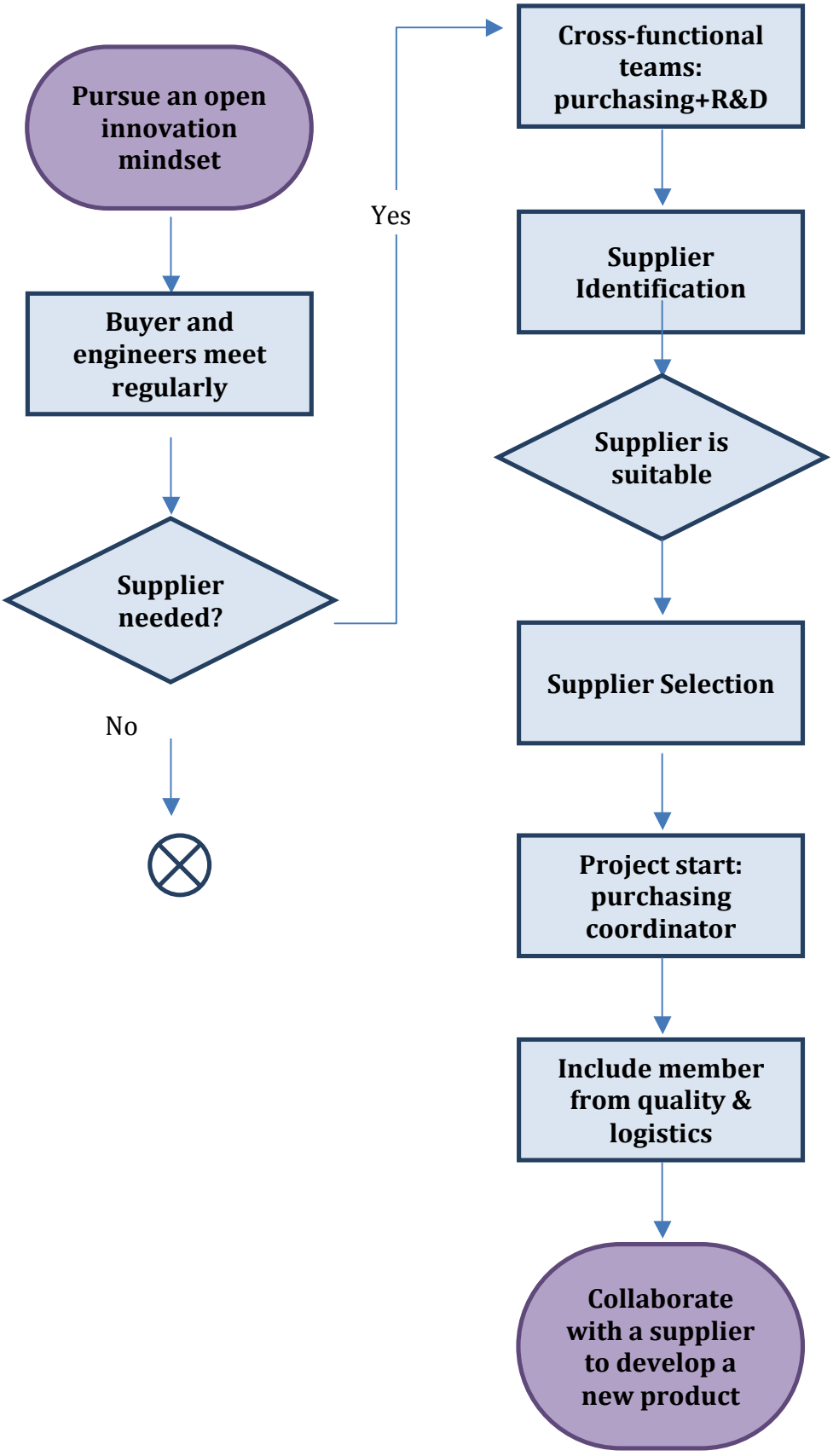


Figure 10: Influence on costs in the NPD process

Source: Trailer manufacturer experience + own elaboration

APPENDIX G: Process description early supplier involvement in new product development



APPENDIX H: Purchasing Maturity of the trailer manufacturer

Assessment not public information