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Preparation for supplier involvement in product development projects

With the focus on supplier selection, extent-
and moment of involvement

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Problem description

This thesis will research the literature on supplier involvement in product development and analyze empirical data with the goal to contribute with new insights on the topic. The purpose of the research is to investigate what type of capabilities a company looks for in a supplier when it is decided to involve a supplier in a product development project. Additionally, this thesis will take a closer look at factors which influence the company's decision for the extent and moment of involvement.

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Abstract

It has been increased recognition of the benefits which can be generated by involving suppliers in product development. Although, some research suggests mitigating factors of the involvement. Those factors relate to poor management of the involvement. In addition, it is poor theoretical contributions on selection criteria on suppliers involved in product development projects.

Therefore, the aim of this research is to contribute with new knowledge on effective preparation in the supplier selection process in product development projects. The problem statement is to investigate if there is a relationship between the supplier selection criteria and factors influencing the extent and moment of supplier involvement in product development. This thesis has focused on the topics concerning the extent of supplier involvement, the moment of supplier involvement and buyers focus on supplier selection criteria in product development projects.

A qualitative research approach was applied which included a multiple case study to gather the necessary empirical material. This thesis examines five different cases with individuals who have had experience with supplier involvement in product development projects. By using semi-constructed interviews and the logic of comparison of these cases, I conducted new empirical work with the aim to gain greater awareness and a deeper understanding of the effects of supplier involvement in product development projects.

The result of the study showed that the companies in these cases did concern suppliers' capabilities with the relation to the type of involvement. Factors such as development risk, lack of competence, high technology uncertainty, volatile market, need for flexibility and number of suppliers were reasons for early supplier involvement. In respect, technical- and complementary capabilities, goal correspondence and propensity to adapt were supplier capabilities which were discussed to mitigate these uncertainty enablers. Further research point to incorporate these findings and establish greater awareness of this relationship in the selection process to efficiently exploit the benefits of supplier involvement in product development.

Sammendrag

Det har vært økt anerkjennelse av fordelene som kan genereres ved å involvere leverandører i produktutvikling. Selv om noe forskning tyder på faktorer som kan redusere effekten av involveringen. Disse faktorene relaterer seg til dårlig ledelse av involveringen. I tillegg er det dårlig teoretiske bidrag på utvalgs-kriterier på leverandører som skal involveres i produktutviklingsprosjekter. Målet med denne forskningen er derfor å bidra med ny kunnskap om effektiv forberedelse i leverandørvalgsprosessen i produktutviklingsprosjekter.

Problemstillingen er å undersøke om det er forhold mellom leverandørvalgs-kriteriene og faktorer som påvirker omfanget og mengden leverandørinvolvering i produktutvikling. Denne oppgaven har fokusert på temaene om omfanget av leverandørinvolvering, tidspunktet av leverandørinvolvering og kjøperes fokus på leverandørvalgs-kriterier i produktutviklingsprosjekter.

En kvalitativ forskningsmetode ble anvendt som inkluderte en multiple-case studie for å samle det nødvendige empiriske materialet. Denne oppgaven undersøker fem forskjellige prosjekter med personer som har hatt erfaring med leverandørinnblanding i produktutviklingsprosjekter. Ved å bruke halvkonstruerte intervjuer og logikken av sammenligning for disse casene, gjennomførte jeg nytt empirisk arbeid med sikte på å få større bevissthet og en dypere forståelse av effektene av leverandørinvolvering i produktutviklingsprosjekter.

Resultatet av studien viste at selskapene i disse casene diskuterte leverandørens egenskaper i forhold til type involvering. Faktorer som utviklingsrisiko, manglende kompetanse, høyteknologisk usikkerhet, volatilt marked, behov for fleksibilitet og antall leverandører var grunner for tidlig leverandørinnblanding. Respektivt var tekniske og komplementære egenskaper, målkorrespondanse og leverandørens evne til å tilpasse seg var leverandørfunksjoner som ble diskutert for å redusere disse usikkerhetene. Videre forskning bør inkludere disse funnene og etablere større bevissthet om dette forholdet i utvelgelsesprosessen for effektivt å utnytte fordelene ved leverandørinvolvering i produktutvikling.

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1. Introduction

Product development is for many industries the leading strategy for competitive advantage. Schilling and Hill (1998) argued product development can be the way to achieve success or fall behind with failure. The achievement of success is difficult as product development is a complex process with an increasing number of product and process technologies (Maffin & Braiden, 2001). Earlier research has investigated and support early and extensive supplier involvement to be a significant contributor to performance in product development with benefits for cost, quality, higher innovation and time-to-market (Afuah, 2000; Carr & Pearson, 1999; Van Echtelt, Wynstra, Van Weele, & Duysters, 2008). Maffin and Braiden (2001) argue the product development complexity may be decreased by sufficient supplier involvement. Others argue supplier involvement in product development will contribute to “shortening the product cycle and increasing the rate of successful new product programs” (Bonaccorsi & Lipparini, 1994, p. 144). The involvement may range from minor specification issues to total responsibility of a product component. More and more companies are employing the strategy of Porter’s (1996) model, to focus the companies’ resources on core technologies. Non-core activities and the complexity of product development projects contribute to the necessity of increasing involvement of suppliers. Dowlatshahi (1998) states a buyer’s perception of supplier involvement should be to take advantage of the capabilities a supplier can contribute within a product development project. However, these benefits are not generated out of the blue. Improvements in project efficiency and effectiveness are not always the outcomes of supplier involvement (Birou & Fawcett, 1994; Petersen, Handfield, & Ragatz, 2003; Wynstra et al., 1998). This constitutes a problem area in the research of supplier involvement and causes an impediment this paper aims to mitigate. Van Echtelt et al. (2008) argues supplier involvement is not an easy procedure, because the processes of supplier involvement are quite challenging. This proacts Wagner Hoegl and Wagner (2005) empirical evidence on project management challenges with supplier involvement processes in product development projects.

Nevertheless, supplier involvement should be implemented to exploit external organization benefits. It just needs more emphasis on management processes. This is eligible especially for projects with contribution from several suppliers. Wynstra and Pierick (2000) claim for such situations it is crucial to map the different types of involvement each supplier is suitable for.

Relationships with suppliers can become more manageable by differentiating between forms and phases of supplier involvement. This involves the diversity of extent of involvement a supplier contributes to the final product. It is important to acknowledge the need for contribution and not the potential of contribution. This argument concerns the primary focus in the literature with regards to early supplier involvement (Bidault F., 1998; Takehishi, 2001). It is important to recognize that early involvement is only thought for a few, appropriate suppliers, not all suppliers. The appropriateness is based on certain criteria, which is discussed in the literature. Some discuss supplier with a high degree of responsibility for high valued complex building blocks should be involved (Clark & Fujimoto, 1991; Kamath & Liker, 1995). Other research supplements this with an evaluation of innovative and complementary capabilities (Hartley J.L. , 1997; Petersen, Handfield, & Ragatz, 2005). Sometimes, modification from suppliers in the final product is only needed for small components. Thus the manufacturer does not have the necessity to involve the supplier early on. Moreover, successful involvement will also depend if the supplier selected to be involved in the project is the most suitable. Uncertainties emerged in doubt of the correct choice of supplier can impact the results of the project and may companies reevaluate and change the supplier (Van Echtelt et al., 2008). Change of supplier after co-design activities have been completed can be costly and result in entering the market too late. Therefore is it very important to have a successful selection process in order to exploit the benefits of collaboration in development projects. The management difficulties of planning the extent and moment of involvement of supplier involvement have made my interest to investigate factors that influence the decisions for the extent and moment of involvement. Additionally, as it has been a lack of research on supplier selection criteria for suppliers to be involved in product development projects, I am interested to exam the criteria companies have set for these suppliers. In particular, the variety of types of uncertainties in the supplier selection phase of collaborative product development projects has not been a focus in the literature but will be under my examination for relation to the supplier selection criteria.

This thesis will research the literature on supplier involvement in product development and analyze empirical data with the goal to contribute with new insights on the topic. It will examine five different cases with individuals who have had experience with supplier involvement in product development projects. The projects of the cases have a diversity of scopes and environments; potential patterns will be explored to understand essential factors to evaluate in project planning

processes. The purpose of this study is to investigate if there is a relationship between the supplier selection criteria and factors influencing the extent and moment of supplier involvement in product development with the aim to contribute with better preparation in the supplier selection process in product development projects. This investigation will be done by first analyzing factors that have influenced the decision of extent and moment of supplier involvement, each an exclusive analysis. Second, it will be analyzed if there is a relation between factors influencing the extent- and factors influencing the moment of involvement. The third part of the study will exploratorily analyze the focus companies have had on selection criteria on capabilities of suppliers involved in development projects. This research will mainly focus on dynamic capabilities related to technological and collaborative attributes. Then it is investigated if this focus is related to the factors influencing the type of supplier involvement. Therefore, questions which will be answered are

- What factors influence the decisions of the extent of supplier involvement?
- What factors influence the decisions of the moment of supplier involvement?
- What is the relation between these aspects?
- What type of focus on selection criteria do suppliers have and what factors related to the type of involvement influence this focus?

As a result, findings will reveal what factors buyers examine when deciding the extent and moment of supplier involvement in product development. This mapping of factors may help future managers to direct their focus on factors that can cause a significant impact on the collaboration between buyer and supplier in development projects and help to decide the right extent and moment of involvement to eliminate potential risk. In addition, findings from the third part of the study will reveal which capabilities of a supplier the buyer focus on in the selection process of product development projects and if this focus is related to decisions of the type of involvement. This will contribute to first, new empirical data to the selection process for product development project literature by understanding if managers actually base their focus on the extent and moment of involvement. Second, gain new knowledge on the focus of management efforts in the planning process of product development. but also, to suggest what type of capabilities a supplier should have in projects with the impact of these factors.

2. Methodology

This chapter will present the research approach and its related aspects applied in this study. Next, I will present the selection and collection guidelines for my literature review, which has made the foundation for my theoretical background. Moreover, I will discuss the sourcing process of collecting empirical data and present and discuss the collection method of my empirical data. Finally, is an elaboration on the study's reliability and ethical considerations.

2.1. Research methodology

In order to investigate possible relations between the extent and moment of supplier involvement and establish an understanding of its relations to the supplier selection process, I applied a qualitative research approach in order to gather the necessary empirical material. By applying a qualitative methodology, I will find an understanding of the participants focus through an examination of the interpretations of the selection process by the participants (Bryman, 2012). I did a qualitative research because it would produce a broader context of supplier involvement in a project than what a quantitative research would. I feared with quantitative research; participants may have answered with a subconscious aim to make the organization or project look good. Such answers could also be produced with a qualitative study, but with semi-constructed interviews, it would be easier to ask questions where the interviewees had to go in depth in their answers. The flexibility of a semi-constructed interview also allows for an iterative approach, that is, “one which the there is a movement backwards and forwards between sampling and theoretical reflection until reaching theoretical saturation” (Bryman, 2012, p. 420). Additionally, the aim of the research was to investigate factors which could influence decisions made by the participants, and these factors may the participants not directly answer to but may be reviled indirectly through discussion of the projects.

Bryman (2012) states a research design “guides the execution of a research method and the analysis of the data”. For practitioners, he argues the research design should be a “framework for the collection and analysis of data” which should present a general idea of the meaning of the research in the specific context. This research is performed with a comparative design. This entails a multiple-case study of five major production and manufacturing companies with identical methods. By using the logic of comparison of these cases, I will conduct new empirical work with the aim to gain greater awareness and a deeper understanding of the effects of supplier involvement

in product development projects. The comparative design will allow to distinguish the characteristics of the cases and make it useful for theoretical reflections about contrasting findings (Bryman, 2012) and Robert K. Yin (2014) argue it can become more robust than a single case study design. However, I do recognize the complexity Robert K. Yin (2014) discuss utilizing a replication logic to either predict a literal replication when the cases give the same results or a theoretical contribution where contrasting results is found but with predictable reasons. Although, because of time and resource restrictions, entirely accurate predictable reasons will be hard to explore, but also because of a lack of information as the participants wanted organization and individuals to stay anonymous. However, an analysis will try to reveal attributes and factors which will impact these patterns.

A multiple-case study was decided as research design with the aim to research the focus on the selection criteria companies look at when a supplier should be involved in a product development project. Additionally, a multiple case study would help to investigate if a company applies early supplier involvement and what factors influence the decision to involve a supplier early and to what extent. However, it is important to recognize that this analysis will not contribute to state a common law for how and what selection criteria organizations use, this analysis is meant to reveal factors which take part in influencing the decision of selection criteria and moment of supplier involvement.

The multiple-case study procedure is illustrated in Figure 1 and based on Yin's (2014) figure of a multiple-case study procedure. The procedure initiates with theoretical development, which indicated my motivation for the topic and the establishment of the literature study in chapter 2.2. When a theoretical foundation was established, then a data collection protocol was created, and cases were selected. Sample process will be discussed in chapter 2.3. and data collection protocol are discussed in chapter 2.4. When the data was collected from the cases, each case was thematic analyzed with the use of coding and systematically compared to investigate patterns. The thematic analysis was analyzed between major topics: supplier selection criteria, extent of involvement and moment of involvement. Then it was done a cross-analyze between the topics. The process of the analyze was first, the recordings were transcribed and then it was read through and at the same time I took notes of particular events. Then I began to code each transcription and created a list of themes and subthemes. The themes were developed in an ongoing process were additionally

subthemes were added throughout the process. When the coding has reached an attractive level where it can be constantly compared, it can be done a theoretical elaboration of the relevant categories (Bryman, 2012). The themes with corresponding extracts were categorized with the use of Excel. Excel was also used to execute a comparative analysis where the cases and categories were put in a matrix. Such were the major categorizations examined and emerging points were evaluated as relevant topics. After the cross-case analysis, theory was modified to fit the relevant topic and a cross-case report was written.

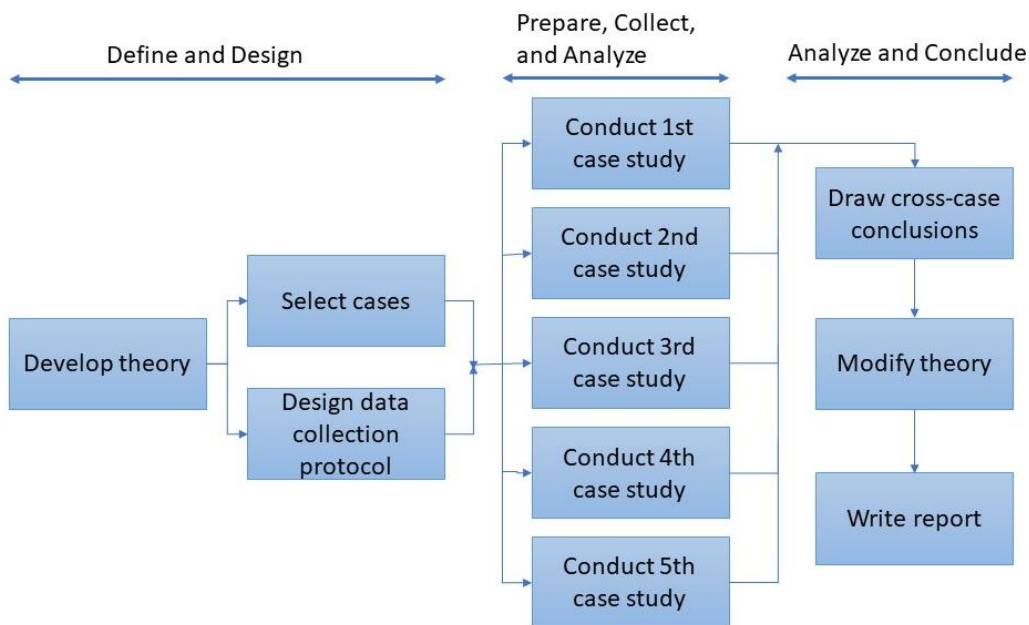


Figure 1- Multiple-case study procedure (inspired by Yin (2014) p.60)

2.2. Literature review

A literature review is conducted in order to be familiar with the focal topic and examine differentiations in the discussion of literature and hopefully arrange the most appropriate methods. It will be found as a basis to accumulate knowledge in the field of supplier involvement in product development, which will be conducted as a research for a master thesis. Furthermore, the literature review assists to narrow the scope of the topic and adjustment of the research problem (Bryman & Bell, 2011; Robert K Yin, 2013). The literature review is conducted to gather information on what is already known and understand former work on supplier involvement in product development. Any inconsistencies or controversies in the literature should be identified and discussed. This employs for theoretical models and strategies as well.

Search engines for gathering literature were Google Scholar and Scopus. These search engines generate quality to the input for this research, by providing academic journals and articles, even books and doctoral theses. Scopus self-description states as follows “Scopus is the largest abstract and citation database of peer-reviewed literature: scientific journals, books and conference proceedings”. Scopus enables to limit the search to desired date range and subject arena. By selecting a certain item, the abstract and full reference is showed. This make it very efficient to discard paper with irrelevant topics. Most of the papers used in this thesis are gathered through NTNU’s account at www.sciencedirect.com

The problem statement established the focus of the literature review. The research of the literature was found on a wide range of keywords. Main keywords used to search for relevant media includes (new) product development, product development, (early) supplier involvement, supplier integration. Additional sub keywords could be moment of involvement, extent of involvement, supplier selection, etc. A lack of relevant papers discovered, caused an experiment with the use of keywords. The keywords came along during the project and literature review. For papers with high relevance, a review of the reference list was performed to search for additional related articles. This method is known as snowball sampling of media (Bryman, 2012). In other words, one sample led to another. This aided to recognize new relevant literature and if new research was consistent or contradictory. In addition, a realization of ideas in the article have been developed with new data in more recent research. Moreover, the search results were categorized by times cited to obtain well known research and accumulate the paper’s validity. The papers were first judged on content of title and abstract to decide the relevance. In addition were they validated as I looked the journals up in “Norsk senter for forskningsdata” (<http://www.nsd.uib.no/>) which have made a register of validated papers. Relevant articles were saved on the computer and stored references in EndNote.

2.3. Collecting data

The initial sampling plan was based on the method of purposive sampling method. Bryman (2012) states the purposive sampling approach “is conducted with reference to the goals of the research, so that the unit of analysis are selected in terms of criteria that will allow the research questions to be answered”. Therefore, the aim of purposive sampling in this research is to strategical select candidates for interviews who should have experience and can contribute to the subject. Therefore,

my sample target withstood of purchasing managers who had direct experience with supplier involvement in new product development projects to be able to gather the most relevant data. Small and big companies from Norway with product development experience was contacted to get reliable and relevant candidates. However, because of lack of response and a complicated searching process to find suitable candidates, I also had to employ snowball sampling. Through one of the interviewees, I got contact information for a relevant candidate in another organization. Several of the smaller companies which were contacted stated it was a project manager/ director who personally had contact with the supplier but did not have time to do an interview. Therefore, the five candidates in this study were employed in big companies with a settled procurement department and hierarchy functions.

To access the proper candidates were an arduous and time-consuming process. Several complications emerged in the process, and the first resulted from the selection criteria which formed a relatively small pool of possible participants. Another complication was the complicated process to reach the potential candidate, due to inconvenient procedures employed by the companies to prevent the release of sensitive data, such as employees contact information, and lack of knowledge about company activities by the friendly stationaries of the central boards. This inconvenience led to accessing contact information to an HR employee who looks for a suitable person for my requests. The process was time-consuming cause it had to be done through e-mail and the mails often were forwarded several times before it got to a person with the relevant knowledge. When I first was in contact with the potential participant, I explained the goals of the thesis, the topics of the interview and discussed potential dates for the interview. After the call, I sent an email with a summary of the conversation and potential additional points for the interview and an invite to a scheduled meeting on Skype. Although the contact information process was inconvenient, the participants were friendly, and all the participants discussed that they enjoyed helping students with their research after the meeting.

In total were 24 companies contacted were five companies participated with one interview each. Four of the interviews were done one-to-one with the computer program Skype, and the fifth interview was a group interview with two employees from different departments, also on Skype. Table 1 consolidates information about the role, goal of the project, interview duration of the participants in this study, and are listed in the order in which the interview were conducted. All

the participants wanted the organization and themselves to stay anonymous in the thesis. Therefore, pseudonyms were assigned for the participants. In addition, I have intentionally neglected to give any information relevant to the industry of the companies and specific details of the projects to protect the participants, which constitutes one of the occasions Robert K. Yin (2014) argue it is necessary to use anonymity. Although, Yin argue anonymity is not desirable as it neglects the background information. However, this should not be compromised on the quality of the research as I have presented all the information relevant to the problem statement. The decision to use Skype was mainly made because of resource and time limitations, but it also imposes several advantages. Bryman (2012) discuss “audio” conversation may remove a potential source of bias formed by interviewee’s interpretation of interviewer characteristics or for example facial expressions.

Participants	Role	Goal of project	Duration of interview
Alpha	Group leader in purchasing and logistics	Project utilized for manufacturing	62 minutes
Beta	President of procurement in the project segment	Project utilized to enhance a production process	74 minutes
Delta	Head of procurement	Project utilized for manufacturing	65 minutes
Zeta	President of supply chain for the project segment	Project utilized for manufacturing	68 minutes
Gamma	1) President of supply chain 2) Strategic sourcing	Project utilized for manufacturing	71 minutes

Table 1 - Interviewee information

2.4. Research interviews

The method used to gather data will be a semi-structured interview. This approach will make use of an interview-guide with specific topics and questions which is necessary to lead the interviewee to deliver the appropriate information (Bryman, 2012). However, it will also give flexibility for discussion which is helpful when a person feels less confident by strictly answering to an interview. Then the discussion can be used as a tool to harvest the relevant information. By doing this, the qualitative data can be gathered. Although, external validity is weak when non-random methods of sampling are employed. By having prepared questions beforehand may make the interviewee acknowledged that I come prepared and appear competent, and for my own part I will be more confident as well. The flexibility of the semi-structured interview gives the informants the option to express their views on their own terms. This will provide reliable, comparable qualitative data. The drawbacks of this method are that the questions may easily be written in a leading manner. Therefore, it is essential that the interview guide is carefully planned. Further on, is the factor of interviewing a sufficient number of people to make a general comparison. This will produce many interview sets which need the necessary capability to analyze the data as it will be very time consuming and resource intensive.

A predeveloped interview guide was used for each interview. The interview guide was applicable from the computer. All of the interviews were recorded with a smartphone and were transcribed later on. This disqualified the need for notes, such that full attention was given to the interviewee and follow-up questions could be provided when the opportunity presented itself. The interview guide can be found in the appendix but note that it was an earlier edition of the interview guide. The interview guide had small modifications after the first interview. This modification was made because the first edition had too many specific questions, which made it hard to create a good flow in the interviewee discussion. Therefore, the interview guide was modified with questions which regards the broader topic, which made the discussion with the interviewees much better. Otherwise, the same interview guide was used for the rest of the interviews. The interview guide was developed with a foundation of the theoretical frameworks.

As stated earlier, the empirical data is based on five projects, each from a separate company, so in total of five companies. Each project constitutes a case. Before the interview was started, the interviewee was asked to introduce a project, such that the answers could be based on real

situations from the company. This was important to get the interviewee to answer with practical situations and not base their answers on what they believe would be the best option, cause then it would be harder to reflect on the causes that made a positive or negative impact on the project. However, the fifth interview was a group interview with two employees from different departments. They did not want to give answers specified for a case, cause of the loss of sensitive data. However, the interview made good reflections on different types of situations that had earlier emerged, and it was a good communication flow where the two individuals built their answers upon each other's reflection. Therefore, I could draw good data from this interview. However, they had difficulties by stating any concrete answerers as they felt it depended on the type of project. But discussions and deliberations relieved some relevant information. Four of five interviews were conducted in Norwegian and one was conducted in English. The extracts from the Norwegian interviews is translated to English in the best possible way to make it understandable, and without losing content or context.

Before the interviews were conducted and the interviewees were contacted, it was not decided what type of supplier involvement that the interviewee would discuss. I think it is important to mention that the interviewees all described the cases with the supplier as a strategic supplier. None did not directly mention it, but of the analysis of the timing and extent of the supplier involvement, I could define all the contribution to be strategic suppliers. For my sample criteria of interviewees and the contact process, it was only asked if an individual in the company had experience from a project where they had involved a supplier. Then, everyone had assessed “supplier involvement” to be a situation where the buyer and supplier had a close collaboration like co-development or in a project where a supplier would do most of the development with specification requirements by the buyer. However, this was not the intentions, but it would affect the results of the samples. It can also be discussed if supplier involvement in the industry is defined as more complex involvement than delivering commodity product with minor design adaptations, which in the literature is also defined as supplier involvement. Further on, as mentioned the interviews were conducted with the intention to narrow the answers in relation to the case projects. However, this would become a more difficult challenge than expected. Several of the interviewees had a tendency to drift away from the relation to the case and explain topics from subjective experiences. Though much of this information was relevant to the topic, and therefore I used it in the analysis to substantiate the views of the interviewees and establish the background they base their answers

from. My evaluation of this data has been executed, and relevant data has been analyzed as it has been relevant to the context of the research questions.

2.5. Reliability and ethical considerations

Since the company and participants had to stay anonymous, it will be impossible to replicate the same social context which Bryman (2012) endorse to enable reliability of the research. Therefore, I have documented the procedures and methodology processes of selecting and collecting empirical data to ensure reliability at my best. Descriptive collection of data and issues conducting the semi-structured interviews is elaborated in the chapters above. An interview guide is included in the data collection and is presented in the appendix. Such, may later researches find the same results by using the same procedures (Robert K. Yin, 2014). Additionally, to minimize bias and ensure reliability I conducted a systematic and structured analysis approach with an objective perspective on the empirical data to avoid subjectivity.

While doing qualitative research, it is essential to be aware of and account for ethical issues concerning personal integrity and human rights. This can be managed by assuring confidentiality, maintaining dignity and ensuring participants or material is unidentifiable (Bryman, 2012). When conducting this study, an important issue was to meet the request of anonymity by the participants and companies along with details of the projects that can be related to the mentioned elements. The anonymity was fulfilled by not mentioning the name of the interviewees, give imaginative names to the cases and describe case material in a general sense to eliminate the risk of company or project recognition. In addition, I alone retain the transcripts and audio from the interviews and the corresponding name of participants and companies.

3. Theoretical background

In this chapter, I will present the theoretical background used in this study. The chapter will be separated in three sections, namely (1) The extent of supplier involvement, (2) The moment of supplier involvement, and (3) Supplier selection for product development. Each part will be summarized with important theoretical contributions which will further be used in the analysis.

3.1. The extent of supplier involvement

With regards to the extent of involvement Wynstra and Pierick (2000) suggest to assess two criteria for deciding to what extent a supplier should be involved: Degree of development responsibility held by the supplier and the development risk. These criteria set the foundation of the supplier involvement portfolio illustrated in Figure 2, which identifies four types of supplier relations: Strategic development, critical development, arms-length development and routine development. They distinguish four levels of the responsibility a supplier can have for the building block based on the buyers technical specifications, detailed design, a global design and functional specifications. Below the figure is an elaboration of the model and how management should use the model.

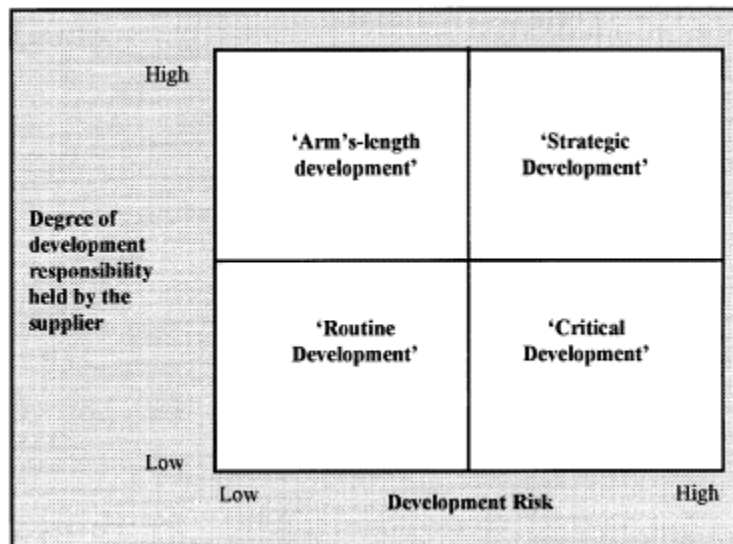


Figure 2 - The Supplier Involvement Portfolio (Wynstra et al., 2000, p. 51)

The phase of involvement is affected by the degree of supplier's expertise (knowledge, know-how, and experience). The degree of expertise is related to the choice of responsibility degree for a supplier. Wynstra and Pierick (2000) argue if a supplier shall contribute with high responsibility

in the later phase of a product development project, the supplier should be included in the early phase to prevent a reduction of freedom in the supplier's development. The reduction may be cost by other actors in the development project which freezes certain components. That will cause problems for the concept with the focal supplier contribution. Further on to the development risk. The time and effort required to develop a specific part are dependent on its importance, newness, and complexity. The earliness of the development is proportional to the amount of development efforts.

Strategy for the quadrants

Strategic development

Wynstra and Pierick (2000) states suppliers with high development responsibility for a high development risk concept could be used to prepare a global design for the building block. In order to develop the global design, it must be involved early in the development project. In the early stage, the information is vague, and the uncertainty is high. The buyer wants to be involved due to the development risk, while the supplier bears high uncertainty grounded in the small amount of specified demands by the buyer. This process needs regular verbal communication to clearly define if the desires are possible to achieve with the supplier's contributions.

Critical development

The Critical development quadrant with a low degree of supplier development responsibility and high development risk entails components which to a large extent determine the global design for other building blocks. Suppliers in this quadrant must be involved early in the project, in order for the manufacturer to accumulate the essential information. To make the right choices and not delay decisions for other components, one must ensure enough information intended for what is and what is not possible solutions for technical problems.

Arm's length development

In the case of Arm's length development, the development risk is low, but the supplier responsibility is high. The relationship with these suppliers is distant, as the manufacturer experience low uncertainty and risk for the building block. This lack of involvement from the manufacturer's side causes suppliers to have high uncertainty, due to the necessity to know the manufacturer's specific desires.

Routine development

Routine development is characterized by low development risk and low responsibility held by the supplier. The manufacturer specifies all the technical details for the involvement of the supplier, and coordinate and monitor processes to ensure no delays in the construction. Changes in technical specifications or cost are the main reason for communication between the buyer and supplier.

Kamath and Liker (1995) argue successful partnership “depend on the right balance among a supplier’s technological capabilities, a customer’s willingness to share information, and both companies’ strategic requirements”. Four roles as a supplier are explained in the table below, where each role has a different level of responsibility, which forms different relationships in the form of closeness and intensity between buyer and supplier. The choosing of the wrong type of relationship may dismiss potential benefits.

Role	Description	Responsibilities during product development
Partner (Full-Service provider)	Relationship between equals; supplier has technology, size, and global reach	Entire subsystem Supplier acts as an arm of the customer and participates from the preconcept stage and onward
Mature (Full-System Supplier)	Customer has superior position; supplier takes major responsibility with close customer guidance	Complex assembly Customer provides specifications, then supplier develops system on its own. Supplier may suggest alternatives to customer
Child	Customer calls the shots, and supplier responds to meet demands.	Simple assembly. Customer specifies design requirements, and supplier executes them.
Contractual	Supplier is used as an extension of customer’s manufacturing capability.	Commodity or standard part. Customer gives detailed blueprints or orders from a catalog, and supplier builds.

Table 2- Four Supplier Roles(Kamath & Liker, 1995)

Petersen et al. (2005) went further with the criteria of suppliers’ responsibility and developed strategies for the black box. A building block that is treated as a black box will have a supplier design and develop the block with concept requirements from the customer (Kamath & Liker,

1995). Petersen et al. (2005) made a model that illustrates a conceptualization of level of responsibility with a white/black gradient of boxes, where black is a high level of supplier responsibility (see Figure 3) . I will suggest arguing a supplier involved in a black box will have the same role as a mature supplier in Kamath and Liker (1995) categorization, respectively will gray box have similarities with a partnership. This model by Petersen et al. (2005) below may aid management to define the degree of supplier integration when the project team has determined the necessary responsibility of a supplier.

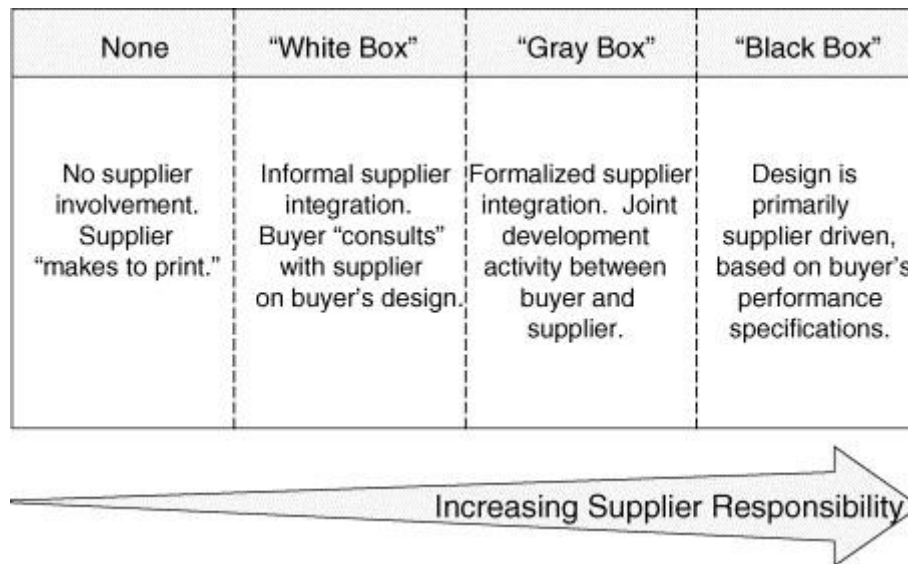


Figure 3 - Spectrum of supplier integration (Petersen et al., 2005, p. 378)

Petersen et al. (2005) argue supplier input on a technology object are effective for black box, but not necessarily in situations where suppliers have less responsibility for the development. This could be lack of interest when responsibility is low. Then again, their findings support former literature on the theory that contribution from suppliers promote better decision making for development project teams, which endorse better design and financial performance. Zhao, Cavusgil, and Cavusgil (2014) research states black-box integration positively affect speed to market, but best results is achieved when technologic uncertainty is low. Furthermore, Petersen et al. (2005) argue the culture of a supplier is as important as the supplier's capabilities for the establishment of effective interactions between the buyer and supplier. Nevertheless, in some cases a manufacturer are not able to handle the whole system themselves, thus must the degrees of integration be considered. Responsibility level will vary and are dependent on the type of project. For example, suppliers will have a different level of responsibilities for a know-how and capacity

project. For the former is the need for responsibility for critical systems, while the latter is it only necessary with responsibility for subsystems. Handfield and Lawson (2007) support the degree of suppliers responsibility separates the integration efforts in grey box and black box. Their analysis states tasks put with black box efforts need more supplier involvement in technical assessment than grey box tasks. On the other hand, business project assessment has the opposite result of the degree of supplier involvement. There grey box efforts have higher advantages with more supplier involvement. This suggest that components with technological complexity needs a high degree of supplier involvement.

Zhao et al. (2014) results show that the complexity of the product development tasks is “positively correlated to black-box integration”. Complex tasks a company does not have the competence to develop themselves is devoted with high responsibility to suppliers. This way a lot of resources is freed, and suppliers can contribute with more improved quality in parts where the focal company lacks expertise. By this research, I identify two criteria: tasks complexity and the value of the task for the focal company. If the task has high value to the company, it becomes a core competence and competitive value for the organization. Yoo, Shin, and Park (2015) argue that customers willingness to pay for quality products may impact the extent of supplier involvement in new product development. This relation is formed by the reasoning that quality products are in need of high quality in the design phase of the product and such may impact the extent which a supplier can contribute to the involvement with. Yoo et al. (2015) also found a correlation if the supplier involvement in the new product development leads to a reduction in R&D expenditure, it is likely that extensive supplier involvement would be more beneficial. Parker, Zsidisin, and Ragatz (2008) research tell us that the need for new technology is correlated to earlier supplier involvement in product development. Organizations must be able to respond to emerging needs in the market before competitors, by being more agile and flexible. With the involvement of suppliers early on and more frequent, can organizations rely on suppliers to contribute in the design to execute faster development and enhance quality in the products. Another aspect Parker et al. (2008) researched was the relationship between prior relationships in the supply chain and the level of integration in product development projects. His results made an argument for a former strong relationship with a supplier influenced to a great extent of involvement in a product development project. This relationship may not cause a surprise as the opportunity of pooling risk in projects with uncertainty

will be significantly valuable. However, he found no correlation between the familiarity of the supplier and the timing of the supplier.

To summarize, the literature argues a product’s development risk and especially the responsibility held by the supplier for the development are essential criteria to evaluate for planning the extent of supplier involvement. The supplier responsibility has been discussed in relation to different roles and the black box phenomenon with relation to several factors which may influence the degree of supplier involvement. The roles established by Kamath and Liker (1995) and Wynstra and Pierick (2000) matrix will be used as a framework to analyze the extent of supplier involvement in the case-projects in chapter 5.1. The different roles and responsibilities will be analyzed and see what how these factors will influence the initial selection criteria.

3.2. Moment of supplier involvement

This section covers the second topic of the theoretical background and will present essential factors that constitute a model which is derived from my literature sources. It is an important topic as it often interrelates with the extent of involvement.

Handfield, Ragatz, Petersen, and Monczka (1999) have developed a model for the development process from the initiation of the product to full-scale production of the product, process or service. The total process is separated into five stages as shown in Figure 4, and illustrates possible integration points.

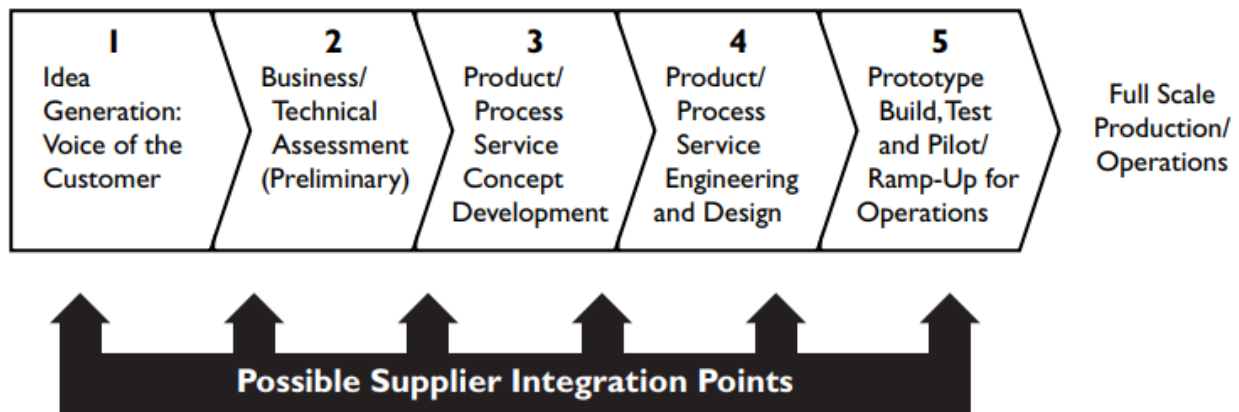


Figure 4 - New product development process (Handfield et al., 1999, p. 62)

The design and marketing functions ask customers of ideas in the first process and consider the need and demand for the product. The second process institutes a business assessment and a

discussion of potential technical solutions. In the third stage is the concept of the product developed with fixed performance specifications. Next is the actual development process where the interaction between buyer and supplier can be done in several forms, as described in chapter 3.1, to develop design specifications. The fifth stage will create a working prototype with testing and verification of fit in production systems. Which then will finally enter full-scale production. Suppliers contribute to the cost of many new products by the provision of materials and services. The impact especially emerges when suppliers provide critical technologies. This can be either innovative product or process technologies. Often have suppliers' greater expertise regarding the technology than the focal company's design personnel, if it is not apart of the core activities. Such, may supplier input be sought at any of the stages in Figure 4. Activities provided in the third and fourth stage do not impact the cost a lot, but the decisions in these stages will highly influence on total cost later on. Handfield et al. (1999) results declares 80% of the total development cost was generated by decisions in these stages. Surely this is because of the difficulties and costs of changing design later in the development.

Bonaccorsi and Lipparini (1994, p. 135) define the time of involvement as "the stage of the NPD process at which the lead manufacturer begins to search for suitable suppliers and make them aware of the project". They argue for effective management of early supplier involvement in new product development will contribute positive to a company's performance. Supplier relationships should be changed from arms-length to integrated partnerships. This is crucial for the performance in the design process. Jointly development work, established already in the design process, contributes to rapid and constant organizational learning. This supports the results of Chung and Kim (2003) study who argue suppliers involved early learn more about the component technology and market opportunities which leads to greater innovation, compared to late involvement. Problems may arise if close collaboration is not applied, e.g. schedule problems and lower quality, especially with unfamiliar second-tier suppliers. This relates to Wagner and Hoegl (2006) findings of exploiting the benefits of strong relationships by the use of early supplier involvement. Additionally, is the argument that later decisions in a project contribute to a higher impact on cost, which favors early involvement of supplier. This principle relates to the Japanese supplier involvement model (Bonaccorsi & Lipparini, 1994) and supports the argumentation that early supplier involvement in new product development shortens the development cycle. Wynstra, van Weele, and Weggemann (2001) state the motivation of early supplier involvement is increased

efficiency and effectiveness in the product development by gaining better leverage on the suppliers' technological capabilities. By facilitating suppliers', knowledge to complement internal core competencies will reduce time-to-market, costs, and improve efforts on quality and overall design (Ragatz, Handfield, & Petersen, 2002).

Griffin and Hauser (1996) claim early supplier involvement is beneficial for most cases, though Petersen et al. (2003) research suggested mitigating factors which reduce the effectiveness of early supplier involvement. Therefore, an examination is pursued to distinguish certain criteria in the literature which decides the moment of involvement. The mitigating effect of early supplier involvement may emerge when early assessments of a supplier which is not supposed to be involved before the latter stages of the development project(Petersen et al., 2003). On the other hand, assessment of a supplier which will be involved early in the project sees to be beneficial. The mitigating factor regards the degree of resources both buyer and supplier apply on the assessment. Petersen et al. (2003) argue for a situation where the supplier is not seen with a long-term strategic relationship, the value of the assessment may be inferior than the cost of it. Wagner and Hoegl (2006) research had mixed result on when to involve suppliers. The timing of involvement depended on the type of project, but the research also recommended to involve supplier as early as possible, anchored in the extensive time necessary to build and exploit the advantages of strong relationships. Eisenhardt and Tabrizi (1995) argue that fast product development is more technological uncertain and experiential which makes it more problematic to involve suppliers. These types of project have less likelihood for early supplier involvement, because of the high uncertainty in early phase and the desire to have supplier selection flexibility later in the development phase. Contractionary, early supplier involvement was more preferable in predictable projects. Problems may also arise with supplier involvement in product development. Lack of in-house technical capabilities will cause unforeseen delays and problems(Wasti & Liker, 1999). This will especially be a problem for a project context where the supplier may not be qualified for the strategic supply chain, and no efforts of improving the supplier capabilities are of interest. Wynstra, Corswant, and Wetzels (2010) raise another problem where certain functional departments may be opposed to involvement if the supplier does not have a finished product. Other drawbacks can be a loss of proprietary knowledge, conflict of objectives, loss of control of ownership, and emerging competition Littler, Leverick, and Bruce (1995). Melander (2014) research promotes flexible selection methods for uncertainty in technological,

organizational and commercial areas and suggests a firm to be flexible and not commit to a single supplier, in order to not lose opportunities of superior technology.

In the evaluation of the moment of supplier involvement in product development process, Handfield et al. (1999, p. 77) state there are two significant factors to examine; “the rate of change of the technology and the level of supplier expertise in the given technology”. Their practical recommendations in a changing technology environment are to delay the suppliers’ involvement to later in the development cycle. Missed opportunities caused by improvements in the technology environment during project lifetime is crucial for the final product. A high rate of change in the technology must be combated with late supplier selection in order to exploit the newest technology in the market and not fall behind in level of technology caused by being stuck with a supplier. This is in concurrence with Brown and Eisenhardt (1995) statement for a concept with high technology uncertainty for a fast product development project, the manufacturer should have supplier flexibility and therefore involve the supplier late in the development. However, if a supplier has high expertise and can contribute with valuable knowledge for crafting a new product, Handfield et al. (1999) recommend involving the supplier early in the process. Then, the relationship need enough time so both of the actors can develop trust and not feel uncertainty of each other. Early involvement will give the potential to develop a trustful relationship with the evaluation of the relational capabilities of the supplier (Melander, 2014).

The supplier involvement portfolio by Wynstra and Pierick (2000) also discuss the moment of involvement. The four quadrants set guidance for the extent and moment of involvement. Such, may the moment of involvement for these quadrants be discussed up against the theory of early supplier involvement. The supplier involvement portfolio sets certain criteria for when to involve suppliers in product development projects. Each quadrant qualifies for the combination of degrees of development risk and degree of development responsibility held by the supplier. Thus, can these two degrees be set as criteria for when to involve suppliers. For example, a supplier in the strategic development quadrant should be involved early in the development project to join the preparation of the global design of the building blocks.

Through this literature discussion, I have identified several criteria which may contribute to decide when to involve suppliers in new product development. A lot of the literature supports early supplier involvement, but some research found mitigating factors for the early supplier

involvement. Therefore, factors such as technology uncertainty, suppliers responsibility, development risk and suppliers expertise of the technology are essential to assess to decide the right moment to involve a supplier in product development projects. I believe the assessment of these factors in the (early phase) will be very influential on project success but also need to be assessed during the implementation phase. Understanding the influence of certain criteria will give managers rich guidance for successful involvement of suppliers. Additionally, will a priority of the factors be vital for effective management of the moment of involvement.

3.2.1. Model for the moment of involvement

When the supplier has been selected, the moment of involvement should be determined. By examining the literature on when a supplier should be involved in product development, certain criteria have been identified, which can be categorized and set in a priority list to more easily determine when to involve a supplier. Below is a list of the identified criteria:

Relevant study	Major findings
Eisenhardt and Tabrizi (1995)	<ul style="list-style-type: none"> • Technology uncertainty • Predictability/complexity
Handfield et al. (1999)	<ul style="list-style-type: none"> • Rate of change in technology • Level of supplier expertise for the technology
Petersen et al. (2005)	<ul style="list-style-type: none"> • Supplier development responsibility
Van Echtelt (2004)	<ul style="list-style-type: none"> • Technical risk • Supplier's assumed responsibility • The order of the development of critical functions
Wagner and Hoegl (2006)	<ul style="list-style-type: none"> • Type of development project
Wynstra and Pierick (2000)	<ul style="list-style-type: none"> • Development risk • Supplier development responsibility

Table 3 - Literature on moment of involvement

The criteria will be discussed if they are valuable to consider in the process, which criteria is most important and in which order should the criteria be investigated. Van Echtelt (2004) do not discuss when a supplier should be involved or what criteria the moment of involvement are dependent on. However, his studies at Ocè indicated the moment of supplier involvement depended on level of technical risk, suppliers assumed responsibility and the order of the development of critical functions. In this discussion, high technology uncertainty for a manufacturer would be in need of

early supplier involvement which is in concurrence with Handfield et al. (1999) and Wynstra and Pierick (2000), if the supplier has technical expertise. Although, this contradicts with Eisenhardt and Tabrizi (1995). The decision is grounded in consensus and later research. Former literature has discussed several variables that may determine the moment of involvement. Therefore, a model for this procedure has been created (see Figure 5) and suggested criteria will be elaborated on. Additionally, I recognize Wagner and Hoegl (2006) claim that type of project will determine the moment of involvement. However, no methods were identified in the literature which concerns when a supplier should be involved depended on the type of project. Therefore, is this criterion not implemented in the model. Already has the moment been estimated by Wynstra and Pierick (2000) matrix based on the degree of development risk and supplier's responsibility. The different strategies of Wynstra and Pierick (2000) matrix decides for early or late involvement, as illustrated in Figure 5. Wynstra and Poerick (2000) did not comment on the moment of involvement for routine- and arm's length development, but these states relates to the white box and low uncertainty, therefore should the supplier be involved as late as possible to benefit of supplier flexibility (Handfield et al., 1999; Petersen et al., 2005). If the strategy is sought to be critical- or strategic development, an investigation of rate of change in the technology environment should be pursued to exploit the benefits(Handfield et al., 1999). A high rate of change should influence to involve the supplier later in the development for the sake of having selection flexibility. However, this will depend on type of project. A market search for supplier or an appropriate supplier from the supplier base with high expertise for the focal component will change the decision to early supplier involvement. This will make a company take advantage of a supplier early on, and also have the necessary time to establish a good relationship if the actors are not familiar with each other from earlier. Figure 5 presents a model which is constructed from the theoretical contributions and will eventually be modified if results from the analysis is in contradiction with the theoretical contribution.

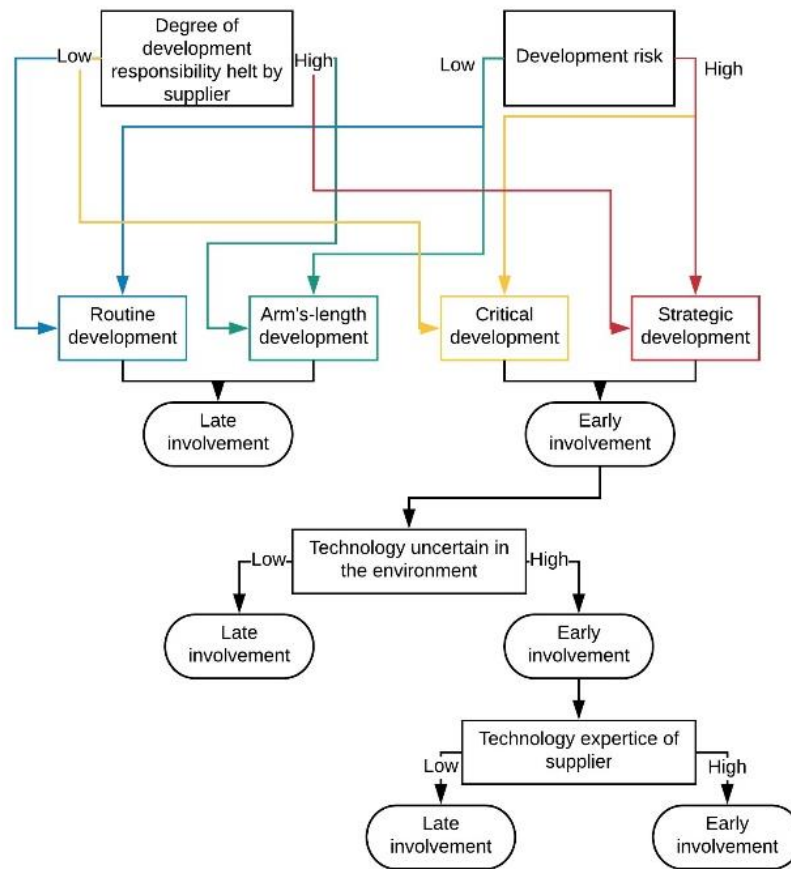


Figure 5 - Determining the moment of involvement

3.3. Supplier selection for product development projects

Supplier selection decisions in new product development are broad and complicated formed by various criteria in the decision-making process. The variety of criteria will be different depending on the purchase situation and product category. Petersen et al. (2005) told a great metaphor which I will rephrase to give a picture of the supplier selection process. A buyer can be seen as a fisherman, and below the water there are several types of different fish that would like to grab the fisherman's bait. The fisherman needs to know what he actually needs and what bait he should use to get this specific fish. For this chapter, I will take a look at what criteria a buyer has for its suppliers when it needs involvement in product development projects. This will give an understanding of what bait the buyer needs to use. In Table 4 is a list of important contributions which will be discussed in this chapter.

Relevant study	Focus	Major findings	Method
Emden, Calantone, and Droge (2006)	Partner selection for Co-development alliances	Technological-, strategical-, and relational alignment is crucial for maximizing the integration and sustainability of the partnership.	In-depth case research
Feng, Fan, and Ma (2010)	Partner selection for co-development alliance	Feng propose a method for supplier selection for co-development alliances grounded in two attributes.	Case study
Handfield et al. (1999)	Involving suppliers in new product development	The criticalness of the needed technology is vital in the assessment of suppliers	Case study & survey
Hartley J.L. (1997)	Manage Buyer-supplier interface	Technically component suppliers can reduce product development delays.	Survey interviews
Kamath and Liker (1995)	Suppliers' extent of involvement in PD	Suppliers in collaborative partnerships should have good technological capabilities and sophisticated management	Case study & survey
Little et al. (1995)	Factors affecting the process of collaborative PD	Flexibility among partners for successful collaboration	Survey
McCutcheon, Grant, and Hartley (1997)	Designer-supplier relationship in PD	Supplier cooperativeness contributes to technical success	Survey
McIvor and Humphreys (2004)	Factors effecting ESI process	Buyer and supplier must have a culture for collaboration in order to encourage problem solving	Case study
Melander (2014)	Supplier selection and uncertainties in collaboration projects	Supplier selection framework for managing technological uncertainty	Case study

Petersen et al. (2003)	Supplier integration	Supplier involvement may cause benefits when a technology in NPD projects are very complex	Case study
Petersen et al. (2005)	Supplier integration	Complementary technical capabilities and culture had a positive impact on project team effectiveness.	Survey
Takehishi (2001)	Management of supplier integration	Good communication and integrated problem solving with supplier would positively affect design quality	Multiple case study of Japanese auto industry
Tyler (2001)	Cooperative competencies	Cooperative competencies are complementary to technological capabilities	Literature review: resource-based perspective

Table 4 - Literature contribution on supplier selection in product development

The literature screens a lot of benefits achieved by involving suppliers in product development projects, but some studies also show mix results on project speed with this involvement (Eisenhardt & Tabrizi, 1995). A high degree of uncertainty in projects showed no beneficial effects of supplier involvement compared to more predictable projects where supplier involvement enhanced positive effects. Petersen et al. (2003) argue this comes from “the success of supplier involvement is contingent upon the process of evaluating and selecting the supplier for collaboration”(Melander & Tell, 2014). Petersen et al. (2003) state this selection process involves finding a supplier with complementary knowledge and that is easy to collaborate with. For the evaluation process of the potential supplier to be involved in product development projects, Petersen et al. (2003) argue to only, at least initially, approach suppliers that are trusted and with a proven track record. He states a company should assess the supplier’s expertise for the given technology and level of experience with product development projects. Technology complexity and a buyer’s lack of internal expertise in the area are factors which should promote supplier involvement. The big challenge with supplier selection for product development projects is the direction and rate of technology change. Different uncertainties and needs for suppliers in product development context will differentiate the supplier selection process compared to traditional criteria from supplier selection in traditional purchasing literature.

As shown by Handfield et al. (1999) case studies, the successful companies had developed a systematic process to decide what activities to insource or outsource. Here: insource is to perform an activity internally in the business, often with contribution from a third-party on site. These systematic processes would define the type and level of product technologies to outsource. A tendency illustrated from the case studies was that companies had increasing request for suppliers to increase the integration of their subsystems. In the majority of the cases, the companies focused on its internal competencies, and outsourced commodity items and these decisions were made at the higher level of the organization. The final decisions of insourcing/outsourcing were made jointly by the product development team and purchasing. Purchasing should identify lead suppliers, and the company should have defined the roles and responsibilities for a supplier in development projects. Handfield et al. (1999) discuss elements beyond cost, quality, and delivery for the evaluation of suppliers potentially involved in product development. These elements are the ability to accomplish for quality and cost targets, timing, (ramp-up) ability to increase capacity if needed, innovation and technical expertise, training. Emden et al. (2006) and Feng et al. (2010) has similar attributes and support the framework below.

Further on, Handfield et al. (1999) discuss the criticalness of the needed technology is vital in the assessment of suppliers. If the technology is critical and there is a few a number of suppliers available a more technical assessment of the supplier would be appropriate to develop the suppliers capabilities early in the product development process. After a performance assessment, the company should make a technology roadmap assessment to identify if the supplier shares future complementary technology plans. This is to ensure short and long-term alignment of objectives. Furthermore, the market structure may influence the selection process. The number of suppliers varies with the specific technology. Then if the technology is critical, it will influence the selection. Handfield et al. (1999) state a technical assessment of potential suppliers is necessary when technology is critical, and there are few available suppliers. Kamath and Liker (1995) argue suppliers involved in collaborative partnerships need excellent technological capabilities and sophisticated management.

Through a study of supplier selection in seven new product development projects, Melander (2014) developed a general framework for managing technological uncertainty. She defines technological uncertainty as outcomes which are not known, e.g. future development of the technology; the

direction of the technology; lack of knowledge of the technology. The framework initiates with an evaluation of a supplier's current situation and an evaluation of the suppliers' earlier collaboration with the focal firm. Technology reports, company visits, and supplier reputation are aspects which are investigated to evaluate a suppliers' current situation. For evaluation of collaboration, it is investigated how well the supplier have collaborated in earlier new product development projects, previous strategic meetings, and supply of existing products. By executing both these dimensions of evaluation, can the selection process accomplish the necessary assessment of a suppliers' capabilities as well as a suppliers ability to collaborate (Feng et al., 2010). By knowing what type of background a buyer uses to evaluate a supplier may help to evaluate the choice of selection criteria and why these were chosen.

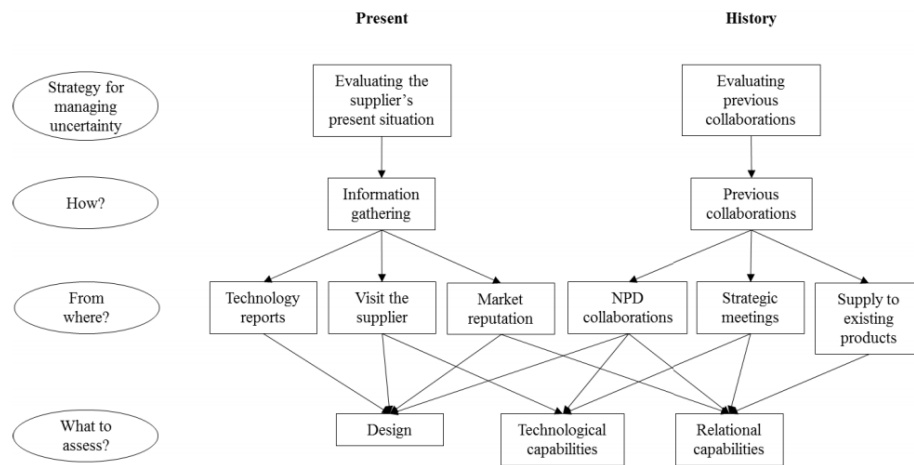


Figure 6 - Strategies for managing technological uncertainty (Melander, 2014, p. 79)

Another factor to discuss which will influence the supplier selection is the suppliers strategic focus on innovation which can be related to development capabilities in the framework below. Through a questionnaire survey of suppliers with European automobile vehicle as final manufacturers, Wynstra et al. (2010) found that a suppliers strategic focus on innovation will have an impact on suppliers product development activity, even more than the supplier position (tier-level) will impact. Buyers should try to affect the strategic agenda of a supplier by selecting suppliers with an innovative-oriented strategy if they want the suppliers to be active in the development process (Wynstra, Weggeman, & Van Weele, 2003). Therefore, the supplier should as well be able to produce high technology to integrate into the final product. Because supplier involvement promotes innovation Chung and Kim (2003) argue suppliers should strive to improve their innovative capabilities. Such will innovation capabilities can be set as a criterion in a selection

process for a project which sought to produce newness in its technology. Innovative capabilities can be put as an own criterion, but in this analysis, it will emerge under technological alignment, cause it is caused by a suppliers technical expertise.

Hartley J.L. (1997) results show suppliers with technical capabilities would help to avoid technical problems and aid with rapid problem-solving in product development, thus reducing supplier-related developing delays. For a supplier with high technical competence, Petersen et al. (2005) found it valuable for project team effectiveness to integrate the supplier in the determination of technical metrics and targets, especially in situations when supplier get high responsibility. The most important considerations for the supplier selection revealed in Petersen et al. (2005) survey were product and process knowledge. Such may buyers be depended on suppliers expertise on what can be possible and accomplished in the design. Their results indicated that “buying firms that are more successful at eliciting the supplier’s input on technical issues will make better decisions during the course of the project”(Petersen et al., 2005, p. 384). However, for complementary technologic competence to have a positive impact on effectiveness, it is given that the supplier has a culture for cooperation and can interact effectively on the project. This aspect is interesting to this research which will examine if buyers are able to investigate both these dimensions in the selection process.

On the other hand, for a long term relationship with future projects will cooperative capabilities be more important than the technical capabilities(McCutcheon et al., 1997). For projects with high uncertainty, these cooperative capabilities may compliment the technological capabilities(Tyler, 2001). McIvor and Humphreys (2004) argues to establish a culture that encourage collaboration between the two parties. Their findings stress that the culture in both parties must break down internal barriers, and attitudes among all business functions and senior management must be aligned to encourage and value collaboration. Such culture must be addressed in the pursuit of collaboration between buyer and supplier in order to encourage and facilitate joint problem solving. Especially, as this will enable frequent face-to-face communication and early integrated problem-solving between the parties which will positively affect design quality(Takehishi, 2001). This culture and potential benefits relates to Emden’s attribute and support why it should be emphasized as a selection criterion for supplier involved in product development projects (see framework below). McCutcheon et al. (1997) argue suppliers cooperativeness was the main

attribute to technical success for product development projects. More concrete could the cooperativeness of the supplier be specified as the quick response, and the understanding of the problems and willingness to work around the developer's agenda. This is supported by Littler et al. (1995) results which shows that the common perception among managers to have successful collaboration was flexibility among partners. This flexibility relates to a supplier propensity to adapt and is an important aspect which have emerged in the literature study and will be further analyzed. Melander (2014) argues for the company demand of technological capabilities is relative high for projects with both low or high uncertainty. On the other hand, relational capabilities were mostly desirable for projects with high technology complexity. This support Tyler (2001) findings on cooperative competencies importance in product development with high uncertainty, due to the complementary effects on technical capabilities. It is a debate in the literature of the degree of familiarity a company has to its suppliers that is involved in projects with high technological uncertainty. Some argue high technology uncertainty project tends to have unfamiliar suppliers involved, while other claim companies involve suppliers with former experience. The former arguments consider previous experience may harm innovation and creation, while the latter seeks the advantage of already known knowledge of the supplier's capabilities.

Emden et al. (2006) discuss three forms of alignment which need evaluation for selection of a partner in collaborative product development projects, see Table 3. These are technological-, strategical-, and relational alignment. He refers technological alignment to technical capability, resources complementarity and overlapping knowledge basis which will create the foundation for the potential of technological synergy. The strategical alignment concerns motivation and goal correspondence with the purpose of increasing the maximum potential to collaborate. While the relational alignment refers to compatible cultures, the propensity to adapt and long-term orientation which are attributes to foster and sustain the relationship.

Technological alignment	Strategical alignment	Relational alignment
Technical capability	Motivation &	Compatible cultures
Resource complementarity	Goal correspondence	The propensity to adapt
Overlapping knowledge basis		Long-term orientation

Table 5 - Supplier selection criteria (Emden et al. (2006))

These attributes will be defined as they will play a central part in the analysis and it is critical to set a base where my analysis comes from and how the participants may interpret in another way. Emden et al. (2006) define technical capability as a company's innovative technology or expertise. A buyer would seek such a capability cause the supplier would have technology of significant quality, or it could be competences of expertise utilized to develop a product. Resource complementarity base on a suppliers resources which is distinct but will complement a buyer's resources. This could be a supplier's technical recourses which would complement the buyers and together they would create new opportunities. Or it could be that a supplier would have market knowledge beyond the buyer's segment and help the buyer to expand into new segments. Complementary resources also define collaboration between the parts, but here it is important to state that this is supplier selection criteria. Therefore, the supplier has the ability to develop, but the buyer will not know if the supplier is actually able to collaborate before it has checked out the suppliers cooperative capabilities, such as goal correspondence and compatible cultures. Overlapping knowledge bases is produced by similar knowledge bases and could provide to "(1) to realize the technology's potential; (2) to discover complementarities of their competencies; and (3) to communicate these interorganizationally"(Emden et al., 2006, p. 336). Motivation and goal correspondence regards if actors will behave opportunistic to the project and have non-competing goals to benefit from mutual gains. Compatible cultures are important to overcome conflicts and is expressed through the organization's expectations, cognitions, mindsets, norms, and values. The propensity to adapt regards the supplier willingness to adapt when the collaboration requirements change and are important when a project is in necessity for flexibility. The last attribute, long-term orientation, will tell something about a suppliers considerations of current and future outcomes.

It is important to recognize that Emden et al. (2006) interprets that a co-development alliance governs more than just funding of research or purchasing of components, it should involve some sort of integration. The principles Emden calls can be discussed for a supplier with a great extent of involvement. Moreover, I recall that Emden position technological alignment before strategic and relational alignment, as from their study shows that the first objective of the alliance is mutual gains of pooled technologies. As these projects will obtain competitive knowledge, common goals and motivation – strategic alignment – must be aligned not to loose proprietary knowledge. It should not neglect the relational alignment, cause if the partners are not sharing the same language or norms and have trouble communicating, the benefits of co-development alliances will be

undermined. Handfield et al. (1999) discussed additional elements on the evaluation of suppliers: the ability to accomplish quality and cost targets, timing, ability to increase capacity, innovation, and technical expertise. These are elements a buyer can evaluate to see if a supplier is a right fit for the specific project. Another contribution to the alignment of technology literature is Petersen et al. (2005) who talked about the importance of technical competence. With relevant technical expertise, a supplier can make more significant contributions to the design of a product. This is supported by Hartley J.L. (1997) who argue suppliers technical capabilities will contribute to prevent emerging problems and product development delays.

Emden et al. (2006) work has contributed significantly to (Feng et al., 2010) research to produce a method for partner selection for co-development alliances. Through literature research with different dimensions; supplier selection in supply chains, partner selections for virtual enterprises, - for dynamic alliances, - for joint ventures, - for production networks. Feng et al. (2010) propose two attributes with different criteria for selection of a partner. The FMADM approach to process data for linguistic terms is not discussed upon here, but we will look upon the attributes Feng promotes from the literature review. However, be aware that this is produced from literature from other dimensions than the rest of this theoretical section. Feng et al. (2010) made a framework for selecting a partner for development alliances using individual and collaborative activities. The framework focuses both on the individual and collaborative utility. The former focus mostly on a supplier’s contribution of quality, availability, reliability, and performance. As for collaborative utility regards the desired outcomes as knowledge sharing and reciprocal exchange of information.

Outcome of individual utility	Outcome of collaborative utility
Quality	Knowledge sharing
Availability	Reciprocal exchange of information
Reliability	
Performance	

Table 6 - Outcome of utilities (Feng et al. 2010)

Such outcomes are constructed from compatible culture, non-competitive goals, and will establish a foundation for future collaboration by reducing uncertainty. The attributes related for the individual utility are technology capability, financial health, knowledge and managerial experience and capability to access a new market. While the collaborative utility comprehends resource

complementarity, overlapping knowledge bases, motivation correspondence, goal correspondence and compatible cultures (Feng, 2010, p. 161). As you can see these are very familiar to Emden’s suggestions. Below is a model by Feng which illustrates the attributes.

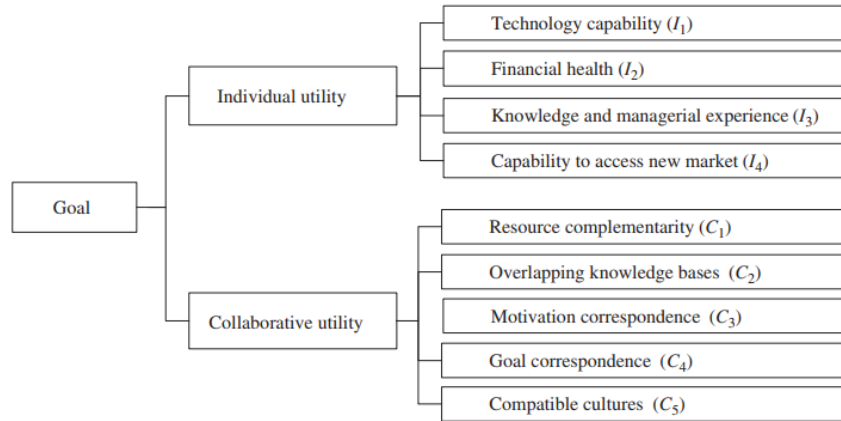


Figure 7 - The evaluation hierarchy for partner selection of co-development alliances (Feng, 2010, p. 161)

Emden et al. (2006) separated technological alignment in overall three attributes which were technical capabilities, complementary resources, and overlapping knowledge. Feng et al. (2010) discussed some of the same attributes but added financial health, knowledge and managerial experience as attributes to explain a supplier’s individual competence. Financial health and managerial experience are not directly measures for the technicality of a supplier, but here it is set as an input for technological alignment as financial health will measure the reliability of a supplier and managerial experience is necessary for the translation of the technical competence.

Further on in this dissertation will I use Emden et al. (2006) and Feng et al. (2010) categorizations and modify them to fit in for the analysis. Therefore, I will state the two main categorizations which will be further discussed in this literature review, which will build the foundation and used as a framework for the analysis (see figure 6). These categorizations are technological alignment and collaborative alignment. For these categorize will Feng’s outcomes of utility be set for each categorization. Thus, the former, technological capabilities, will contain results as quality, availability, reliability, and performance, while the latter, cooperative capabilities, will result in topics such as knowledge sharing, reciprocal exchange of information.

Technological alignment	Collaborative alignment
Outcome	Outcome
<ul style="list-style-type: none"> • Quality • Availability • Reliability • Performance 	<ul style="list-style-type: none"> • Knowledge sharing • Reciprocal exchange of information
Attributes	Attributes
<ul style="list-style-type: none"> • Technical capability • Resource complementarity • Overlapping knowledge basis • Financial health 	<ul style="list-style-type: none"> • Motivation & goal correspondence • Compatible cultures • The propensity to adapt • Long-term orientation

Table 7 - Framework of selection attributes (inspired by Emden et al. 2006 & Feng et al. 2010)

However, with regard to the attributes of the supplier, Emden et al. (2006) and (Feng et al., 2010) separates a bit how they interpret the relation of these attributes. For this research, I will state technological alignment will constitute of technical capability, resource complementarity, overlapping knowledge basis, financial health. Here: remember capability to access new market would regard resource complementarity. The cooperative capabilities will constitute of motivation and goal correspondence, compatible cultures, the propensity to adapt, long-term orientation. Even though Feng Feng et al. (2010) would constitute resource complementarity and overlapping knowledge bases as a collaborative utility, which it is, it will help to collaborate between the two actors, however, I see it like Emden that those attributes are constituted under technological alignment as it regards the technological functions of the supplier. Also per this definition, technical capability, resource complementarity, and overlapping knowledge basis are all attributes which will not be ensured without any cooperation, it needs some type of cooperation between the actors. But the collaborative attributes will be criteria that should be investigated in a supplier as these will decide, to a certain degree, how to enable the cooperation between the actors. Since I will not discuss strategical and future cooperation in this research, I will set motivation and coal correspondence under cooperative capabilities category, as these factors will also influence the ability to cooperate, e.g. lack of motivation from employees in a supplier may make them less focused on the collaborative project and instead focus its energy on other projects.

4. Empirical data

This chapter will give a description of each of the five cases. As stated in the method, I cannot go in details of specifications of the system of each case as it was a request for anonymity. However, information relevant for this study is descriptive elaborated on. The case descriptions are structured as the following, the interviewees role in the organization, project description, selection process, extent of involvement and finally moment of involvement, as far as the participant have elaborated on the subject.

4.1. Case description – Alpha

The interviewee is a group leader in the purchasing and logistics department and took a central part in the upcoming case. He had been working in the company for almost eight years with purchasing and logistics activities.

This case is about a manufacturing company which chose to develop, instead of buying, a system component for ships and maritime. The company recognized an increase in shipping and foresaw the shipping industry to become more green and environmentally friendly. According to the company, the market for the system component would increase by a factor of two by 2024. Further on, this case is focused on the company's involvement of a supplier to develop a complete system. In this case, I will take a closer look at the decision for why the company chose to involve a supplier in the development of the battery.

First off, is a narrative of the timeline for the decision of developing the system. In 2014, an assessment at the corporate level was made to purchase a supplier who could produce the system component with satisfactory specifications. It was some disagreement about the compatibility of the design of the suppliers' component; then it was decided rather produce the component itself. At the beginning of 2015, purchasing was involved in starting initiating contact with suppliers. Until purchasing was involved, the company had been to a daughter company to get inspiration and then a cost-benefit analysis was completed. The decision to involve a supplier was done by the project manager in consultation with individuals from R&D and purchasers. These held a meeting which constituted the decision of «make or buy» and looked at alternatives; what other companies use and what types of suppliers it was in the market to deliver according to the company's scope. In 2015, purchasing was involved to gather bids from suppliers and found two suppliers for further examination. At the end of 2015, one supplier was selected to be incorporated

in the demo. A framework agreement was reached with this supplier, including a developing agreement where the focal company could get access to the component which it could test. This deal made for the final decision for the focal company to develop the component itself with involvement from a supplier and a design of the system was created. One year after the press release, it delivered the first supply.

In 2013, it was a single supplier market. In 2014, was another competitor established. For this type of a system, it was only two competitors in the world, where only one of them was a reliable company. The industry had slow growth and suppliers who could provide whole-systems ruled the pricing of the market. An assessment of the cost for developing such a system made a verdict that the products in the market were overpriced. The focal company saw the opportunity to establish itself as almost a single provider in the marketplace. Pricing from the supplier and the supplier's thoughts on how pricing would be in the future was essential for that decision. The interviewee told he had to involve the supplier early, because of the complexity of the component and the high cost it brought to the total system.

The supplier was involved earlier than the design phase with the planning of the functions of the component. It was especially crucial for this case as the component was the core of the product. It was critical in revealing the performance of the component to disclose how the system could withstand specific external factors. Therefore, the characteristics of the component were very important to get cleared before the design of the system. Without involving the supplier for the component, the buyer would not get any further in the project as it lacked the necessary knowledge.

The interviewee stated it was hard to define what criteria that were most important for the selection of a supplier as every product development project was unique. However, for this project he stated three criteria they investigate to see if a supplier is fit to be involved in the project. The first criterion was if the supplier had any reference in the market; if it had made deliveries of this sort before. The next criterion was the size of the company. He grounded this in the argument that a lot of companies are innovating, but many of these are just start-ups. Therefore, they looked for a reliable supplier that had many years of experience. Reliable companies will have benefits exceeding start-up companies. The third criterion was the will to cooperate; how the supplier looked at the cooperation process with the company; if it were locked with competitors. This could easily be recognized on how the supplier was willing to share information. He stated in product

development, it was essential to be open to suppliers suggestion of innovation and if they want to develop the product or just be an ordinary commodity supplier.

The interviewee also discussed the importance not to be locked with a system design when the technology environment was in fast development. With regards to the component supplier, the company requested an assessment from the supplier on how the technology was then, and how they foresaw their technology to be and their competitor's technology to be in 3-5 years. This feedback contributed to the design of the current system. If the technology was developed, it should have been easy to implement new parts in the system. This was a lesson learned from a competitor. The competitor designed the system for a particular component, and some years later the system needed a new design for the new technology. Therefore, the company provided a functional description that indicated that the component had to be flexible in the future.

4.2. Case description – Beta

The interviewee has worked in the company for 33 years with procurement within the project segment. She has experience as a leader for the contracting office within the project segment and has been a part of several development projects. At this time, she was a president of the procurement department in the project segment and also a coordinator and facilitator for the procurement network in the company.

This project regards an industry which is very exclusive. In the company, there are several internal projects to develop existing technology to reduce cost, but also to reduce environmental impacts. This project is aimed at utilizing the heat which emerges from the production. Simplified, it needed to develop a product to enhance a process in its production system. The focal company has been in contact with several suppliers with applicable equipment, but the equipment is not customized to the buyer's requirements. This forms the necessity for the involvement of a supplier. The difference in this company's involvement method is that it invites suppliers to do a research study. In this case, it had contacted three companies and invited each of them to do a research study. These three suppliers did the study in parallel (time context), where each of them designed and engineered a product to satisfy the buyer's functional requirements. The buyer provided the suppliers with opportunities to come to the factory and test the equipment(product) before testing it on a large scale. This small scale of a test contributed to analyze if the product worked or if it needed further improvements. The strategy behind the studies was to get the suppliers to

understand that the development of the product could benefit themselves by implementing the new knowledge from the study into their product line. Such may the buyer reduce the cost of the study(development), if the supplier would understand the component can be useful later on. Here, the buyer is dependent on the supplier to continue the development and production for the market/ industry. If the supplier commercializes the developed products, it will contribute to keep the prices down (which is essential for the buyer).

The suppliers were introduced to the project in the concept stage. This was necessary as the buyer did not have this competence as a core competence. The buyer had certain thoughts and ideas of solutions, which it had worked with some research institutes, but it did not have the technologic expertise in the field. Therefore it needed supplier involvement. In this project, the buyer involved one supplier early on in the project. A bit later, it involved two more for the development of the same product; referred to the studies mentioned above. The buyer defined functional requirements for the suppliers to develop. The interviewee discussed that they might have involved these two suppliers too late in the project. She anchored this in fear of spending too many recourses on several suppliers early on, but the result of it would become a lack of competition in the later phases. She argued it would have been more profitable to use more resources early on several suppliers than be locked to one actor in the end.

When the interviewee was asked if she was familiar with any factors which would influence the criteria for supplier selection, she responded with a “no” but emphasized for a situation where the company would cooperate with a supplier she would primarily do it with a supplier with good technical capabilities and was a big company in the market. The supplier should have had the needed technology as a core business, been doing it for a while and have had a certain market share. She supported this by stating “we do this to be able to use it in the future, and we need some assurance that this supplier exists within this segment in future years”.

4.3. Case description – Delta

The interviewee was the head of procurement, and he was leading the procurement network for his business unit. He has been working in procurement for ten years, but in the organization for a total of twenty years. Additionally, it is essential to recognize that the interviewee was not involved from the start of the project. Therefore, some of the information regarding the initiation of the project was based on reports and communication he had experienced.

This case is about a project with supplier involvement for a manufacturing company. The project constitutes the development of a new component which is to be implemented in a product system. The characteristics of the product are essential to gain a competitive advantage, and one characteristic which is in focus is the sustainability of the product. The product system itself is an ongoing development project. But for the rest of this case, I will refer to the development of the component as the project, because it is in focus with regards to the supplier involvement and the newness of the component. The supplier involvement for the component is in the form of co-development, and the component is essential for the whole system. A strategy for this company is to utilize captive hardware and sell completely integrated solutions. For this case, one of the goals of this project was to develop hardware(component) that can only fit in the product system. Thus it may not be sold to other companies. For the next ten years after the development, the organization must buy this hardware from the supplier. The component was inspired by one of the supplier's products and adapted to the focal organization's system and upgraded to a higher level of quality and functionality. This was done in a step by step development process to define the right sizes of the hardware and to make it commercially available to all the regions worldwide.

The industry for this project was not particularly huge, and the organization knew most of the actors through networking. A critical factor for the supplier selection for this project was that it had to be a reliable supplier so that the organization was sure that the supplier could, in fact, develop the product. Another factor for this selection was previous development experience with this supplier. The interviewee mentioned certain factors might be influenced by emotions, but they tried to make it as objectively as possible. For the timeframe, the selection process was in the planning phase of the component. In the selection process, it was involved several suppliers in a tender process. But when the supplier was selected, the organization only worked with the selected supplier as it would not do another development for the same system.

The selection of the supplier was anchored in its development capabilities and capacity, but also for its capacity to be able to deliver the component in the future. The supplier was willing to make certain commitments in the agreement for commercial conditions and how commercial conditions would be adjusted over time, even certain economical developments. Other points the decision for the selection was based on the price estimate at the point the component would be developed, the

supplier's willingness to commit to the price, the willingness to share intellectual property (to a certain degree), the initial technical specifications, and the estimated outcome.

Since the interviewee was not a part of the selection process, he argued he would have liked more documentation from the selection process. In the final negotiating, he felt he had a lack of knowledge of what had been discussed between the two actors in the initiation of the relationship. For this project, the actors had a good relationship, so the procedure went fine. But if the relationship had not been that good, the interviewee argued the lack of documentation could have made a hazard as the business relationship was initiated for a long time period and the developed component could only be supplied from the selected supplier.

For this project, the organization had identified specifications for the requirements of the component. It had developed the functions, but it had not defined any design specifications for the component. The supplier was involved in the design of the component. This way the supplier was given the responsibility to do all the strength calculations. Thus the supplier had a particular responsibility to warrant the functionality of the component. A certain function of this component is critical for the whole system, as it may cause damage to humans. Another is it to be sustainable for a long period of time. The development of the component was an iterative process, where the organization came with requirements of materials and challenged the supplier to improve the component's practicality, aesthetics and to make it more economical. These improvements would not be on the compromise of cost.

When the interviewee was asked if the moment of involvement was the "best time", he commented it was the best option as the design was supposed to be co-developed. Another factor that made an impact of the decision for this moment was the organization's lack of competence in this area. It had developed solutions for this type of component themselves earlier, but not on the same quality and function level as the supplier could contribute with. This moment contributed to some flexibility in the form of an iterative development process, where the buyer and supplier could spar with each other to develop several options to optimize the component to satisfy the demand of the market. The interviewee also discussed early involvement as an advantage to the discussion of IP-rights. He stated with early involvement a buyer could communicate a line of the development scope without being too specific. This way allowed the buyer to still have the IP-rights by not having a too intense involvement from a supplier, but it would be more challenging to keep the IP-

rights for heavy involvement of a supplier where the supplier might have suspected more to own the solution.

4.4. Case description – Zeta

The interviewee has a background as a vice president of procurement and president of supply chain for the company's project segment. The last three years, he has been in the supply chain function. Earlier, he has been working with engineering and project management for almost twenty years.

He explained about a project with the intention to take advantage of the knowledge and expertise provided by a company outside of the focal organization's supply chain. This project ran product development in an area where the organization did not have the specific competence itself. Therefore, the organization tried to coordinate a partnership with a supplier for technology and manufacturing benefits. The aim of this partnership was to incorporate a supplier which could take more responsibility for the development, not just commodity deliveries. The necessity of the partnership was to find a partner who could develop greater parts of the system. The buyer had experience with incorporates of smaller components themselves, but they wanted to investigate if a partnership could contribute to reduce cost and cause other potential benefits. The buyer looked at old statistical data of how much it had produced, then the thought was to integrate a supplier with a potential for greater deliveries, but also had the flexibility to contribute with development/research/innovation competence that is complementary to the buyer's competence.

The supplier selection process initiated with a screening of the market, where they looked at a similar type of competence or similar type of product they had developed earlier. From the beginning had they a demand to not work with small companies, but to work with a company with a sturdy solidity and had experience in more segments than the focal company had itself. Based on this screening, the organization could identify the type of competence and interface the suppliers had for innovation and development projects. It was a well established market with many potential suppliers. Therefore, the buyer initiated the selection process with a so-called, "long list" with ten to twenty potential suppliers. One of the elimination activities was to look at the suppliers' reference list. Then, the buyer did a screening and reduced the list to a "short list" with five suppliers. For the suppliers left was a phase with a lot of communication between higher hierarchy managers for both buyer and supplier, especially with the focus on cost, of whom the buyer should establish a partnership with. This communication phase enabled familiarity between the actors,

and the buyer investigated the research and development department and the R&D focus the supplier had. The interviewee discusses the development process as a pre-stage to deliver quality and therefore discussed this as a subtopic for quality. He stated, "...quality is a chain where you need to make evaluations of the entire chain to arrive at a delivered product". Anchored in this, the buyer investigated the supplier's capabilities to enable quality in the production, statistics on quality deliveries, reviewed its process on industrializing the production, and the product development capabilities. To what degree do the supplier have references and a layout that allowed it to take results from research and development into industrialization, and also how the research and development department and project implementation methodology was constructed. This constitutes the quality aspect of a supplier defined by the interviewee, which he evaluated as one of the most important criteria. As mentioned in the case description, flexibility and potential volume on deliveries were two criteria for the selection process. But the interviewee emphasized cost importance for the project and mention the organization's standard selection criteria for supplier involved in product development: cost, quality, HSE, a review of company structure with regard to compliance, research, and development competence. He argued cost, quality, and volume of deliveries were the main criteria in the end evaluation.

The aim of the partnership was to co-develop new technology by sharing development segments and potentially share new IP-rights. With regard to IP and patents, the interviewee told it was two possible solutions; an agreement can be established to distribute the potential solutions to the relevant company functions, such may the function apply for a patent or an agreement where the partners share the solutions which are developed from the cooperation. In this industry, the supplier did not have any particular interest to claim ownership of the developed technology. This was important for the buyer, as it would not look at a supplier as a potential partner if it was a possibility it could become a competitor. Thus, the supplier had to be flexible with regards to ownership of IP and patents. Such, might the buyer secure its efforts through patents and got a partner who focused on deliveries to create wealth.

The discussion of how much the supplier would be involved was done in the selection process with regards to the shortlist, more specific when it was three potential suppliers left. Then the buyer investigated if the supplier's competence fitted the buyer organization's competence structure. This process was also the time when the actors discussed which one of them that was most suitable

for the different development activities. These decisions that regard the extent of supplier's involvement had to be discussed before the final selection of a supplier. An additional point on why the extent of involvement must be fixed before the final selection was the necessity of a legal commitment describing who did what.

The supplier would not get total responsibility for the development. This was anchored in the buyer's business strategy to not set the supplier in a singular position where it would get full leverage on the buyer's potential on product deliveries. Cause if one of its subcontractors became bankrupt, the buyer had to be in a safe position if the supplier had chosen to not invest in that industry segment anymore. Then, the idea was that the buyer must have the opportunity to establish a similar partnership with another supplier. To summarize, the strategy would be to work closely but to ensure that the buyer could have an opportunity to go in another direction if it turned out that the supplier either failed to deliver quality or did not want to run the segment anymore. However, the buyer's strategy was to let the partner have a great responsibility to a certain part of the whole scope; high responsibility and great involvement in the segment in which the supplier had significant expertise. For this segment, the buyer had access to and defined the performance function of the product part. The supplier had no access to the rest of the scope after the completion of its sub-product.

As mentioned earlier, the supplier was introduced in the project during the planning phase. This decision was based on gathering the necessary information to define what the production phase should constitute. The tendering process discussed earlier would be a part of the selection phase, due to the suppliers' suggestions in the planning phase would be very valuable to identify the critical activities in the production phase. These contributions would contribute to the selection criteria for which way in the industry segment the buyer would further proceed with. Additionally, early involvement promoted a close relationship between the actors which was necessary to enable the supplier to reduce cost by industrializing the prototype and exploit the supplier's knowledge to adapt to other industry segments and development trends. Hence, product life and cost are drivers for close cooperation which needed early involvement. The interviewee also stated when it was fast development in the industry, good cooperation could make it easier to initiate development and respond to changes in the industry direction.

4.5. Case description – Gamma

As mentioned in the methodology chapter, the last interview was a group interview which would not present any case, but it will present the discussions with regards to the relevant topic from the interview. First is an introduction of the two interviewees. The interviewee number one is the leader and president of the supply chain. In his function, he has a commodity structure with commodity managers who handle large-scale purchase segments. This function also involved strategic logistics for the whole organization. The second interviewee worked with strategic sourcing within a sub-segment of the organization. This department had come farthest with implementing supplier involvement in the organization and had familiarity with early supplier involvement.

The focal department of the organization had developed a process, in this thesis called “integrated product development (IPD)”, which was meant to visualize the necessity of a generated business case and identify its value for the organization. This process set paths to develop a new product, and supplier involvement was an activity in this process. Activities in this process was a make-or-buy process, establish project teams, etc. The supply chain was a part of this process by suggesting and/or selecting a supplier that can assist in the development based on former experience or capability evaluations. By utilizing the IPD process for the project would the organization secure competition and a good life cycle on the purchased components.

The organization will primarily use suppliers that they already have experience with, anchored in the knowledge of social and technical competence, both capacity and capability, and also cause the supplier was familiar with the requirements of the buyer, that was a significant advantage. Parts of the organization’s portfolio was to compete in a peculiar market, and it demanded the organization to push the technology to the next level consistently. Thus, a capability of the supplier would be to be very proactive in developing technology and products in its own segment. To ensure the supplier also did this had the relationship to be optimized claimed one of the interviewee’s. Proactiveness in the development would contribute to penetrate a market early on, he claimed. The organization divided its suppliers into four segments: basic, core, preferred and strategic. A tool with eleven parameters was used to classify the suppliers. The parameters were: CSR, quality and delivery, proactive approach, quality beyond the demand, successful completion of R&D, world-

class excellence, secure IP rights, commitment to values, and global perspective with regard to development segments outside of the buyer's industry and compliant strategy.

The interviewee mentioned a case where the company involved a supplier early in a product development project to contribute to the functions and design, and with a generic description of inbound components to create competition and not lock itself to one supplier, could make an impact of 30% on cost reductions. The interview argued that early involvement is mostly positive, but a condition was that the supplier had been mature to understand it took part in a development project and that part does not determine it was fixed for production. The supplier would be involved as neutral part and be paid for the development it did. Then the supplier would be marked as a strong candidate for series production if it had the necessary capabilities. Additionally, they argued early supplier involvement was very beneficial to the organizational strategy of being in the lead in the market on the technology. They stated it would cost more in the early phase, but it would become profitable on a life cycle perspective.

5. Analysis and Discussion

In this analysis, I will draw different points from the interviews and carry out a comparative analysis, which I will illuminate it with a theoretical contribution. This chapter will be separated in five sections (1) The first section is an analysis of the cases with regard to the extent of involvement with theoretical contribution from chapter 3.1 to answer the first research question, (2) the second section is an analysis of the cases with regard to the moment of involvement with theoretical contribution from chapter 3.2 in order to answer the second research question, (3) while the third section will discuss the relationship between the extent and moment of involvement to answer the third research question. The final two sections will answer the last research question, which will (5) analyze the focus each case had on selection criteria and (6) discuss if it was related to the results from the earlier sections.

5.1. Extent of involvement

First, I will categorize what type of role the supplier has had in each of the cases and what degree of responsibility this has resulted in. The categorization will be analyzed and based on theory from the literature review. Then the development risk of each building block with supplier involvement will be analyzed. As a result, I have categorized the supplier involvement with Wyns Wynstra and Pierick (2000) matrix and identified and captured factors that have influenced the decision on the extent of supplier involvement.

5.1.1. An analysis of the extent of supplier involvement for each case

In the next paragraphs, I will analyze the extent of involvement the suppliers had in each case, cause this was not directly mentioned in the interviews, and it is important to categorize with the same base, and for this, I will use Kamath and Liker (1995) categorization of different supplier roles. This is necessary for further analyze the moment of involvement, and to examine if it can cause correlation with other factors.

What role had Alpha?

The interviewee from Alpha did not define the supplier's role in the case description. However, with the information provided and literature definitions by Kamath and Liker (1995), I will define the supplier's role in the case as a partner. This categorization is based on the interviewee's quote "we had to work closely with the supplier to find what type of characteristics... [the component]...

had, which outlined premises for how we could build our system”. The buyer would not be able to build this system without involving a supplier, and it had to be involved early to advance in the project as the buyer did not have the necessary competence. Therefore, I have defined the supplier’s relation as a partner as it participated from the pre-concept stage and defined functions of the system, which put it as a partner compared to Kamath and Liker categorization. The partnership is also established by the fact that the supplier had to develop the building block with certain requirements from the buyer and co-develop the system as the building block was such an important part of the system. The interviewee stated the supplier could supply a complete battery system, then it would have been a pure contractual relationship (Kamath & Liker, 1995), but that system did not have the degree of security requirements the buyer demanded for its system. Thus, the co-development differentiates the relationship between the actors from a mature relationship. Additionally, did the buyer tests for the supplier which it could benefit from. The testing of these developed components would become a common interest for both the buyer and the supplier. The buyer would have access to how the component worked and the supplier would have unrestricted testing of the developed component editions. The necessity the buyer is of the supplier constitutes this relationship as a partnership. Moreover, Alpha stated it was important to have close cooperation with the supplier to estimate how the technology would advance and to clearly state to the supplier that it should regard that the system need to be adaptable as technology in the industry advances. Compared to Wynstra’s four level of responsibility a supplier can get for the development of a building block, in this case, the supplier would have the responsibility of the functional specifications of the component it would develop. This is grounded in the involved it had in the concept study and feasibility studies, even though it was the buyer which facilitated the testing.

What role had Beta?

This case created a unique situation as three suppliers were involved in making a so-called “study” where each supplier had to develop a component, to a certain degree, as a selection process. The buyer defined certain functional requirements which the suppliers had to design around. The three studies were done in parallel where the selection of the final developer was finalized based on the prototypes of these studies. Then the selected supplier would develop to a full-scale product. This can not be recognized as a partnership as it was not any co-developing. However, the buyer did

facilitate the supplier with pilot projects where the suppliers could test their component. The interviewee said it was in agreement that each supplier could bring the component and mount it in one of the buyer's factories as a test pilot, before testing it on a large scale. In this pilot test, the buyer and the supplier could together examine if it worked or if it needed further improvement. It is complicated to categorize the role of these suppliers in the categorization of Kamath and Liker (1995), for many reasons. First, it was several suppliers. Second, the supplier was not selected yet, but they were still in a selection process. Third, the buyer facilitated with test equipment and resources to discuss the technological evaluations done by the supplier and potentially any modifications, which does not fit into Kamath and Liker (1995) categorization. It does not fit as this facilitation constitutes a partnership, but the relation between the buyer and supplier in the context of neglect of co-development will constitute the relationship as a mature, which is grounded in the interviewee statement: "... we did not get involved in the suppliers' technical development of the product, cause that is his thing". If I refer to the categorization by Wynstra, I could identify the supplier responsibility of the global design on the basis of functional specifications of the building block and is categorized in a black box according to Petersen et al. (2005). This could constitute the suppliers as strategic suppliers (if the development risk is high, analyze will be done later), but it would not constitute the relationships as partnerships as its product is not co-developed between the actors and the relationship has not been finalized for the selection. When the final selection has taken place, then the supplier will have a role as a full-system supplier(mature) (Kamath & Liker, 1995).

What role did Delta have?

The interviewee from the Delta case mentioned they co-developed the component with the supplier. Now I will examine if his information relates to the categorization of the theory contribution. The buyer needed to develop a component but did not have the necessary competence to advance the technology of the component to the level of requirements. Therefore, it chose to involve a supplier. The buyer had very specific demands for the component. A component requirement set by the buyer was that the component could only fit into the buyer's system. The supplier had the technology, but it had to be adapted and upgraded to the requirements of the buyer. This could look like the supplier had a mature role (Kamath & Liker, 1995). However, the development process was an iterative process where the actors co-developed and both came with

ideas and solutions. Here, the buyer would come with requirements, but also ideas, which the supplier created solutions for. The buyer also challenged the supplier continuously to improve the system; to make it “more easy to install, try to reduce the number of components to make it more economical while maintaining certain function, but also to make it more esthetic from a user perspective”. The interviewee also mentioned the supplier would have influence in the specification and the function of the hardware, “we wanted the supplier to have the responsibility to do all the strength calculations, so we chose that the supplier had a certain responsibility for the functionality. Our designers had a responsibility to make it an attractive solution for the end-customer”. The close collaboration with communication back and forth between the actors indicate a partnership between the actors. This close relationship was reasoned by the wish to lift the level in the market and work with a partner to set new standards in the market.

What role had Zeta?

In the case with Zeta, Zeta tried to find a partner who could develop a new component and produce with higher volume than Zeta had been capable of, but also had flexibility where Zeta could utilize the supplier’s research and development competence. In addition, the supplier would get a high degree of responsibility for a part of the scope which it had its expertise in. However, Zeta would still have access to this part and define the performance and the functions of the component. The supplier had no access to the development of the product after finishing its component but had the high responsibility on its part. The interviewee stated: “the goal of the partnership was to establish an arrangement to collaborate on developing shared technology; an agreement where we share the development activities and share the results, which could be IP-rights”. Product life cycle time and cost were additional drivers for the collaboration, as the supplier would have access to a broader market and the ability to reduce cost by industrializing the processes. Therefore, I will state that the supplier would have a role as a partner since the buyer provided specifications and both the buyer and the supplier would cooperate to provide the solutions(Kamath & Liker, 1995).

Development risk

Wynstra and Pierick (2000) defines development risk to be the “importance, newness, and complexity of the development of the part”. In all the cases, the building block with supplier involvement were critical for the product systems. Alpha, Beta, Delta and Zeta, all said the suppliers’ competencies were of high necessity for the development of the systems. Alpha argued

the technical complexity of the component and the high impact of it on the total cost made it undoubtful to involve a supplier. He stated, “we could not advance without talking to a supplier”. Thus, they had to involve the supplier early in the concept stage. Additionally, to incorporate the newest technology in the product they had to have a supplier’s technical competence and its contribution to foresee how the technology would progress. Beta also were under these circumstances as the technology was not their core competence and she mentioned “we do not have the technology on this device. We could have some thoughts and ideas [...] but to advance we had to involve the supplier market”. The same applied for Delta’s development project. Delta did not have the capability to develop the component themselves. Delta also mentioned that they have now decided to buy a source which can develop these type of components, but at that time they had to involve a supplier because It was not a part of the business plan. This shows the importance and complexity of the component. Zeta said it had done the development on their own before, but now they wanted to expand the volume and to advance the technology. Thus, I could say the new development had a higher amount of complexity and newness to it, and it was of importance and necessary to involve a supplier for the development. The situations for these actors show the importance of the component will lead to a necessity to involve the suppliers heavily and early. Thus, suppliers can be put as a strategic suppliers in Wynstra and Pierick (2000) matrix, see figure 7.

From the analysis above of the responsibility the supplier had of the development and the degree of development risk each project had have, I used Wynstra and Pierick (2000) matrix and placed each case-situation in the matrix. In all of the cases, the supplier is constituted as a strategic supplier. As Wynstra and Pierick (2000) discussed, strategic suppliers would have a high responsibility in the preparation of a building block which supports the extent of involvement by the suppliers in these cases. As mentioned earlier, Gamma did not contribute with a case in the interview. Therefore, it is only four cases in the matrix and not five. By utilizing this categorization, I can compare the results of each project and see the importance of these factors: supplier responsibility and development risk. Further on, it can be easier to define boundaries and look at other factors which could have made an impact on the selection process and the results.

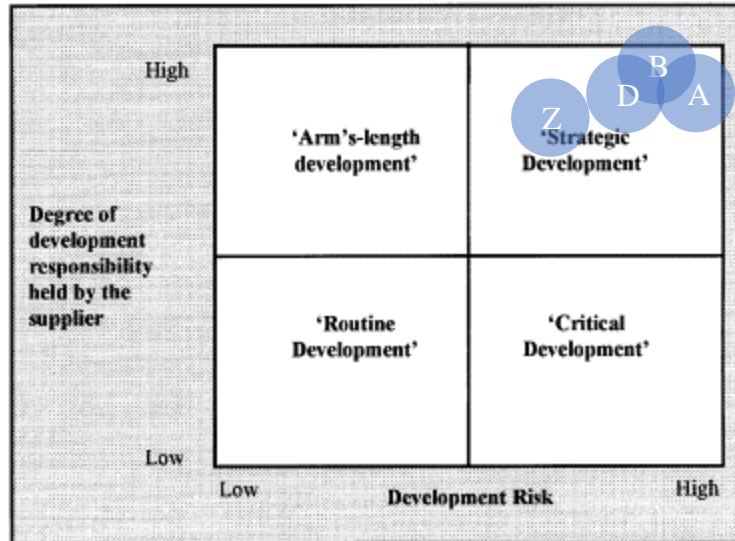


Figure 8 - The Supplier Involvement Portfolio (Wynstra et al., 2000, p. 51)

5.1.2. Factors influencing the extent of involvement

This analysis of the extent of involvement can confirm that all the suppliers were strategic suppliers. A factor that seems to be the clearest of why the buyers would involve the suppliers would be the development risk. The importance and complexity of the component and necessary contributions of the suppliers would make a significant influence to involve the suppliers to this extent. The analysis shows certain patterns among the cases. Through all the cases the supplier is heavily involved in the project, and it is majorly based on the development risk of the component. The development risk of the building block and the lack of competence by the supplier to progress in the project, are the essential factors that determined the extent of involvement in these cases. This supports Zhao et al. (2014), who argues supplier will get high responsibility of complex tasks. As these factors are so crucial, it is difficult to state if there may be any other factors that could have affected this choice. From the analysis we can see that the amount of involvement is relatively similar among the cases, which is proclaimed as co-development; partnership. In three of four cases has the buyer decided to co-develop, at least to a certain extent. But I cannot state exactly what kind of activities where the co-development has been unfolded, as this would vary from project to project, but the collaboration goals for the development-processes has been very similar. The extent could vary based on the competence of the buyer and how much it can be involved in the design. Cause all of the buyers has specified certain function requirements. However, they lack the competence and are therefore not as much involved in the design. An

exception is the case with Beta. Beta did not involve the supplier as a partner but allotted the supplier to take the major responsibility for the development with certain specification requirements. This relationship can classify the supplier to be in a black box (Kamath & Liker, 1995; Petersen et al., 2003). The reason why Beta did not choose to co-develop was because Beta did not have the competence and had no interest in expanding the production of it. In the other projects, the finished product should be included in a production/manufacturing process, while in Beta's case, the product was supposed to be developed to enhance a process. Therefore, the product was not supposed to be produced more than to Beta's factories, and Beta was therefore not interested in gaining ownership of the developed technology. The interviewee stated she wanted the supplier to establish the component on the commercial market by understanding the developed technology could be used in other industries as well, which contradicts very much to Delta goal that the component would only fit in their system. However, Beta claimed the benefits of this by exploiting the benefits of cheaper prices. Beta's strategy of pushing the supplier to commercialize the product is a concept Chung and Kim (2003) also discussed as they argued suppliers should utilize the opportunities learn by the development project to reduce manufacturing costs and improve market adaptability. This concept can also be utilized by the manufacturing companies to motivate the supplier to take more interest in the development and make them understand the new knowledge can be used to create efficiency and effectiveness in its own businesses.

If we take a look at other factors that the interviewees reasoned for heavily involvement, then factors such as the impact on total cost, technology uncertainty, higher volume productions emerged in the interviews and are captured in Table 7. The high degree of involvement would all be based on the fact that the buyers do not have the necessary competence. In all of the cases, the buyers do not have the technological competence to advance in the project. Thus, it is essential to identify that the development risk is high for these projects and it is a factor which defines the importance of supplier contributions to advance in the project. This may not be a surprising reason to involve supplier at this extent as literature contributions state to focus on core capabilities. What may be more surprising is Beta's lack of involvement in the development as she stated they would not be a part of the developing activities, only the specifying requirements. It could be important to recognize that for both manufacturing and production units, they both want to involve a supplier early even though they want the competition to reduce cost. However, the extent and the supplier involvement can be scaled differently in the black box when the outcome of the development is

different. Such, a buyer would not be involved in co-developing a product if it does not have interest in producing it later on, but rather utilize it to enhance its process. The extent of the supplier involvement, including development risk and the responsibility of the supplier, will be further analyzed in this research in the next chapters with the relation to the moment of involvement.

	Alpha	Beta	Delta	Zeta	Gamma
Extent of involvement	Partner	Mature	Partner	Partner	
Reasons for involvement	Lack of competence, technical complexity, impact on total cost, technology uncertainty	Lack of competence, Non-manufacturer	Lack of competence, complexity	Lack of competence, complexity and newness, produce higher volume, product life- cycle time, cost	

Table 8 - Case comparison related to the extent of involvement

5.1.3. Discussion of results

To summarize, lack of competence and complexity of the component, which is an aspect of development risk, were the findings which had a major impact on the decision of extent of involvement in all of the cases. These two factors should be in focus of evaluation when managers see the necessity to involve suppliers in product development projects and contribute in the design to enhance quality in the products (Parker et al., 2008). Additionally, factors which were identified in the analysis but more specific to each case were the component impact on cost, technology uncertainty, expand of volume production, product life cycle time and the utilization of the outcome. This last factor relates to the aspect if the buyer will not use the end-product for manufacturing, then the supplier would be involved as a mature role – full development responsibility of the component. Even though this was only specific for one case, it can be taken into consideration in support of Kamath and Liker (1995) who states the wrong involvement can lead to loss of potential benefits. Which brings me to Zhao et al. (2014) statement that the complexity of a component is positively related to black box integration, which does not fit my results in accordance with Petersen et al. (2005) responsibility gradient. Because for my results, with manufacturing companies, shows the component in each case had high complexity, but the

relationship between the actors in these cases constitutes a grey box. However, as I did not have a quantitative study on these measures, it should be evaluated carefully.

5.2. Moment of involvement

This chapter will elaborate on an analysis of the moment of involvement the suppliers were involved in each case. Additionally, are there an analysis of factors that have influenced the decision of the moment of involvement and a discussion elaborating on the results.

5.2.1. An analysis of the moment of supplier involvement for each case

In all of the cases, the suppliers were involved early in the development. Alpha involved the supplier in the concept stage to define performance metrics of the system. Because the supplier component was the heart of the system and the characteristics of it were very important to be defined before they began the design of the whole system.

In the case of Beta, the supplier was also involved from the concept stage, because the technology of the development project was not one of Beta's core competence. Therefore, Beta had to involve a supplier with this sort of competence, but it was not customized to satisfy Beta's needs. Thus it needed development. As I mentioned in the case description, Beta involved three suppliers, but further in this analysis, I will recognize it as one as it is the concept of extent and moment which is in focus of this analysis.

Delta had specified requirements for the concept of the component and involved the supplier from the concept phase as Delta needed the supplier to be involved in specifying innovative functions of the component. The supplier would further be involved in the design and on towards production. The buyer had one solution of the component from before, but with this project, they wanted to involve a supplier to contribute to set new standards in the market, and the buyer would not be able to do it alone. The supplier would design the component with design ideas from the buyer. The component-technology competence belonged to the supplier. The interviewee mentioned they run a tender in the planning phase where suppliers are able to generate ideas for the right technology direction to proceed.

Zeta discussed they would have several suppliers in the planning phase to create competition and the suppliers would suggest directions of the development and what the production phase would contain. He argued they would have the selection process in the planning phase because it would

be very critical for the production phase. The buyer would have several suppliers to contribute with ideas and the supplier who established the “best road to go” would be selected and involved further in the development. The selected supplier would be adequately involved in the concept phase where the collaboration and co-development began.

The analysis of the moment of involvement for each case shows that in each case after the selection process the supplier was involved in the concept phase. Here: Beta’s ongoing selection/development process is included. It is important to point out that the buyers had already indicated certain terms and specifications for the functions and requirements of the component. However, the supplier would come up with statements regarding features of the product and argued about what was realizable. Here, the concept phase and design phase will overlap slightly which is common according to Handfield et al. (1999). This overlap will indicate that the suppliers were not involved exactly at the same time of project activities, cause every project is unique, but there were similarities in the activities in which the suppliers were involved. Figure 8 shows when the suppliers were involved in each case. In addition, a thick line indicates cooperation between the buyer and supplier in each case, while the dotted line, here only for Beta, shows the time the supplier developed the product on its own. Gamma is included based of the points they stated in the case with regard to co-development. In addition, Beta and Gamma have a separate line in the production; this illustrates a new selection process with the possibility of a new supplier for the production phase. Moreover, factors that have influenced the decision of early involvement will be discussed in the next chapter.

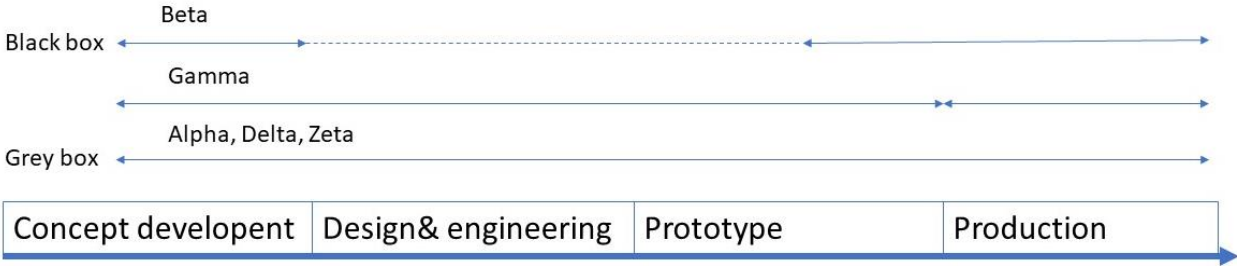


Figure 9 - Moment of involvement and time of cooperation

5.2.2. Factors influencing the decision of early supplier involvement

In this chapter I will discuss factors that influence the decision for when to involve a supplier in product development projects. The case descriptions and the chapter above, shows that in all the

cases the buyer utilized early supplier involvement, thus will the factors be analyzed for its influence on this decision. Factors such as development risk, suppliers degree of responsibility, technology uncertainty, volatile markets, the necessity for flexibility and the number of available suppliers (see Table 9) will be discussed of how it made an impact in the cases for deciding to utilize early supplier involvement.

	Alpha	Beta	Delta	Zeta	Gamma
Extent of involvement	Partner	Mature	Partner	Partner	
Reasons for involvement	Lack of competence, technical complexity, impact on total cost, technology uncertainty	Lack of competence, Non-manufacturer	Lack of competence, complexity	Lack of competence, complexity and newness, produce higher volume, product life cycle time, cost	
Time of involvement	Concept	Concept	Concept	Concept	
Factors influencing the timing of involvement	Development risk, could not advance, technology uncertainty, need of flexibility, number of suppliers	Development risk, could not advance, volatile market, cost	Development risk, could not advance, need of flexibility	Development risk, could not advance, technology uncertainty, volatile market, need of flexibility, cost	Need of flexibility, cost

Table 9 - Case comparison including relation to the moment of involvement

Development risk

The development risk seems to be the factor with the most significant impact on why to choose supplier involvement, as it was mentioned in chapter 5.1.1 in relation to the extent of involvement. This factor will also be of major influence on why a buyer has to involve a supplier early. The

complexity of the project-component and the importance of a supplier's contribution to advance further in a project was the main reasons why the buyers utilized early supplier involvement in these cases. Alpha, Beta, Delta, and Zeta could not advance without the suppliers, and therefore the development risk can be concluded to be the most important factor. Development risk would also be the factor for why Zeta involved the supplier early as it needed to be a part of the process of specifying the production phase cause of the complexity of it. Through this analysis, it seems like the interviewees feel as it is a relation to the extent and moment of involvement in the way they answered the questions. Therefore, this will be a subject I will come back to in chapter 5.3.

Development responsibility / technology expertise of the supplier

In relation to the lack of competence of the buyer and the supplier's expertise, is the necessary responsibility a supplier would have for the development of the building blocks. Wynstra and Pierick (2000) argued the supplier's expertise is related to the choice of responsibility degree of a supplier. In addition, with the relation to the degree of development risk would decide of the moment of involvement, and for these cases, it is a high degree for both factors which constitutes the cases with strategic suppliers that should have early involvement. The responsibility and the role of the supplier were analyzed in chapter 5.1.1, so I will not go too deep into it again. But the high responsibility the supplier holed for the development appears to be in relation to the moment of involvement to create good collaboration. However, the necessity of the suppliers contribution to advance in the project was the situation for all of the cases and is very important in the further analysis.

Technology uncertainty

Handfield et al. (1999) claim if the rate of change of the technology is high a buyer should delay the involvement of a supplier as long as the supplier did not have remarkable high expertise. These cases have very diverse backgrounds, and the technology uncertainty is different for each case. Therefore, I will begin to talk about what Alpha commented about the rate of change in the technology environment. He stated it was a high rate of advancement in the technology, which made it very important for them to have close collaboration with the supplier. As mentioned earlier, a selection criterion was related to get knowledge of how the supplier predicted the technology to become in the future. As the buyer knew the technology developed fast, he stated it was important that the design of the component did not set certain premises such that the system would become

locked with certain components. A statement was “if new technology is created, then it should be easy to install the new technology in our system”. Although the choice of early involvement contradicts with the first part of Handfield statement, in this case, Handfield et al. (1999) statement regains validity as he states a supplier with good experience should be involved early, which would be true for this case as a supplier with relevant core competence contributed to the product and was precisely involved early. The interviewee from Zeta argued the early supplier involvement would be beneficial if the pace of technology introduction in the industry was high. He stated the development would usually be more rapid than what was estimated and then the buyer would more quickly advance in the right direction if it already had established collaboration with a supplier. Related to high degree of change in the technology he said, “then I would like to say that it is usually positive that you have a high level of supplier involvement and are probably faster to turn around to face a market development”. Beta was not familiar with a high rate of change in the technology environment. She did involve the supplier early; in the concept phase. This would support Handfield theory of involving supplier early in a low degree of technology change. Since the suppliers of these cases had a high degree of expertise, seen with the relation to the degree of responsibility (Wynstra & Pierick, 2000), this research will support Handfield’s argumentation to involve suppliers early as long as the supplier has a high degree of expertise.

I did not have any cases where a buyer worked in a high rate of change in the technology, and the supplier did not have technical expertise. As it seems from the literature and the case analysis, a buyer uses a lot of resources in the selection process. Thus, it would be very uncommon to select a supplier with a small amount of technical expertise. Of course, the suppliers in these cases can all be categorized as a strategic supplier based on Wynstra’s matrix, and maybe Handfield concerned of waiting to involve suppliers of “standardized” products without defining it, cause then the price and flexibility of technology would be the most important factor, as was also stated from Alpha “we don’t use much time on standardized products”.

Volatile markets

The interviewee from Zeta argued about one negative aspect of early supplier involvement, and that would emerge when the volumes in the industry become very volatile. When the volume of the deliveries fluctuates with a high margin, the interviewee argued such deliveries would be harder to handle in tight collaboration than in a distant relationship. The interviewee from Beta

also discussed the impact of a volatile market. She argued in a situation where the volume was low, and the investments become too low to continue the project, then a project could take a long time, and the project team would lose focus and motivation. In such a situation, the interviewee stated it was essential to do the development in steps to get some sort of result. With these iterative results, the management can clarify if the team should move on with the project or not. Cause if the project had to stop for a while without the iterative results, then the interviewee was afraid a lot of resources would have been wasted. A structured timeline with iterative reports and physical results of some kind, both internally and with the supplier, would be important especially for a volatile market with the potential of breaks in a project. Such processes would also be important were people might change responsibility areas. Thus, it would be more manageable for the next person to continue the responsibility. This was a situation where later involvement of a supplier in the project could be better for resource utilization in volatile markets, but with proper management, the buyer could be able to exploit the benefits of early involvement.

Need for flexibility

I mentioned earlier that a criterion in the project planning for Alpha was to be able to fit future technology in the system for the development project. This flexibility can be reviled as a factor to involve supplier early and will be discussed further in this paragraph. In the mentioned case, this type of flexibility needs a good relationship with the supplier for the supplier not to incorporate its own components in a fixed position in the system. With late involvement, the supplier may not be able to implement these flexible system designs as other parts of the system set the supplier component in a fixed position where it is too costly to adapt it(Wynstra & Pierick, 2000). Without the good relationship formed by early involvement the supplier also may set a higher cost to adapt and modify the component to fit in the system. Flexibility was also an important aspect between the buyer and the supplier in the case of Delta. The flexibility between these two actors was in the form of an iterative process where the supplier came with proposals that the buyer's marketing and R&D departments tested and responded with conclusions, new ideas or other directions. The interviewee the importance of this relationship by saying "... we had developed quite a few different options which led to a product that was very much optimized for the market...". The interviewee from Zeta also mentioned this aspect. He said it was important that the supplier had certain flexibility such that the buyer could exploit their research and development competence to

complement its own. You could argue early supplier involvement is essential to gain flexibility in the relationship and the development process as the project team needs time to establish relations.

The flexibility a supplier can bring with early involvement can be beneficial for cost reduction. An example of this was presented in the Gamma interview. An example from Gamma, they had done the development internal in the organization and specified certain components but withstood in a single-source situation and had a hard time with establishing competition for the supplier components. In this situation, they did some negotiation to make the product competitively over time and with this made a range of three to seven percent in cost reduction. However, when Gamma involved suppliers early in the product development in influencing the design and the requirements, then they were able to create a more generic description of inbound components. This established competition on the inbound components and the buyer would not be locked to one specific component. The effect of this competition could be up to 30 % in cost reduction. This example stems from a case where a supplier was involved in designing a component, and it was vital to design the component for ease of production for specialization tools which can be huge cost drivers. The supplier's competence was essential to develop the component to be production friendly, and this would reduce the cost drastically.

From these three situations, I can discuss the concept of flexibility to be valuable as a result of early supplier involvement but also be a factor to be thought about when involving a supplier in product development projects. First of is the beneficial results, as cost reduction and improved quality, caused by early supplier involvement. Second, is to discuss the factor that the buyer should require a good relationship with a supplier who is aware of the need to be flexible for the buyer. Thus the buyer should go into a negotiation phase with the concept of flexibility in mind. The buyer should not take flexibility for granted as to believe the supplier will give this away as long as the buyer establish a good relationship. Both actors should be aware of it before the development to exploit the best benefits from both the actors and go in the relationship with good collaboration in mind.

Number of suppliers

The number of suppliers as a factor have not been discussed in the literature but will be analyzed in this paragraph. Though, it seems like it does not have any impact on when to involve a supplier or the outcome of early supplier involvement. The industry Delta worked in is not huge, and the

buyer knows most of the actors very well. With a familiarity with most of the actors, I could believe the buyer would have good knowledge of the competence and quality of the actors. Thus, it could have waited a long time to involve the suppliers as it knew how the actors would operate. Additionally, the assessment of resources should be delayed to reduce cost according to Petersen et al. (2003), and the supplier could claim more of the IP-rights. However, Delta involved the supplier early to be able to advance in the project. On the other hand, it could be even more important to involve the supplier early as the buyer already has the knowledge to the supplier and can expand on the familiarity, which trust can be a concept where it is not afraid of losing proprietary knowledge. In the case of Alpha, they had a small number of actors to ask for contributions. Though he argued it was more suppliers in the market, then the supplier did not need to be involved as early – especially for a case with the need of a key component, where the buyer can develop its solution before the supplier needs to implement/develop its key part. As he said, “if one supplier can’t give you what you need, then you could go to the next”. However, if it would be few suppliers in the market he stated “... in my opinion, they must be involved early when developing a product”. Even in the other cases where it was an established market, early supplier involvement seemed to be the best alternative. Some could argue the more suppliers to choose from, the later the supplier should be involved. However, this seems not to be the case, especially not when the buyer is in need of a technology which it is not able to advance on its own.

Cost

I may argue cost can also be a more significant problem as it may be a hazard to use a lot of resources early in a project when the end results not have been finalized (Petersen et al., 2003). However, here we have to take a look at the cost-time curve where we can see that changes early on will have less impact than changes made later on in the project. However, in the cases, it is a consensus that it is better to invest more money early on than having problems caused by late involvement. Beta stated it could be a bit difficult to invest much money in supplier doing studies as a tendering process early in the project. However, she said it was necessary as it would be worse to be locked with only one supplier later on. In this case, not only one supplier was involved early but several. Zeta also argued early involvement would be necessary to influence and make changes when the impact of cost is minimal. The same with Gamma who had quality as its primary aspect of the products. They mentioned “It will take a little longer to get it back. But again, considering the total cost and ownership and the lifetime of the products, then again, the amount of involvement

and cost involved depends". These findings promote the literature on exploiting benefits of early supplier involvement(Carr & Pearson, 1999; Handfield et al., 1999; Van Echtelt et al., 2008).

5.2.3. Discussion of results

The patterns among the cases were that in all the projects the suppliers were involved at about the same time. This circumstance was unquestionably the result of the need to involve a supplier. However, the necessity can be divided into different categories. For example, in Alpha and Beta projects, the complexity and importance of the component itself needed supplier involvement and played an essential role in continuing the project. For Zeta, it was necessary to know the supplier's volume production capabilities and therefore had to be integrated into the planning phase. In addition, Zeta would develop a product with complexity beyond their competences that made Zeta unable to continue alone. For Delta, it was the necessity of a supplier's contribution to create newness in the component which created the necessity of close collaboration, and therefore they chose to involve the supplier in the early phase.

It is essential to substantiate that these factors such as the importance of supplier involvement not only meant that the supplier had a significant responsibility and that was the reason for early involvement, although the interviewees mentioned that this was the relation, it is important to separate the extent of involvement from the moment of involvement. The moment of involvement was crucial because the buyer could not go any further in the project with its own competence, the supplier would control the volume production and needed to be a part of the planning, the supplier would define functions that would create new technology in the industry, the supplier had to be involved early to communicate how fast the technology progression was in the industry, the supplier was involved early to create good cooperation throughout the project – not just heavily involvement later on as this could lead to small amount of ownership of the development, and the supplier was involved early to reduce the cost through industrialization that required close cooperation. These factors were project specific but can contribute to new knowledge on the subject.

There are few surprises in this analysis, as several of the factors concerning early supplier involvement is also recognized in the literature. What might be more surprising is that several of the cases focus strongly on the fact that they could not continue the process without supplier involvement. Thus, this indicates that there was not a choice but rather a necessity to involve

suppliers early and this could influence the amount of discussion regarding other factors which could affect the moment of involvement. Although the necessity of involvement has been the absolute factor, I have also discussed other factors that may have influenced the necessity for early involvement such as technology uncertainty, volatile markets, the need for flexibility, and the number of suppliers. These conclusions cannot, of course, be concluded for all types of projects and relationships, but may lead managers to be aware of these factors and what choices should be made when projects are exposed to these factors. My results show that buyers are positive to early supplier involvement in a variety of different projects with different goals. The number of suppliers, technology uncertainty, production volume, the outcomes of production or manufacturing, creating newness, through all these circumstances the buyer still chose to involve supplier early. Further discussion and answering the research questions on management appliance for these factors will be discussed in chapter 5.5.

5.3. The relationship between extent and moment of involvement

When the interviewees discussed the proportionality between the extent and the moment of involvement, it was different opinions on the matter. I will examine these opinions and compare them to the analysis of the moment and extent of involvement. To be clear, when I talk about the proportionality, this would mean early involvement would declare a high amount of involvement. Wynstra and Pierick (2000) were the supporter of this statement that it was a proportionality between the moment and extent of involvement for strategic suppliers. However, are there any exceptions to this rule in the industries and what is the interpretation of it? Could it be high involvement late in the project phase or low involvement throughout, even when it is involved early? There have been several points concerning this enigma through the interviews and Gamma gave one point on the matter. They argued early involvement in the development would give the supplier a higher possibility to be a part of the production. This possibility was grounded in their statement that they always wanted to involve the strategic supplier early, but the supplier had to be mature and understand it was a part of a development project and that does not necessarily mean they would have the responsibility for the production. The interviewee stated “they have to join as a neutral actor and they are going to get paid for the job they have done with the development. Then they would be a strong candidate as a production actor. However, if they would not have the capabilities, are they only involved in the development?”. The interviewee argued even though the supplier would not be a part of the production, it would be advantageous to involve them earlier.

Though, he mentioned when they would select a supplier for long-term production, the supplier which was involved would become informed that after the development process it will be a tender process for the production. The procedure Gamma involves the supplier in is to be fair for both actors, and it would look like they are trying to create a good relationship for future cooperation in production through the development. However, Gamma does not talk about how it would have been if he involved the supplier in a later phase, but he does favor early involvement for the future greater extent of involvement. Zeta mentioned a situation (not relevant to the case-project) where they were too late with the involvement of the supplier and familiarization. Thus, the extent of involvement became very high for a short time period which was not good as it withdrew too many resources from Zeta. This situation explains a case where it is not proportionality between moment and extent, but where it is a high degree of involvement later on. Though, through the interviewees' statements, it is safe to say this was not a good place to be and should not be recommended to others. As mentioned earlier, Alpha stated the number of suppliers would be a factor of how to involve a supplier. In this case, I will take in the context of proportionality. Cause he mentioned if it was many suppliers, then it would not be necessary to involve a supplier early. However, in this case, the component could be important for the system, but because of several suppliers, it would not be necessary to involve the supplier that early. Thus, it is a situation that contradicts the proportionality. However, the interviewee from Delta mentioned another point. He mentioned it would be a difference between the moment and extent of involvement with the negotiation of IP-right. He stated the amount of involvement was very much related to the idea-rights. He stated "...the more you involve a supplier, the more a supplier suspects to own the solution. [...] It varies of course with the supplier, but typically the logic is that the more a supplier contributes, the more it suspects to own the rights for the IP". However, he argued in early involvement a buyer could still have an outline of the scope of the development without being too specific to the supplier. Such, would the buyer keep the IP-rights. However, he argued this would be difficult with heavy involvement. Then the supplier would have more demands on IP-rights for its contribution. In this context, this would show that it does not have to be a proportionality between the moment and extent of involvement. For example, a supplier can be involved early in the project but only have the responsibility of a particular part of a building block without getting access to the design of the whole system. This circumstance would make it hard for the supplier to claim any IP-rights as the supplier would not have any value in the part it was cooperating in. However, the buyer would see

the whole system and would only need certain capabilities and develop a more significant and more tangible scope. However, the aspect of IP-rights is an important emergent concept through the interviews and will be discussed more later on. As a result of these findings I can conclude that contractionary to Wynstra and Pierick (2000) statement, it is not a proportionality between the moment and extent of involvement for strategic suppliers. However, my findings show it is a relationship between the two aspects which I will discuss below.

In several of the cases are early involvement interpreted with close cooperation. For example, when Zeta was questioned about early involvement, he responded by discussing the importance of close collaboration. This relation may indicate that there is a certain amount of proportionality between the moment and extent of involvement. It is important to point out that the companies expected early involvement to be aligned with heavily involvement, and not small amount of involvement through the development process. However, this does not indicate that the involvement cannot be heavily later, as this case was also mentioned in one of the interviews, but it was viewed to be negative situation with relation to IP-rights. Another point which are important to discuss in view of the fact that the interviews interpreted early involvement as close cooperation would be the development risk and its relation of the necessity to involve a supplier. The importance of involving a supplier in order to be able to move forward with the development is an important point to state early involvement equals close cooperation. It is impossible to generalize that early involvement always gives heavy involvement, since I have no empirical data where a buyer has involved a supplier early and the involvement was not of high importance.

My findings show that there is a very strong relationship between the extent and moment of involvement caused by some delimitations. These delimitations are that (1) the relationship must regard a manufacturing company, the company must make product it will sell, and that (2) the importance of the component is critical for further development and (3) the complexity of the product is beyond the competence of the manufacturer; thus, the company must involve a supplier. These three delimitations cause the manufacturer to must involve a supplier early. These results will also show that early involvement complies with getting a close collaboration with a supplier so that the actors can spar with each other and complement each other's competencies. These findings support Wynstra and Pierick (2000) strategy that strategic suppliers should be involved early and heavily to reduce uncertainties concerning the development. However, the collaboration

process will be unfolded in a varying degree; how much the actors cooperate back and forth in the development process. The supplier will be responsible for the bulk of the design and specifying possible functions of the product, and the manufacturer will be involved in specifying demands and push the technological boundaries of the component. Additionally, provide ideas and requirements that may be useful in the component as it is a buyer who has the information about market requirements or which sees the opportunity in the market for the product . In addition, the buyer should ensure that certain components are not locked into the product so that the buyer cannot change this later. Here, of course, there is a flow of processes that must be done between the actors to show that the supplier will also receive benefits from this. These benefits will vary with the project and if it is decided that the supplier will be a part of the production or not.

We have now seen that it is a relationship between moment and extent of involvement, but it is also certain delimitations that will affect the relationship between extent and time of involvement. This relationship stems a lot from the goal of having close cooperation where companies have felt that they must have the supplier early in the project to be able to determine functions for present and future technology uncertainties, which supports Petersen et al. (2005) claim for buyers to integrate strategic suppliers in the determination of technical metrics and targets. The buyer should involve suppliers earlier to establish good collaboration for a longer time period. Good relationships develop over time, and so does trust. We will look into this in the next chapter where we follow up this relationship with how this can lead to what kind of focus a business should put on supplier selection criteria. The last chapter of this thesis is a discussion of the relation between the factors which influence the choice of extent and moment of involvement and the choice of supplier selection criteria. Such, may the factors of extent and moment influence what type of criteria a company sets in its supplier selection process.

5.4. Supplier selection in product development

This chapter will be divided into sections of information related to technological alignment, collaborative alignment, and factors influence the choice of supplier capabilities.

First off, I would like to summarize the capabilities the interviewees discussed, cause I will only analyze the ones which were most mentioned and discussed. Additionally, where some of the capabilities are results of certain standardization which also is regulated by the Norwegian law, and therefore is not a dynamic variable and not so important and interesting to discuss in relation

to this thesis. Here is a list of capabilities with the most frequently mentioned starting first: Technical capabilities (includes quality), size of the supplier, cost, development capacity and capability, production capacity, will to cooperate, sharing of IP-rights, HSE, compliance issues of the company structure. I will not further discuss capabilities as HSE and compliance issues. First of, because it was infrequently mentioned and the interviewees did not have any interest in talking about it in, that could have been because it was a semi-constructed interview where the interviewees may want to respond to topics that they feel is more important compared to litany by structured interviews. Second, these capabilities were described as binary criteria; the supplier would fulfill the HSE requirements the buyer had, or the buyer would go no further with the selection process. It would become a binary point as either the supplier fulfill the requirements, or it does not. Similarly, it is also like that with compliance. If the buyer would find issues with the corporate structure of the supplier, or the way the money flow in the company or the way they use their subcontracts, the buyer would also discard the business if it does not set the standard the buyer want with ethics and implementation. This analysis will contribute to investigate dynamic variables which diverse itself from supplier selection criteria for traditional purchasing literature.

5.4.1. Cost and competition as factors in the selection process

The cost will always be an important issue if you are developing a product or service which a customer has to pay for. Cost and the competition aspect of it was mentioned several times in the interviews. Therefore, I will analyze what the interviewees talked about the subject. As mentioned in the case description, Beta had several suppliers in the development phase, each to develop their version of the product, to create competition among the suppliers and reduce the cost. In the start of the project, Beta could choose to work with one or more suppliers. For this project, they started with one but brought in two more later in the process. The interviewee mentioned she would rather have more suppliers cause “the challenge which will emerge if we only work with one, if we together with this supplier developed the equipment further so that they can be an important part of this improvement, then we will eventually only have one supplier to work with. That would be a little stupid because we think it should be competition”. This was anchored in the disadvantages of a supplier with total power of the price of the component and the buyer’s dependence of having this supplier to continue this type of production. Enabling several suppliers to be interested in developing this product will cause reduction in price and continuous product development in the industry. However, she mentioned she might have been too late to involve the other two suppliers,

and this may have been caused by the fear of using too many resources early on (concept phase). She argued this would be a cost she should have taken as it would be cheaper than only developing with one supplier later on, such that he gets the monopoly factor. Another argument Beta had to reduce the cost was that they wanted the finished products to become available on the commercial market. By commercializing the product would it reduce the price by not have one supplier have monopoly on the product and that Beta would be “depended on the supplier to continue the development and be apart of that market”.

The other buyers did not have this kind of selection process. They used a more standardized tendering process (Delta, Zeta, Gamma). As mentioned from the case description, Zeta had a longlist with 10-20 suppliers where it excludes suppliers by certain selection criteria, and when it became a shortlist of five suppliers it was communication about the price. In contrast to Beta which had the suppliers selection process through the development phase, Zeta had the selection process in the planning phase/concept phase. This example is to show that price is still a very important criterion in the selection process for supplier involved in product development projects. Gamma also mentioned the importance to ensure competition and lifecycle quality through their IPD process. As they were afraid to be stuck in a position where they only have a single-source, which they would be stuck with disadvantageous prices or terms, or costly elements contained in the product system. Alpha did not mention they had a competition process but mention the disadvantages of being locked with one supplier or certain components, which he discussed would increase cost and would disable the opportunity to have future developments in the product as the technology in the industry grows. Cost and competition was not originally a part of this study, but it is important to recognize as it may influence other capabilities or factors of the buyers supplier selection criteria, and also the process of deciding the extent and moment of involvement. However, this topic will not be further analyzed in this research.

5.4.2. Technological alignment

This chapter is an analysis of the attributes the case companies have set as criteria in their supplier selection process. These criteria will be set in relevance to the attributes which constitute the technological alignment that was developed in the framework in chapter 3.3. This was done to create a categorization and such it may be more pleasant to understand the focus of the buyers.

Through all the interviews it was a consensus that technical capabilities were the most critical criterion and a selection criterion which was mentioned in all the interviews. When the buyers were looking for suppliers, they investigated the technological specifications of a supplier's contributions and what the estimated outcome would be. By securing itself of the suppliers' suggestions, all of the buyers had a similar procedure of examining references in the market. As a sub-topic of technological capabilities was the development experience mentioned by several of the buyers as an important capability. Delta argued this would be necessary to become the leading actor in the future; "We asked the supplier what they could do, what is their basic system, do they have experience in developing such system. We said we want to lift the level in the market and want to work with a partner to set new standards in the market". While Zeta investigated technical capabilities and the supplier's structure of executing research and development projects and Gamma stated it was important the supplier was proactive in the development of own technology specialization. Gamma argumentation was grounded in its two main product factors; delivery quality and product quality which was related to Gamma vision of pushing the technology in the market. These cases support Emden et al. (2006) claim to prioritize technological alignment to pool technological competences before strategical alignment. However, Alpha did state the collaborative capabilities would be more important than the technological references. However, this I will come back to in the next chapter. Moreover, all the interviewees discussed the degree of reliability in a supplier to be a significant criterion in the selection process. Topics discussed concerning reliability was the number of years a supplier had produced the needed technology, the size of the supplier (market share), relations to other industry segments, and compliance issues. Beta stated, "we do this to be able to use it in the future, and we need some assurance that this supplier exists within this segment in future years". From this analysis, the reliability of a supplier seems to be an essential criterion for these buyers. This criterion can be formed with the relation that all the buyers are prominent actors in the industry and potentially have a vast network which it can use to communicate with other well-established actors. However, these cases support (Melander, 2014) findings that technical capabilities are preferred even with high or low uncertainties.

Gamma and Zeta discussed the importance of the suppliers' complementary capabilities. Zeta first stated a criterion of the supplier was its knowledge on a technology field that Zeta was not familiar with. The purpose of the knowledge was to adapt to new the market segment and progress with

the development in this unfamiliar technology field. Additionally, when Zeta was working on the short list of suppliers, one of the activities was to examine how the supplier's competence would fit into the project. A discussion went through to arrange who could do what in the project and one elimination criteria would be which supplier could contribute with more complementary factors. The complementary capabilities would also be one Emden's aspect with the technology alignment, and these are some empirical data that supports it as a selection criterion. Although, not every interviewee mentioned it as a criterion. Another parameter Gamma used was the supplier's ability to contribute Gamma to be as good as it could become. These parameters support the literature contributions on complementary capabilities and enable further discussion on this subject. However, it was a bit surprising that there was no discussion with relevance to overlapping knowledge bases as this could lead to realize a technology's potential (Emden et al., 2006), but it could be caused by the lack of knowledge the companies had on the complexity of the component in each case. In the next chapter, there will be an analysis of the buyers focus on attributes of collaborative alignment.

5.4.3. Collaborative alignment

This chapter is separated into two sections. First, I analyze aspects related to collaborative alignment directly mentioned by the interviewees, and then I analyze aspects which they talk about that are important for the project and related to collaborative alignment but are not mentioned directly as selection criteria.

Cooperation was only directly mentioned as a selection criterion by one company. Alpha stated the will for cooperation was one of its selection criteria. With this, he mentioned how the supplier express to cooperate with his company. Whether it was tied up with other competitors or not. Which accords with motivation and goal correspondence, by engaging in opportunistic behaviors and the focus on noncompeting goals (Emden et al., 2006). The interviewee argued from experience, the will to cooperate would be clear by watching how open the supplier would be to share information. He even stated, "the cooperativeness to develop will trump the supplier's reference list". For this case the buyer would emphasize cooperative capabilities higher than the technical, which contradicts Emden et al. (2006) prioritization of technological alignment. However, the prioritization of cooperation could withstand from the few number of supplier available. Why the number of supplier could be an important factor is the importance of having a

supplier which would be able to see and try to reach the same goals. As if it was few suppliers it would be hard to find another supplier with the same technology. Therefore, a supplier which is willing to share the technology or self-develop to be able to cooperate with development capabilities would be significant for the development of the product. He also mentions this factor that could influence this choice of criteria for this cause could be the number of supplier as he argues "... these systems where there are not many suppliers worldwide delivering, one must have a supplier that has good technology knowledge and can see the same vision as our company". The interviewee also mentioned they as a buyer have to be open to input on the development and innovative suggestions by the supplier with the focus of compatible culture. This emphasizes the importance the buyer set on a supplier's cooperativeness for such a project where it *plans to get contributions early on*. The buyer sets the collaboration highly to even start the initiation of the project as he discussed they had to "work closely with suppliers to discover what kind of properties their systems had, which outlined the premises for how to build our system". The interviewee from Zeta told something similar. When they were working with the short list of supplier, they would contact the top management of the supplier and create a familiarity to investigate what type of research and development department the supplier has and what type of research and development focus on strategic level the supplier has. Another point the interviewee from Alpha gave was about the necessity of cooperativeness was to know how the supplier foresaw the technology to be in the future. The interviewee mentioned the technology of this system had rapid innovation, therefore it needed close dialogue with suppliers to know the suppliers predictions of how its and competitors technology would become in future years. He grounded this by saying "because it is important when building a new system that you also take into consideration that there will be development along the way". The Alpha case seems to confirm Melander (2014) argument that relational capabilities was desirable for projects with high uncertainty. Cause in this project it was few suppliers in the market and the technology were developing very fast, and based on the interviewee's discussion, these were factors that influence the selection criteria.

Cooperation indirectly mentioned

It was a surprise that the other suppliers did not directly mention collaborative attributes as selection criteria. Cause Littler et al. (1995) and both discuss suppliers cooperativeness to be a significant capability for project success. However, in several of the other cases, the interviewees discuss the importance of cooperation or factors related to it. One of the interviewees from Gamma

stated the collaboration had to be optimized for a development project. Especially, when a project goal was to penetrate a market early, he stated it would be very important for the actors to know each other very well. The interviewee from Delta discussed their good relationship with their supplier was very important for the final negotiating to be successful. As the interviewee did not have information documented on what had been said when they entered the relationship, he feared the final negotiation could have been very difficult if the two actors did not have a good relationship. For this case, it would have been a worst-case scenario if the developed product will be the only one who fits in the case system. Both these arguments promote the necessity of compatible cultures, especially in the latter to overcome conflicts.

Flexibility was another criterion which emerged through the interviews, although flexibility was mentioned in a variety of context. For instance, Alpha mentioned the supplier needed to be flexible in a volatile market where it also would be a progression in the industry. This instance is related to Emden's theory that a supplier must have the propensity to adapt. In this setting, it would be adapting to changes in the industry, but Delta needed the supplier to be flexible and adapt to changes and new requirements in the iterative process between the actors. Moreover, Gamma mentioned it as one of its supplier performance measurements that was a proactive approach. This proactive approach regarded how the supplier follows the buyer's wishes and potentially adapt to changes. Therefore, the propensity to adapt would be an essential criterion in these cases. However, it is kind of a vague subject where it could be hard for a supplier to estimate what a buyer means that it should be flexible. Especially, in these cases where it is put in different contexts. But the main thing from this analysis is that the supplier should be open-minded and be aware to adapt to changes in the process and do not think that everything is fixed after the planning phase. Moreover, it is hard to set it as a criterion as it also relates to technical and complementary capabilities where some buyers may also evaluate the cooperation element when they ask for for example the development competence. A buyer may evaluate the culture of a supplier on a cognitive basis, e.g. in a site assessment, instead of evaluating it as a fixed criterion. Meaning, when the buyer is in contact with the supplier and examines whether the supplier is capable of developing, then it may occur that the buyer will also get an understanding if the culture and norms of the supplier's organization will cause hazards or conflicts during a collaboration.

A concept which emerged in several of the interviews and can be put under the cooperation umbrella was intellectual properties (IP). In the project from Delta, one of the points the supplier was chosen was the willingness to share IP rights. Cause in the development project, both actors could generate ideas and the actor who created idea got the right to the IP. The interviewee announced they had a good relationship in that context and told it by “So they have their own idea from the base system, and then we have IP-rights that come on top of this because certain parts are specifically developed for this project. So we have specific IP-rights, and then we have components that can be patented or protected by Beta. Because Beta came with that contribution”. The interviewee from Zeta also discussed how to share the IP-rights in a partnership. Moreover, Gamma had a parameter in the selection process of how good a supplier was to secure the buyer’s IP. The emphasis on IP protection, ownage or sharing of IP emerges the criticality that a supplier’s cooperativeness may be helpful to ease this process and agreements. I would imagine a stubborn supplier could create several hazards if conflicts arise with the discussion of IP. Therefore, I have analyzed relations to IP as an aspect of cooperativeness as it will influence and make an impact on the project if the cooperative mindset is bad and the final rights to the development of the IP will escalate to conflict, and many recourses must be used to solve the conflict.

5.4.4. Discussion of results

In Table 10 below have I illustrated the supplier selection framework from chapter 3.3 with the focus given to each attribute from the different cases. The table shows the findings of the research, thus what type of criteria the different companies has focused on in the selection process, but also attributes which they indirectly explained where important in the project. The attributes which were indirectly discussed are highlighted with italic text. It is important to recognize that the attributes in the table is not direct quotes, but it is attributes which constitutes the aspects the interviewees have discussed and related to the framework made in chapter 3.3, these relations are also discussed in the analysis above. First, is the financial health and identification of compliance issues which causes the outcome of reliability which every actor emphasized as an important aspect of the supplier. The supplier had to be very reliable to minimize organizational uncertainty. However, this is a broad topic which will not be discussed further in this thesis. The next criteria would be related to the technical capabilities. All the companies had emphasized on technical capability because this was important for them to advance in the project. Only Zeta and Gamma discussed complementary capabilities while overlapping knowledge bases were not mentioned in

any of the cases. With regard to collaborative attributes were motivation and goal correspondence directly discussed by Alpha and Zeta. While compatible cultures were discussed by Gamma and Delta. Lastly, the propensity to adapt were discussed by Alpha, Delta and Gamma, while no cases discussed aspect related to long-term orientation. An emerging point were the discussion of IP-rights with relation to significant collaboration. Moreover, keep these criteria in mind as this will be discussed upon in the last chapter where it is investigated if the extent and moment of involvement would cause any impact on these decisions.

Technological attributes	Collaborative attributes
<ul style="list-style-type: none"> • Technical capability (all) • Resource complementarity (Zeta & Gamma) • Overlapping knowledge basis • Financial health (all) 	<ul style="list-style-type: none"> • Motivation & goal correspondence (Alpha, Zeta) • Compatible cultures (<i>Gamma, Delta</i>) • The propensity to adapt (<i>Alpha, Delta, Gamma</i>) • Long-term orientation

Table 10 - Results of selection attributes

Through this analysis, I have focused on criteria a buyer sees in a supplier to be involved in product development projects. Here it is important to pinpoint that the suppliers in the analysis have been strategic suppliers who have taken part in major parts of the development of the project. I have realized that cost and competition are key issues that the subjects from the cases have maintained in the selection. But in this analysis, there has been a particular focus on the types of priorities the buyers have done in relation to technical- and collaborative attributes. To summarize and answer the first part of the last research question; aspects related to technical capabilities and resource complementary capabilities were directly mentioned by the interviewees with relation to technological alignment. While, aspects related to goal correspondence, compatible cultures and propensity to adapt was discussed in the interviews with relation to collaborative alignment. The relation to each case can be seen in Table 10. With this illustration we can see that for the most cases the companies had focus on technical attributes, which contradicts Petersen et al. (2005) and McIvor and Humphreys (2004) focus on compatible culture to establish effective interactions but promotes Feng et al. (2010) findings that collaborative attributes were seldom a focus between the actors. Such may these results contribute to the literature that buyers have less focus on collaborative attributes in the selection process, but this does not indicate that the buyers should

neglect it. However, it was one case who was remarkably differentiated of the selection criteria, which will be discussed in the next chapter in addition to a discussion of the relation between the focus on capabilities and factors influencing the type of involvement.

5.5. The relationship between the type of involvement and the supplier selection criteria

This chapter will address the research problem and discuss if there were any relation between the selection criteria and the type of involvement. Through the analysis, technical and cooperative capabilities were sought as major part of the discussion material in the interviews. In this chapter, I will discuss factors which could influence the choice of focusing on technical- or cooperative capabilities. Table 11 is designed to illustrate the relations between supplier capabilities and factors related to the extent and moment of involvement case by case.

For all the cases the participants saw the necessity for the supplier to have outstanding technical capabilities. These cases, a factor which would influence these selection criteria were the development risk. The importance to have a supplier with the technology to further advance in the project was a clear factor which would have the buyers to emphasis these technical capabilities in the selection process. A factor that could make the technical capabilities so crucial for all the projects could be the importance of the suppliers' contribution. In *most* of the projects, the supplier's contribution was the development of a critical component which the buyers did not have the competence to develop itself. This is in line with Handfield et al. (1999) arguments for employing a technical assessment when the technology is critical.

The results indicate that even though the companies have established early supplier involvement with co-development throughout the project, they have anyhow clearly put the most emphasis on technological alignment by examining suppliers technical(majority) and complementary capabilities. In particular, the supplier's technical expertise and development competence, but without considering the culture of the supplier and if the supplier is willing to share the competence with the buyer. As the interviewees have said that the results of these projects have been successful, it is hard to criticize that these choices have been improper. Nevertheless, during further discussions in the interviews it emerged that the flexibility of the supplier was very important, which adds empirical data to Littler et al. (1995) research on managers focus on flexibility for successful collaboration. It had to be a possibility for the supplier to change processes and change

development directions in relation to new productions. Therefore, the propensity to adapt is a very crucial criterion which I suggest that a buyer should investigate when entering such a relationship. For a supplier to have the propensity to adapt to a buyer's requirements, then it must have a culture which does not crash and cause conflict with the buyer in the development process. It is also important to discuss a factor which may differentiate the supplier selection criteria, and that would be that some of the buyers had the selection process only for the development of the product, while others had the selection process for both the development and the production/manufacturing of the product, as illustrated in Figure 8. This will of course establish a differentiation in the attributes such as Zeta wanted higher volume production.

	Alpha	Beta	Delta	Zeta	Gamma
Extent of involvement	Partner	Mature	Partner	Partner	
Reasons for involvement	Lack of competence, technical complexity, impact on total cost, technology uncertainty	Lack of competence, Non-manufacturer	Lack of competence, complexity	Lack of competence, complexity and newness, produce higher volume, product lifecycle time, cost	
Time of involvement	Concept	Concept	Concept	Concept	
Factors influencing the timing of involvement	Development risk, could not advance, technology uncertainty, need for flexibility, number of suppliers	Development risk, could not advance, volatile market	Development risk, could not advance, need for flexibility	Development risk, could not advance, technology uncertainty, volatile market, need for flexibility	Need for flexibility

Selection criteria	Technical capabilities, reliability, will to cooperate, compatible culture, <i>propensity to adapt</i>	Technical capabilities, reliability	Technical capabilities, reliability, goal correspondence and compatible cultures, propensity to adapt	Technical capabilities, reliability, complementary capabilities, goal correspondence	Technical capabilities, reliability, complementary capabilities, <i>compatible cultures, propensity to adapt</i>
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Table 11 - Case comparison including supplier selection attributes

To answer the second part of the last research question, and to understand the findings and examine if the selection criteria had any relation to the factors influencing the decisions for the type of involvement, I will first distinguish the contrasting case with Beta which had involved the supplier with a mature role. Because from the analysis and categorization in table 11, it can be seen that Beta is the only company that has not discussed collaborative attributes and only focused on technological alignment. This can be discussed as a relation to the fact that it was no collaboration between the actors in the development process as the supplier had a mature role and Beta wanted the supplier to commercialize its products. Thus Beta focused on technical capabilities, so the supplier would develop the best possible product on its own. Moreover, in the Alpha case, a relation emerged as the interviewee directly mentioned it would focus on the will to cooperate because of the few number of suppliers and high technology uncertainty. Here it is important to recognize that Alpha did also have high development risk but prioritized cooperative capabilities, such as the same vision and willingness to develop, above technical capabilities. In the other cases, it was not found any relation between the selection criteria directly mentioned and the factors influencing the type of involvement. However, it was found a relation of the attributes which was discussed as important to the supplier and the factors influencing the type of involvement. Cause, here the findings show that the buyers discuss the importance of collaborative alignment with uncertainties in the project. Such as the suppliers' propensity to adapt was discussed in relation to the necessity of flexibility in the project. Additionally, was goal correspondence discussed with relation to be able to cooperate well between the partners. Moreover, I cannot conclude that it is a relation between the selection criteria and factors influencing the type of involvement, but I can state that these companies do concern suppliers attributes with relation to the type of involvement. However,

I will further suggest investigating this relation with a quantitative study as this may reveal better the quantity of the focus on each criterion. In the paragraphs below will I answer the second part of the last research question where I suggest some selection criteria that should be evaluated in relation to the factors which was identified in this thesis to be influencing the role of a supplier.

I suggest even if the technology uncertainty is high or low, I suggest to involve supplier early as results of the analysis state the participants prefer early and extensive supplier involvement. It will contribute to estimating future market predictions and if changes in the industry would occur then a swell collaboration with a supplier will make it easier to change directions. However, even though I have suggested to involve the supplier early in either low or high uncertainty, it should not be a factor that is neglected in the project evaluation process. Cause if it is high uncertainty, a criterion could be that the supplier will help to estimate which directions the technology will work towards and discuss development towards this and with high technology uncertainty the supplier should have the propensity to adapt to change of directions in technology. In addition, the supplier can help to design the system in a way that the product will not be locked to certain components which can be a hazard to design around when the product needs further development or adaptations. Selection criteria such as goal correspondence and compatible culture is a necessity for such cooperation to be successful, thus may the buyer focus on collaborative alignment. Especially, to enable complementary capabilities of a supplier when the goal of the development project is to reach new market segments. Then collaborative alignment will enhance cooperation between the functions of the buyer and supplier. A volatile market was a concept that emerged from the analysis which was not discussed in the literature. A volatile market could potentially stop the development process cause of lack of resources. Therefore, a suggestion would be to enable sophisticated management and establish an iterative process which creates iterative-results.

In one case the low number of available supplier would be a factor to why the buyer would involve the supplier early. However, in the cases with several suppliers, they still involved the suppliers early. In these cases, it was because it needed to advance. Therefore, it could be a factor that should be thought if the development risk or the necessary supplier responsibility is lower. With regard to selection criteria, then collaborative alignment could be more in focus when the number of suppliers is low. Especially if it is high technology uncertainty will it be important for the supplier to work for close cooperation as it can be tough to find a new supplier that is qualified.

Contradictory would technological alignment be in focus in a market with many suppliers as there could the buyer go to the next supplier if it was not willing to collaborate.

Flexibility was another factor which was discussed in several circumstances. It may be a bit vague term but will anyway be an important factor as it can be constituted as an act by the supplier. Flexibility was also discussed in relation to selection criteria, but then it was discussed as a selection criterion as the propensity to adapt. This brings significant relations between the topics. It is important to recognize that from the results shows that early involvement is related to close collaboration, and a goal with this collaboration was proper development of the product where it can be modified several times before it is finished. Therefore, it is essential to have a supplier who is willing to adapt to the requirements of the buyer. Results from the shows that flexibility can enhance the quality and reduce the cost.

Another finding regards the goal and motivation correspondence. This will may be more crucial to the extent of involvement a buyer decide to have. In the case of Beta, they wanted the supplier to commercialize the product, and this could be very difficult if the market is small or exclusive. If the buyer is not going to have ongoing production, like in this project where the product would be used to enhance a process, then it can be less motivating for the supplier to create a product which will only be implemented in a couple of factories. Of course, this was one of the reasons why Beta had a focus on developing the product such that it may also be compatible in other industries. This may also be the reason why the supplier had such great responsibility for the development of the product. Such, may the supplier realize the commercialization itself by developing the processes that fit the efficiencies of the supplier. On the other hand, for manufacturing companies, early involvement was a vital establishment to set common motivation and goals so that the supplier and buyer are on the same track early in the process, and actors can benefit from high quality and the ability of great volume production.

Furthermore, I have modified the model of supplier involvement for the result of the analysis and in addition have I added attributes of selection criteria which should be in focus in relation to the respective factor, see figure 8. The model is inspired by Wynstra and Pierick (2000) matrix and data gathered in this research. This model will aid management in the project planning process to evaluate the extent and moment of involvement based on factors which may impact the effectiveness of involvement and give suggestions to mitigate the potential risk of the factors.

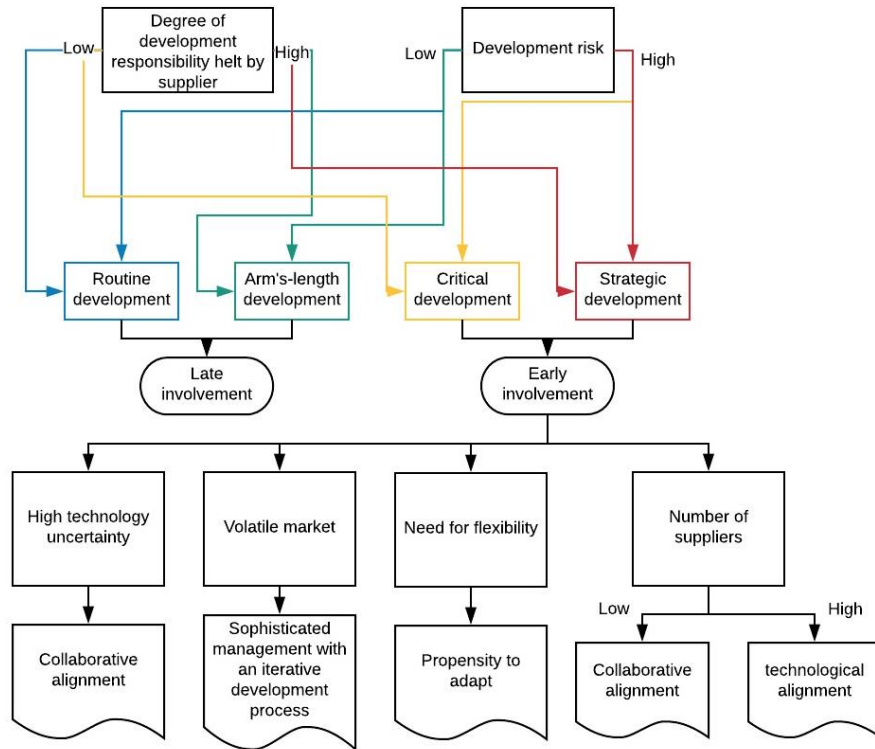


Figure 10 - Preparation for uncertainties in product development model

6. Conclusion

This research establishes new contributions on a topic where topic that have not yet emerged in the literature as this will be the first thesis to investigate the relationship between selection criteria of suppliers involved in product development projects and the decisions of type of supplier involvement. This research has analyzed factors which will influence the extent and moment a supplier will be involved in a product development project. Data collection and analysis has been done through a comparative multiple-case study. My findings suggest the development risk, the buyer's competence with regard to the component were the two major factors which influence the extent of involvement. To be more concrete, the high importance and complexity of a component and a buyer's lack of competence would be the major influences to heavy involve a supplier in a product development project. Additional results suggest high development risk and high responsibility by the supplier to develop the component is the two major factors for the utilization of early supplier involvement. The importance, newness or complexity of a product was causes to utilize early supplier involvement in order to advance in the project and exploit the benefits of a close cooperation. Additionally, factors such as technology uncertainty, volatile markets, necessity for flexibility, number of available suppliers could influence the moment of supplier involvement for specific project context and environment. This research shows clearly that it is a relationship between the moment and extent of involvement. The development risk and the responsibility of the supplier clearly suggest a heavy involvement by the supplier, but also that the buyer will not be able to advance in the project without the contribution of the supplier. Thus, the utilization of early supplier involvement. This is important for buyers to understand such that they do not get stuck in project by trying to plan everything themselves without having the proper competence. However, if early involvement is fixed, the extent of involvement can vary from project to project. Depended on the buyers' competence and the aim of the project will give different adoptions of co-development or full responsibility by the supplier develop to the component based on requirements from the buyer.

Literature have discussed how to exploit the benefits of supplier involvement by explaining methods and roles individuals should manage in a project. This research investigated if buyers looked at this already in the selection process; if the selection criteria could influence these decisions later on and if buyers thought about how to enable these relations already in the selection

process. That's why it was in my interest to analyze what criteria buyers have for suppliers involved in product development projects and the relation to the type of involvement. First, technological alignment has been in focus in the selection process in these cases, except for one case who had a higher focus on collaborative alignment. The focus on technological alignment withstood of the necessity of a suppliers' technical contribution and the reliability of the supplier. The criticalness of a component and the lack of buyer competence to advance without a supplier's contribution were major factors for buyers to emphasis technological alignment. Moreover, several of the companies also discussed complementary capabilities to expand the market segments and utilize non-core competence and exploit suppliers' knowledge and expertise in fields which were both related and not related to the buyers' industry segment. While the combination of a low number of suppliers in the industry and the technology uncertainty where factors which made an impact on the focus on collaborative alignment. The buyer felt it was important for the supplier to have the same goals and for the supplier to share knowledge about the progression in the industry and willingness to contribute with the best development specifications for the project. In addition, a model was made to suggest a buyer's focus on supplier capabilities related to factors influencing the type of involvement, such as the propensity to adapt because of the need for flexibility. By knowing if there is a relationship between the selection criteria and the type of involvement will contribute to new data to the academic field. In addition to what type of focus in the selection process which relates to which type of involvement can lead to better understanding of uncertainties in the selecting process and promote better cooperation in collaborative development projects by selecting suppliers with the proper capabilities.

6.1. Limitations and further research

A limitation emerged in the analysis because of the collective data, anchored in relying on the respondents' memory and the fact that the interviewees had to anonymize some of the data. The anonymization would not make an impact on the analysis of the participants interview, as the information was collected were very well described. However, the limitation of the anonymization was the neglectation of the possibility to get more information from other sources concerning the project, like documents and interviews with the suppliers. Such information could make a deeper contribution of the explanation of the results. Additionally, this will also lead to that I have to take what the participants have said at face value. This leads the interviews to have potential sources of bias, imaginative example would be embellishing the degree of successfulness of the involvement

or not remembering all the factors that influenced the decision of involvement. Hence, rather than reporting factual occurrences, is the potential of reporting socially desirable responses. A deeper case study, with a longitudinal approach, should be conducted with the use of data collection from survey, documents, and several participants in order to access data on project results, the selection process, and the planning of the extent and moment of involvement. Then sources of potential bias can become apparent if the arguments are incongruent with data from other sources.

When I was conducting the analysis, I came over a thought that could have made an impact on the results and the thought was that the participants may have neglected to talk about the collaborative capabilities, because it interpreted as a sub topic under for example the development competence of a supplier R&D function. To give you an example, the interviewee from Zeta would argue they had at suppliers R&D and project implementation methodology within the concept of quality. If I had not asked him to elaborate, then I would not realize his focus on development capabilities. But this type elaboration should be done more in a strict method to gather tangible data. Because individuals may understand criteria and factors differently. However, this limitation will not flaw the results of this thesis, as I aspect the participants would have discussed collaborative alignment if they had a focus on it, such as Alpha did concern willingness to cooperate. Moreover, I regret not including questions promoting descriptive underlings of criteria as it would address issues of interviewees own interpretations of the stated criteria. Therefore, it should be taken in consideration for further research to ask concrete questions about the selection criteria, such as if they have a list of criteria the researcher can investigate or make the interviewee what defines the criteria they set and what undermines it. Another point of view could be to investigate if the participants investigate this on a subconscious level, for example when they are visiting supplier site and examine the culture and structure of a supplier. Then the buyer may not evaluate it objectively and therefore not written it in a report which forward is the reason for why it does not name it as a criterion. This would be important really understand buyers focus in a selection process which can tell what buyers who accomplish successful collaboration focus on in the selection process.

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Appendix

Interview guide

Grunnleggende spørsmål:

Navn, alder, posisjon i bedriften, antall år ansatt i bedriften, antall år som innkjøper, antall år i avdelingen.

Definisjon av prosjektet

1. Hva gjør det til at det blir et produkt utviklings prosjekt?.
2. Hva var behovet som utløste prosjektet?
3. Hva slags oppgave har du som innkjøper i dette prosjektet?
4. Før involveringen ble bestemt, var det prosjektleder som bestemte bruk av leverandør eller var det innkjøpsavdelingen som avgjorde dette?
5. Hvem påvirker valg av leverandør?

Leverandør valg

1. Hvor fant dere leverandøren?
2. Når dere skal finne leverandør for PD prosjekter, finner dere I Supply chain eller I markedet?
3. Hvilken kriterier har dere når dere skal velge leverandør?
4. Føler du det er noen *faktorer* som påvirker hvilke kriterier dere setter?
5. Varierer kriteriene?
6. Spesifikke metoder for denne prosessen?
7. Hva er de største forskjellene på innkjøpsprosedyren for PD i forhold til produksjon, om du har kjentskap til dette tidligere?
8. Før dere velger leverandør velger dere omfanget? Hvor mye ansvar en leverandør skal ha, eller er dette en diskusjon etter valg av leverandøren?
9. Eget syn på leverandørinvolvering
10. Gode resultater?

Omfang av involvering

1. Hvor mye ansvar fikk leverandøren?
2. Basert på hvilke faktorer var denne avgjørelsen tatt? Aktuelle faktorer som kan diskuteres:
 - 2.1. Task complexity

- 2.2. Task value
- 2.3. Ansvarsmengde
- 2.4. Kvalitet
- 2.5. Risiko

- 3. Hvordan bestemte dere dette?
- 4. Brukte dere noe metoder på dette?
- 5. Hva ble resultatet av denne mengden ansvar?
- 6. Føler du at du kunne fått bedre resultat ved en annen mengde involvering?
- 7. Om det er bestemt at en leverandør skal være involvert i en av de senere fasene i PD, hender det at dere involverer de i designfasen for at de skal kunne ha litt fleksibilitet?

Tidspunkt for involvering

- 1. Jeg deler tidsfasen i planlegging, design og produksjon. Hvilken fase ble leverandøren introdusert i prosjektet?
- 2. Hvilke faktorer baseres denne avgjørelsen på?
- 3. Alternative faktorer:
 - 3.1. Fleksibilitet
 - 3.2. Utviklingsrisiko
 - 3.3. Høy teknologisk utvikling i industrien
 - 3.4. Leverandøren teknologiske ekspertise
- 4. Tanker om alternativt tidspunkt?
- 5. Hvis tidlig erfaring, Hvorfor?
 - 5.1. Fordi leverandører er med å påvirke mye av kost tidlig?
 - 5.2. Et godt forhold vil føre til bedre teknologier?
 - 5.3. Noen tanker om at tidlig involvering kan skape høyere reduksjon av kost? Da resultater viser at beslutninger tidlig kan redusere mer enn senere.
 - 5.4. Om du har hatt leverandører i planleggings/design fasen, hjalp det eller møtte du på noe problemer?
 - 5.5. Føler du noen i organisasjonen er motvillig til samarbeid, vil helst ha standardiserte produkter?
- 6. Hvis sent, Hvorfor?

- 6.1. Må ha behov for fleksibilitet? Fleksibilitet for ny teknologi eller kost?
- 6.2. Konkurransen skaper bedre teknologi?
- 7. Hva var resultatet av involvering på dette tidspunktet?
- 8. Erfaringsmessig, angret du på at du har involvert for tidlig eller for sent?
- 9. Hvis du hadde hatt mulighet til å gjøre det på nytt, er det noen faktorer du vil undersøkt mer?
- 10. **Proporsjonalitet mellom tidspunkt og omfang.** Føler du tidspunkt og omfanget er proporsjonalt i forhold til jo mer ansvar en leverandør får jo tidligere må den involveres eller hender det at en leverandør får veldig mye ansvar i utviklingen sent i prosessen?