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SUPPLIER INTEGRATION IN NEW PRODUCT DEVELOPMENT - PROCUREMENT APPROACH

Master of Science Thesis

Examiner: Professor Saku Mäkinen
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ABSTRACT

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Involving suppliers in new product development of a company has been under study for almost 30 years. However, different opinions, on what makes it successful, exist. Key factors to success have been recognized in many different papers but not all of them agree with each other. This thesis tried to gather these key factors and summarize the theory of the subject. Purpose was to create a theoretical framework of the requirements and success factors of supplier integration, and find out how well suited the case company was for that framework.

Supplier integration has been recognized as the "best practice" in new product development. It means involving a supplier in company's new product development early in the development process in order to get competitive advantage from supplier's expertise in its own technology area. Eventually, it is collaboration of two companies in a situation in which both can gain advantage. Succeeding in it is difficult due to diverging interests of the parties in the beginning. Well established supplier integration should improve quality and design lead time of a product, and reduce the costs of the product. This thesis created a theoretical framework of the key factors to success in supplier integration. Research part examined the current state of the case company's new product development and compared it to the created framework. Research included a survey and an interview to the personnel of the case company.

The state of the case company was not ideal when compared to the key factors of the theoretical framework. Outcome was that the case company should set up a clear new product development process for a single purchased item and implement strict process discipline to conform personnel to it. Also, departmental interface between purchasing and engineering needs persons to coordinate projects and improve communication. As a method for better supplier integration, the case company should learn to give a should cost calculation to engineering and supplier, and let them cooperate as long as the given should cost will not be exceeded.

TIIVISTELMÄ

TAMPEREEN TEKNILLINEN YLIOPISTO
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Toimittajien mukaan ottamista yrityksen tuotekehitykseen on tutkittu jo melkein 30 vuotta. Siitä huolimatta on olemassa eriäviä mielipiteitä sen tärkeimmistä onnistumistekijöistä. Keskeisiä onnistumistekijöitä on tunnistettu monissa eri tutkielmissa, mutta ne kaikki eivät ole samaa mieltä asioista. Tämä diplomityö yritti koota nämä tekijät tiivistämällä teoriaa. Ideana oli tehdä teoreettinen viitekehys toimittajan integroinnin vaatimuksista ja onnistumistekijöistä yrityksen tuotekehitykseen. Lisäksi, työ pyrki selvittämään kuinka hyvin kohdeyritys soveltui tähän viitekehykseen.

Toimittajan integroiminen yrityksen tuotekehitykseen on tunnistettu parhaimmaksi menetelmäksi uusien tuotteiden suunnittelussa. Ajatus tarkoittaa toimittajan mukaan ottamista yrityksen suunnitteluprosessiin jo sen aikaisissa vaiheissa, jotta toimittajan tietämystä sen omasta teknologia-alasta saataisiin hyödynnettyä. Kaksi eri yritystä tekee siis yhteistyötä molempien hyväksi. Onnistuminen tässä on hankalaa, sillä yritykset yleensä haluavat eri asioita. Mutta mikäli toimittajan integroinnissa onnistutaan hyvin, se parantaa laatua, nopeuttaa suunnitteluprosessin läpimenoaikaa ja vähentää kustannuksia. Tämä diplomityö loi teoreettisen viitekehyksen teoriasta poimituista tärkeimmistä onnistumistekijöistä. Tutkimusosuus keskittyi kohdeyrityksen tuotekehityksen tämän hetkiseen tilaan ja vertasi sitä teoriaosuudessa luotuun viitekehykseen. Menetelminä käytettiin kyselyä ja haastattelua kohdeyrityksen työntekijöiltä.

Kohdeyrityksen tämän hetkinen tila ei ole ideaalinen verrattaessa teorian käsitykseen aiheesta. Sen pitäisi luoda selkeä uuden tuotteen suunnitteluprosessi yksittäiselle ostettavalle tuotteelle ja asettaa tiukka prosessikuri, jotta uutta prosessia käytettäisiin. Lisäksi oston ja tuotekehityksen rajapinta tarvitsee henkilöitä koordinoimaan projekteja ja parantamaan osastojen välistä yhteistyötä. Menetelmänä kohdeyrityksen pitäisi oppia antamaan valmiiksi laskettu hinta tuotekehitykselle ja toimittajalle. Mikäli toimittaja pystyy alittamaan lasketun hinnan, saa se pitää suuremman katteen.

PREFACE

Writing this thesis was a great and rewarding experience. Even though motivation was not always with me, the thought of finishing studies kept me going. Now that I have to step away from the long path of studying, it is a nice feeling to look back to all those years that I spent on it.

I want to express my gratitude to my supervisor J-P Asikainen, advisor Saku Mäkinen and everybody participating in the interviews. Writing this thesis would not have been possible without you.

Finally, I owe my greatest thanks to Anne and my family who have always been there for me during my studies.

Nokia, November 14th, 2014

Mikko Tuomaala

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ABBREVIATIONS

ESI	Early Supplier Involvement; involving the supplier in early phases of the design process
NPD	New Product Development; creation of new products or services to markets
RFQ	Request for Quotation; a cost quote to a supplier for some product
TCO	Total Cost of Ownership; considering all the costs that one supplier/product affects to a company, including direct and indirect costs

1 INTRODUCTION

Managing new product development (NPD) is a crucial issue for companies because it makes the difference between winning and losing (Cooper & Kleinschmidt 1995, Barczak & Kahn 2012). Best practices for NPD have been extensively researched (Ernst 2002), and even rewarded (Barczak et al. 2009). As a result of the researches, companies have widely recognized their suppliers as important sources of innovation in new product development process (Ragatz et al. 1997, Wynstra et al. 1999, Ritter & Walter 2003, Walter 2003, Fliess & Becker 2006, Schiele 2010,). Furthermore, supplier integration into new product development as a method has been widely accepted in many different areas of industry (Wynstra et al. 2001, Wagner & Hoegl 2006).

Researchers have started to investigate supplier involvement in NPD process in the late 1980's (Jassawalla & Sashittal 1998) when its benefits were noticed and recommended for further study (Clark 1989). Since then, the topic has fascinated many academics and captured their attention (Salvador & Villena 2013). Even to this date, new articles about the subject can be found (for example: Yeniyurt et al. 2014, Zhao et al. 2014 and Lynch et al. 2014). This states that the subject is still under intensive study and there has to be much more to learn. Companies have tried to master supplier integration in their new product development processes in order to achieve better quality, faster development times and reduced costs of new products (Petersen et al. 2005, Goffin et al. 2006, Johnsen 2009). However, when poorly executed, the integration can bring challenges leading to increased costs and misused resources (Salvador & Villena 2013). Supplier integration in NPD process can bring competitive advantage to a company (Fliess & Becker 2006) but before the process can be implemented, cooperation barriers have to be overcome (Ragatz et al. 1997).

One relevant aspect in supplier involvement in NPD process is the role of purchasing, since its tasks include managing outside relations, acquiring materials and supporting company's internal functions (Fawcett 2000). This leads to interdepartmental cooperation within a company, when the whole topic of this thesis can be stated as "cross-functional new product development team with supplier integration".

1.1 Motivation and objectives for this research

This thesis was made for a company that had a new product development project that required cooperation with its suppliers. The idea for the thesis was to research from literature what are the best practices in involving the supplier into new product develop-

ment, without forming a fixed linkage to it and maintaining negotiation power. Former attempts had led to higher prices and practically forced supplier-buyer relationships. After the thesis there should be better understanding in procurement about how the aforementioned can be achieved. Purpose is not to steal or exploit the suppliers but to do design cooperation and to look for occasions where the supplier can also benefit from the situation. According to many cases, properly managed design cooperation can benefit both parties in different ways (Ragatz et al. 1997), which can be stated to be the base argument when starting to establish supplier integration.

Objectives for the thesis are the following:

- Ascertain the current state of the company's NPD process – and give improvement ideas for supplier integration
- Find out the responsibilities of procurement department and its role in a supplier integrated cross-functional NPD project
- Search for tips, instructions, experiences and suggestions from literature to purchasing function's role and responsibilities in cross-functional R&D team and supplier integration in new product development

This thesis was made while the case company had just started to involve suppliers in new product development. Main goals were to study and explain the essence of the literature behind this topic, and to the find most relevant differences between company's efforts and literature's idea of best practices, when involving suppliers in NPD.

The main research question can be expressed:
"*How procurement can participate in a New Product Development project and further assist by bringing the supplier's view into the NPD process?*

1.2 Structure of the thesis

This thesis is divided into six chapters. Next, in chapter two, there is literature review to build a theoretical background for the following chapters. It starts with procurement in general and continues to new product development and cross-functional NPD teams. After having an understanding of these two, the literature review combines them in the third part by integrating suppliers in new product development, which is the main part of the literature review.

In chapter three the research methodology is described. There are short descriptions about which research strategy was selected and how data was collected and analyzed. Then chapter four is dedicated presenting the results which are thoroughly discussed in chapter five. The fifth chapter compares the results to the literature review and points out how well the findings match. The sixth chapter concludes the thesis with academic contributions, limitations of the thesis and possible future research.

2 THEORETICAL BACKGROUND

Core concept of the thesis is new product development with supplier involvement in it. To build a profound understanding of the literature behind this topic, theoretical background is divided into three parts: purchasing and supplier relationship management in general, new product development and, finally, those two combined to supplier involvement in new product development.

First part about purchasing and supplier relationship management gives the basic idea of the tasks of procurement department in a company that uses suppliers in its business concept. After reviewing procurement in general, literature review continues towards supplier selection and product group strategies. Second part reviews the other essential dimension of the literature of this thesis, new product development. It is a short overview of NPD including a peek to cross functional NPD teams and their features. Third part of the literature review integrates purchasing and supplier relationship management to new product development. The focus is gradually moving from requirements and fundamentals to best practices, success factors and failures.

Procurement approach is used in the literature review. Idea is to study this entity in overall to see purchasing's position in it.

2.1 Purchasing as a function of a company

Companies are more and more concentrating on their core competencies and key technologies in order to survive in the competitive markets by doing what they do the best. (Schwientek & Schmidt 2008) This leads to a situation where well performing suppliers are crucial for a company that wants to concentrate on its core competencies leaving the rest for its suppliers. Of course, this kind of a company needs somebody to take care of its suppliers, and that is purchasing department (Stevenson 2012). Leonard-Barton (1992) defines in her highly cited article that a competency is a core if it differentiates the company strategically. When the focus of the company is on its core competence, it creates boundaries which the company itself is not able to exceed (Schwientek & Schmidt 2008). It has to rely on and manage its network of suppliers in order to add value to its products (Schwientek & Schmidt 2008, Anderson et al. 2009). Figure 2.1 describes the purpose of purchasing as a manager of suppliers before company's own production. Figure represents the basic process of a company. Idea is that company buys material, adds value and sells the outcome to its customers (Hofmann et al. 2011).

Figure 2.1 *Core process chain of a company (Schwientek & Schmidt 2008)*

As can be seen from the figure 2.1, purchasing is the previous phase before company's own production. Its task is to acquire resources and capabilities for the firm from outside providers (Anderson et al. 2009, Stevenson 2012). Duties of purchasing are not solely considered to cover only the price of the goods purchased. (Stevenson 2012) It is also responsible of other important factors, such as the quality of the goods and services, and the timing of deliveries, both of which can have huge impact on operations if not correctly placed. Also, it identifies the sources of supply, negotiates contracts, maintains the database of suppliers, is responsible of that the goods and services meet or exceed the functional requirements from own production and manages suppliers (Stevenson 2012).

Purchasing and procurement are generally defined as "*the acquisition of goods, material and services to accomplish the goals of the organization*" (Lightsey 2001). That means the action of acquiring goods, materials or services at the operational level including contract negotiations, different analysis, financing, specifications definition, searching and selecting suppliers and price negotiations (WebFinance 2014). Nonetheless, procurement and purchasing are not synonyms since procurement includes logistics, scheduling and supplier quality issues in addition to purchasing (Lightsey 2001). Purchasing is narrower concept inside procurement, which, in turn, is a part of supply chain management. (Spina et al. 2013) Figure 2.2 illustrates this threefold entity.

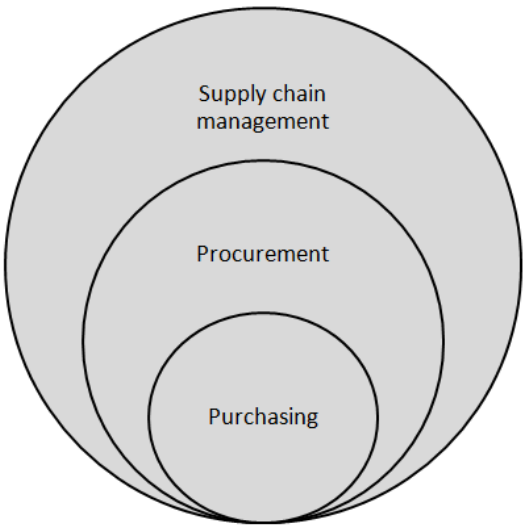


Figure 2.2 *Relations of supply chain management, procurement and purchasing (adapted from Spina et al. 2013)*

Supply chain management is the top level of procurement (Spina et al. 2013). It can be defined "*as the management of multiple relationships across a certain supply chain*" (Lambert & Cooper 2000). Similar, but wider, definition was made by Christopher (2011), whose definition of supply chain management is *"the management of upstream and downstream relationships with suppliers and customers in order to deliver superior customer value at less cost to the supply chain as a whole."* Overall, it means management of the supply chain which consists of all the organizations that affects to the product (Handfield 2011). Understanding supply chain management and purchasing comes together when talking about suppliers. (Anderson 2009, Stevenson 2012) It is on purchasing departments responsibility to work with many interfaces and functions internally and externally in the company. Also, since procurement has gone through some significant changes for more than 30 years, and actions such as cost management, target costing, value creation and supply chain management are nowadays often initiated in purchasing, it is essential to understand the meaning of supply chain management (Schwientek & Schmidt 2008).

One common way to divide purchasing function is to divide it to operative purchasing and strategic purchasing. (Monczka et al. 2009) Operative purchasing takes care of daily flow of materials whereas strategic purchasing handles issues that define the future business, directions, prices, supplier selections etc. This thesis concentrates on strategic purchasing.

Thomas & Griffin (1996) stated that traditionally a supply chain consists of three stages: procurement, production and distribution. It usually consists of many suppliers and customers, Figure 2.3. (Lambert & Cooper 2000) There can be numerous tiers of customers' customers or suppliers' suppliers. Figure 2.3 illustrates how complicated supply chain can be when monitored in overall (Lambert & Cooper 2000).

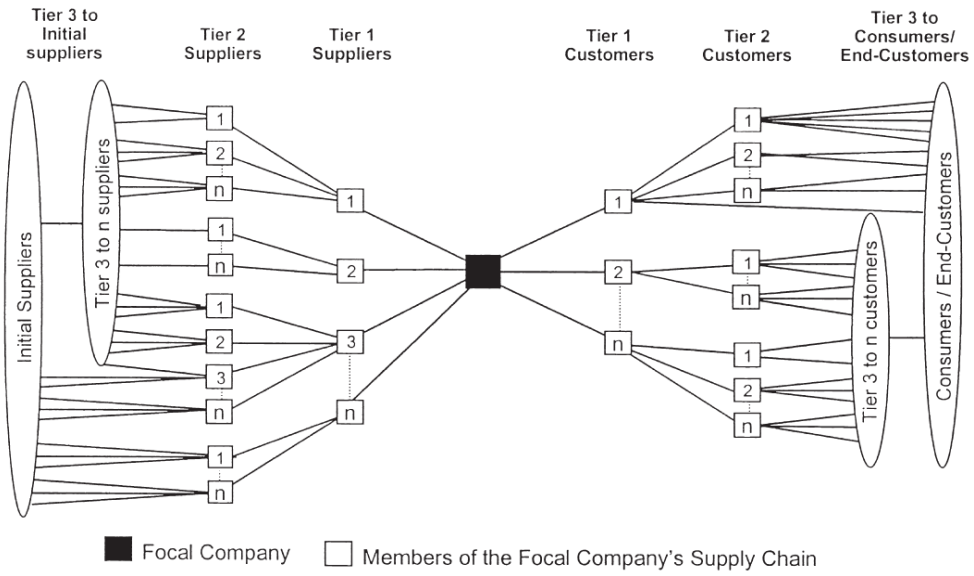


Figure 2.3 *Supply chain network structure (Lambert & Cooper 2000)*

Understanding the whole value chain is important, because purchasing provides great value to end-users, by working close with other functions in- and outside of the company (Anderson et al. 2009). Because of the degree of complexity required to manage all suppliers back to the point of origin of the product, executives would want to manage the whole supply chain (Cooper et al. 1997). At the beginning of 21st century, it has been announced that in the modern business management, individual businesses are no longer competing but rather supply chains compete against each other (Lambert & Cooper 2000, Womack & Jones 2003). This brings us to the importance of purchasing that is extending to more challenged aggregation from traditional buying (Schwientek & Schmidt 2008). Of course, purchasing is responsible only for the supplier side of the supply chain (Stevenson 2012). Nonetheless, modern compulsion to adapt to quickly changing environments has brought many new challenges for purchasing, such as (Schwientek & Schmidt 2008):

- Increasing globalization
- Company's pressure to concentrate on its core competencies forces purchasing to find better suppliers to create value
- Necessity to have alliances in the supply chain because of integrated value creation in the supply chain
- Fast pace to react to customers' wishes ➔ vertical integration with suppliers
- Getting innovations from suppliers
- Rising material prices

Now it can be said that purchasing is not just about bids and buys, but about managing relationships with strategic suppliers aiming to support the manufacturing process and new product development (Cooper et al. 1997).

In order to stay alive in today's competition, companies must have a purchasing strategy (Kraljic 1983, Schwientek & Schmidt 2008, Anderson et al. 2009). Right purchasing strategy executed with right suppliers can significantly improve the performance of the company (Womack et al. 1990). In order to help the buyers to make purchasing strategies, Kraljic (1983) developed purchasing product portfolio. He divided products in four categories depending on how easily they are available in the market and how valuable those products are to the buyer. The point of the portfolio is to give the buyer an understanding to focus its efforts to manage the suppliers, in the right circumstances, with the required means in that recognized category, and not to waste time to inappropriate sourcing strategies (Kraljic 1983). The approach assumes that the buyer is aware of the supply market situation, and understands to manage its suppliers appropriately in that prevalent situation (Cox et al. 2004).

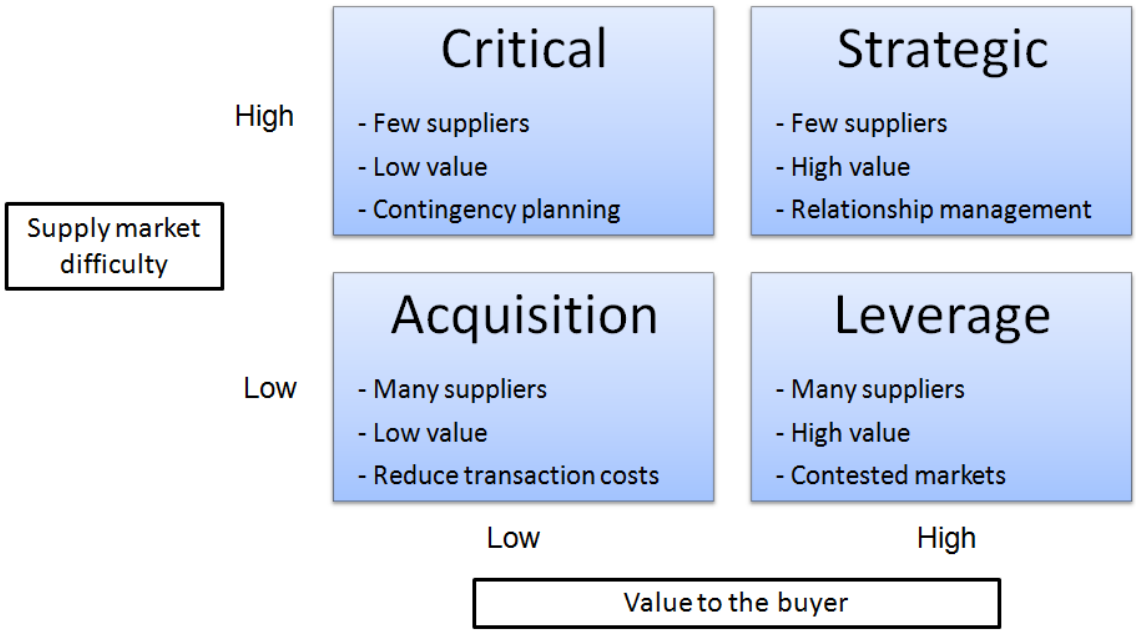


Figure 2.4 *Purchasing portfolio management (adapted from Kraljic 1983)*

In Kraljic's (1983) purchasing portfolio management, the 'strategic' quadrant is meant for those products that need cooperation between the supplier and the buyer, and the buyer must develop close relationship to manage the supplier. The 'leverage' quadrant is for high competition products which is why the product group is managed with regular market tests. (Kraljic 1983) 'Acquisition' quadrant is for noncritical and easy to get parts, which need to be purchased with minimum price. In the critical quadrant, more complicated approach is needed to avoid production stops and reduce the risks from bottleneck products (Kraljic 1983). When the buyer is aware on which quadrant certain supplier is, it can establish correct strategies (Cox et al. 2004). Strategies are needed to remain innovative in the long run, but, they need to be clearly formulated, which requires properly organized purchasing function (Schwientek & Schmidt 2008).

When doing comparison, supply chain management can be seen as an alternative for Kraljic's purchasing portfolio. (Cox et al. 2004) It has risen from Japan, from lean thinking, and it concentrates on value to customers. In supply chain management school of thought, relationships with buyers and suppliers are often long-term and highly collaborative (Womack et al 1990, Womack & Jones 2003).Supply chain management school of thought is not the core issue of the thesis and therefore no longer introduced.

Usually, firms do not see purchasing function as their core business (Schwientek & Schmidt 2008) but as a key strategic function (Humphreys et al. 2000). Its importance originates from companies endeavor to develop and produce products according to what customers want and when, while abominating the fluctuating demand (Ogawa & Piller 2006). This combined to the fact that the most of the costs of a ready product come from purchased parts and materials, create huge risks and potentials in supply management

(Ogawa & Piller 2006). Trends are that purchasing environment has been dramatically growing in the last decades (Sheth & Sharma 1997, Cox et al. 2000, Spina et al. 2013), and that firms try to use their purchasing department as a competitive function to create value (Anderson et al. 2009). However, purchasing functions are organized in different ways (Cox et al. 2000). It can be centralized or decentralized (Humphreys et al. 2000, Schwientek & Schmidt 2008, Stevenson 2012). Decentralized purchasing means, that individual departments or locations can handle their own purchasing needs, which gives the benefit to do local, quick, responses to requirements. (Stevenson 2012) In centralized purchasing, the function is handled by one special department. That gives the function a lot power behind it but makes it slower (Stevenson 2012). Third option is lead buying which is the combination of the previous two. (Schwientek & Schmidt 2008) It includes commodity purchasers which have the power and capability to do company-wide decisions while local buyers can manage with daily businesses.

A factor affecting to the performance of a purchasing department is its maturity. Figure 2.5 shows the maturity steps of a purchasing organization from price negotiation through volume concentration to total cost of ownerships (TCO) which means all the expenses that one supplier creates. From the figure we can see that total potential for savings are greater when the purchasing function is on the third step of the maturity graph. When the purchasing organization and the maturity are in order, a company can divide its purchasing organization's tasks to transactional (local buyer), sourcing (commodity lead and local buyer) and commodity strategy (whole organization), figure 2.6. (Schwientek & Schmidt 2008)

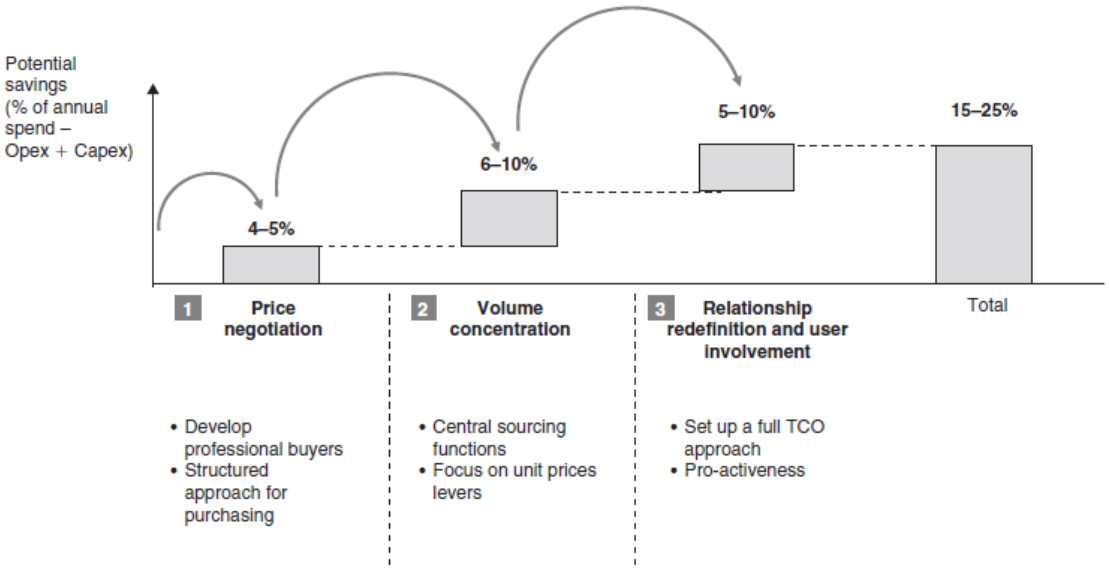


Figure 2.5 *Maturity steps of a purchasing organization (Schwientek & Schmidt 2008)*

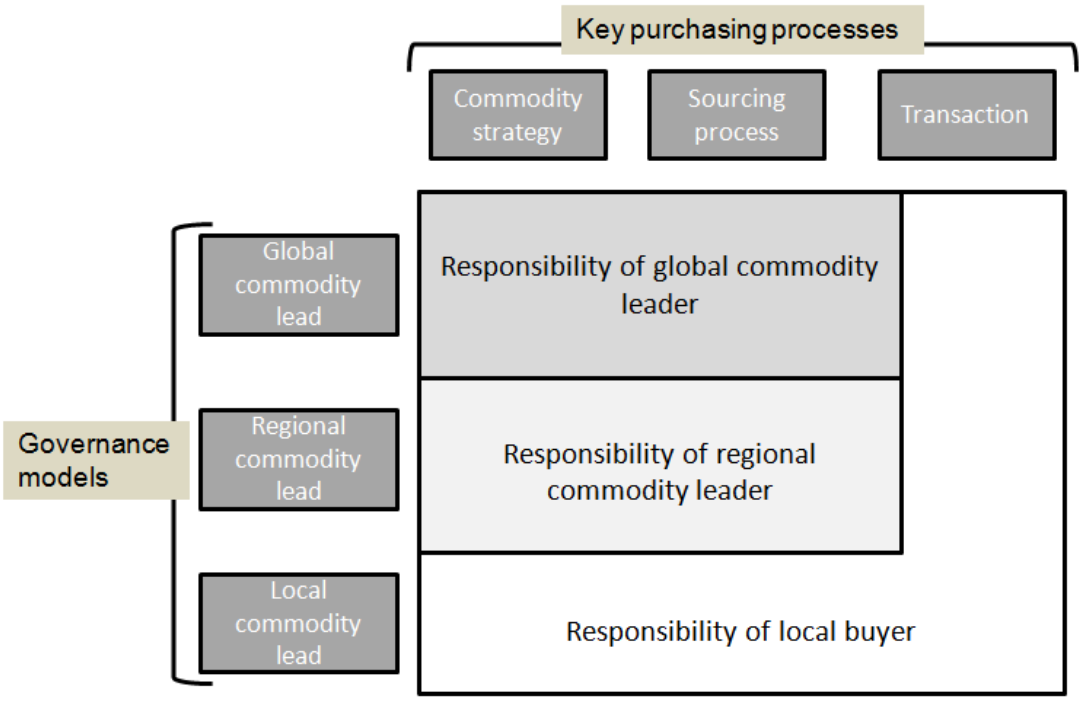


Figure 2.6 *Responsibilities in purchasing organization in overall (Schwientek & Schmidt 2008)*

2.1.1 Supplier selection

Supply chain of a global company usually consists of multiple enterprises and manufacturers that are scattered around the globe. (Choy et al. 2012) Every one of these suppliers is involved in quality, deliveries and cost structure. Because of this overall influence to the end value of the product it is important for a company to select its suppliers carefully (Cox et al. 2004, Basu & Wright 2008, Schwientek & Schmidt 2008, Hofmann et al. 2011, Willcocks et al. 2011). It should not be done based solely on experience (Choy et al. 2012) but on certain processes in which suppliers are evaluated, benchmarked and inspected beyond visible aspects such as production capabilities, prices and quality (Willcocks et al. 2011). These kinds of processes ensure that company is not getting businesses only for the next months but building up long-term relationships (Basu & Wright 2008).

A match between a manufacturer and a supplier must be properly done in order to work harmoniously. (Choy et al. 2012) A successful selection needs both parties to be willing to give input to the partnership. This kind of relation can be achieved by a simple process: specify your product, check possible candidate suppliers, benchmark them and select the most suitable supplier (Choy et al. 2012). Hofmann et al. (2011) describes the supplier selection process as a strategy selection, figure 2.7. It starts with a pool of suppliers and narrows it down by doing financial statements and evaluating and comparing the suppliers. When the list of potential suppliers is shorter, tender documents should be sent only to the relevant suppliers before the selection.

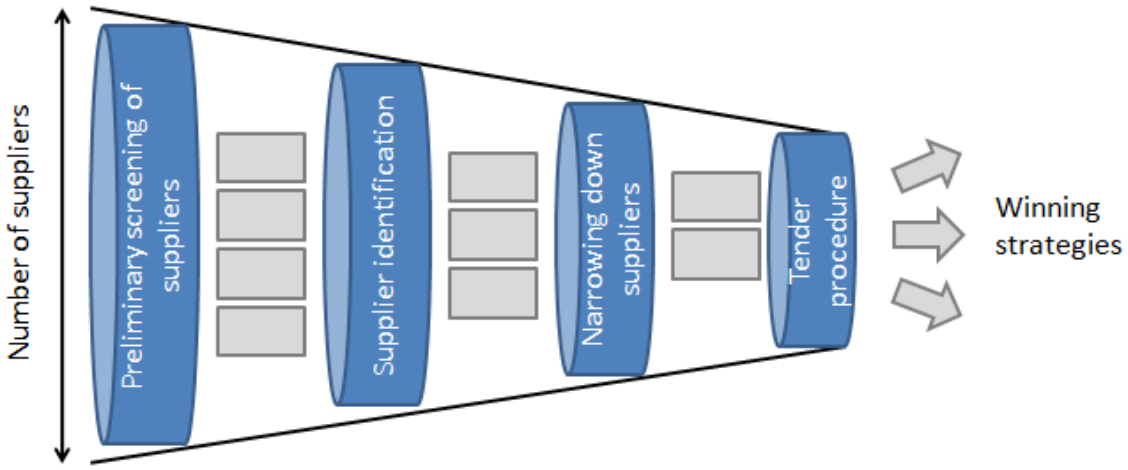


Figure 2.7 *Supplier selection process (adapted from Hofmann et al. 2011)*

Because of its importance, supplier selection should be considered as a strategy selection (Cox et al. 2004, Hofmann et al. 2011, Willcocks et al. 2011). Well placed supplier selection is dependent on the product group and its management (Kraljic 1983, Cox et al. 2011). Therefore, intention to the supplier selection should always come from product group strategy (Willcocks et al 2011, Hofmann et al. 2011).

The ideal supplier is able to deliver enough good quality, at the right time with low profits. (Cox et al. 2004) This kind of situation can be achieved in a situation that is buyer dominated or interdependence exists. Because of supplier's overall influence to the company, top management should be involved in the selection (Willcocks et al. 2011). Also, to select suppliers, a company can establish buying teams to take care of the decision making as a team. (Anderson et al. 2009) There can be different departments in the team, so that all the aspects of the company's core competencies will be covered. In the worst case, company can select a supplier that cannot deliver required functionality or reduce the TCO as wanted. (Cox et al. 2011) This situation is possible when market is supplier dominant or interdependence exists. If the supplier selection and product group management are done successfully, it can reduce tied-up capital and costs (Hofmann et al 2011).

2.1.2 Relationship management

"*Successful relationships don't just happen.*"
(Willcocks et al. 2011)

Commonly, people tend to think that outsourcing is an easy and straightforward action that includes money and deliveries, and the benefits will just automatically emerge (Willcocks et al. 2011). They do not understand that one company can have many suppliers (Lambert & Cooper 2000, Harrison & Hoek 2004) which all need to be managed by purchasing (Stevenson 2012). There can be numerous possible types of different

relationships (Harrison & Hoek 2005) which all need to be handled individually depending on the situation (Cooper and Gardner 1993, Cox et al. 2004, Harrison & Hoek 2005, Caniels & Gelderman 2007).

Relationships between the focal firm and its suppliers can be divided from *arm's length* to *vertical integration*, figure 2.8 (Cooper & Gardner 1993). *Arm's length* means that the foundation of relationship is price whereas *vertical integration* means common ownership of resources (Harrison & Hoek 2005, Koufteros et al. 2012). This continuum of relationship styles from Cooper and Gardner (1993) is already quite old and nowadays there is more literature that divides suppliers to certain categories based on product group strategies that stem from Kraljic's (1983) purchasing portfolio matrix (Cox et al. 2004, Caniels & Gelderman 2007, Willcocks 2011).

Figure 2.8 *Relationship styles continuum* (adapted from Cooper & Gardner 1993)

Kraljic's (1983) purchasing portfolio matrix divides products to groups: Bottleneck items, Strategic items, Non-critical items and Leverage items. (Harrison & Hoek 2005) It is based on the notion that buyer will seek to maximize its power whenever possible. Caniels and Gelderman (2007) extended Kraljic's portfolio by stating that buyer-supplier relationships can be considered through power and interdependence, which construct the basis of strategic thinking in supplier management. The power factor between the buyer and the supplier always exists as interdependence between buyer and supplier. (Cox et al. 2004, Caniels & Gelderman 2007) Power advantage can be on buyer or on supplier, or it can be balanced, figure 2.9. The thought that power is usually seen as money originates from the fact that business relationships are usually far from ideal, and in normal situation the buyer and the supplier have different goals: buyer wants low TCO and great value, while the supplier wants to have long-term big profit (Cox et al. 2004). Because of these diverging goals, different product groups form alternative environments for buyers to plan and implement their strategies in each of the product categories (Monczka et al. 1998, Cox et al. 2004, Caniels & Gelderman 2007). As rationalized above, partnership-like relationship is not always the best because only certain suppliers should be selected as partners (Monczka et al. 1998, Wagner & Hoegl 2006, Goffin et al. 2006).

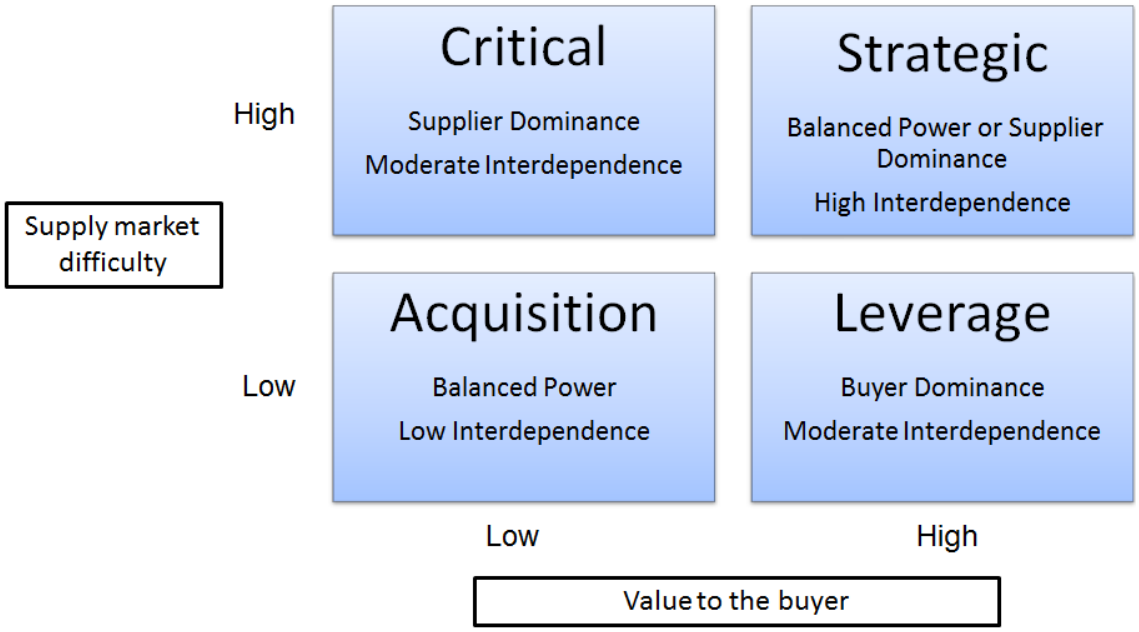


Figure 2.9 *Purchasing portfolio matrix (adapted from Kraljic 1983) with power relations (Caniels & Gelderman 2007)*

Strategy of the each product group is defined by the goal (Kraljic 1983). Goals are easier to achieve in leverage items' product group because there is so many available suppliers. (Harrison & Hoek 2005) In non-critical items ensuring their long-term availability is the issue. Achieving goals is more complicated in bottleneck and critical items. (Kraljic 1983) Company has to ensure the availability of bottleneck products, e.g. finding additional suppliers, and form closer relationships with the suppliers of strategic products. In this case, forming close connection, a partnership, is beneficial and it brings advantages, such as better quality, lower costs and reliable deliveries (Cox et al. 2004, Goffin et al. 2006, Stevenson 2012). Characteristics of a partnership are:

- trust
- information sharing
- mutual goals
- cooperative planning
- long-term
- recognition of mutual interdependence

(Cox et al. 2004, Goffin et al. 2006, Stevenson 2012)

Companies are aware of the value of effective supplier management (Goffin et al. 2006). Professional purchasers understand that power does not always have to be on buyer's side and sometimes it is good for the relationship that the supplier is dominant (Caniels & Gelderman 2007). Instead of getting rid of the supplier as soon as it does not satisfy anymore, Sheth and Sharma (1997) and Willcocks et al. (2011) suggest to show trust and commitment to the supplier, and consider it like a customer. Then you have the basis to start closer cooperation because trust guides the behavior of individual persons

who make the relationship of what it is (Willcocks et al 2011). To be precise, supplier dominance in a relationship is totally acceptable if the situation is satisfactory for the buyer (Caniels & Gelderman 2007). Making moves to any direction is always resource intensive consuming time and money (Goffin et al. 2006). Issue is not black-and-white because a relationship is best when the power is distributed equally between the supplier and the buyer (Willcocks et al. 2011). Nonetheless, trust is the foundation of good buyer-supplier relationship that affects through communication of individuals (Handfield & Nichols Jr. 2004).

For a relationship to be successful between the buyer and the supplier, they have to align their goals, understand the tension in a relationship and see the power balance and dependence between them. Then it is possible to achieve a situation which is optimal for both but not ideal for either one. (Cox et al. 2004)

There are obstacles and challenges when considering closer cooperation with a supplier. Simchi-Levi et al. (2003) summed up that every company has its own core competencies which should not be given to the other party or endanger the rivals to get access to those. Competitive knowledge or skills should not go to the supplier because they can sell them forward in a way or another. Furthermore, if the alignment of goals between buyer and supplier is not properly done it is extremely difficult to make the relationship work successfully. (Simchi-Levi et al. 2003)

2.1.3 Supplier integration

When a manufacturer and its supplier recognize their interdependence, supplier integration can be a solution for the manufacturer to enhance its competence in the markets (Das et al. 2006). Lawrence and Lorsch (1986) defined supplier integration as: "*coming together of diverse interests and people to achieve a common purpose via interactions, information sharing, and coordination of activities*". In Cooper's and Gardner's (1993) relationship styles continuum, this means strategic alliance. (Monczka et al. 1998) It requires mutual goals for both parties and the support from commodity strategy for the product group. Well established supplier integration breaks the organizational boundaries and outsources innovation (Wagner & Hoegl 2006).

In much of the literature, *supplier integration* term refers to NPD and usually it is interchangeable with the word *collaboration* (Jassawalla & Sashittal 1998). Still, literature defines collaboration either as co-development with the supplier or as developing the supplier (Schwientek & Schmidt 2008). In this thesis, supplier integration and collaboration mean co-development and cooperation of manufacturer and its supplier in order to achieve better designs while respecting costs, manufacturability and quality. Goal in it is to find hidden potential from the suppliers while giving advantage to both.

It is known that every company has its boundaries (Wagner & Hoegl 2006), and very few owns the whole supply chain (Choy et al. 2012), which are only two of the multiple reasons why companies search for competitive leverage from their suppliers (Goffin et al. 2008). As a result of intense global competition, companies bring their suppliers closer and closer (Choy et al. 2012) and it usually starts with new product development (Schwientek & Schmidt 2008).

2.2 New product development

Brown and Eisenhardt (1995) stated in their extensive literature research that "*Product development is critical to the viability of firms and an important core competence."* This can be justified by Downlatshahi's (1996) finding that, based on different reports, about 80% of the total costs of a product is determined already in the product design phase. Also, Cooper and Kleinschmidt (1995) agreed with Brown and Eisenhardt that new product development is the motor that keeps companies running.

New product development is recognized among the people as the process of developing new products or services for commercial purpose (WebFinance 2014). Krishnan and Ulrich (2001) defined product development as "*the transformation of a market opportunity and a set of assumptions about product technology into a product available for sale.*" Consequently, product development is a diverse and complex issue that can be divided to four categories depending on its newness and familiarity of markets (Ulrich & Eppinger 2008):

1. new product platforms
2. derivatives of existing product platforms
3. incremental improvements to existing products
4. new products

Beyond categories, the complexity of new product development varies. Ulrich and Eppinger (2008) compared the development of an airplane to a screwdriver. This means that product development can exist in large scale and small scale. Commonly speaking, new product development can be defined as the creation of something new for commercial purpose.

2.2.1 NPD process

To success in NPD and to create a new product, company needs to have a new product development process and a clearly defined NPD strategy (Cooper & Kleinschmidt 1995). Monczka et al. (2000) defined new product development process as "*a series of interdependent and often overlapping stages during which a new product (or process or service) is brought from the idea stage to readiness for full-scale production or operation"*. Figure 2.10 illustrates the new product development process.

Figure 2.10 *The new product development process (adapted from Monczka et al. 2000)*

In the new product development process, above, a product concept moves from idea generation to evaluation of business and technical feasibility, to concept and product design and finally to prototype phase. If the product is then approved, full-scale operations may begin. (Monczka et al. 2000)

A design can change multiple times during the new product development process (Monczka et al. 2000). Because of this, it is important to understand that as the process continues, it becomes increasingly difficult and costly to make any changes to the design, figure 2.11 (Monczka et al. 2000, Barclay et al. 2011).

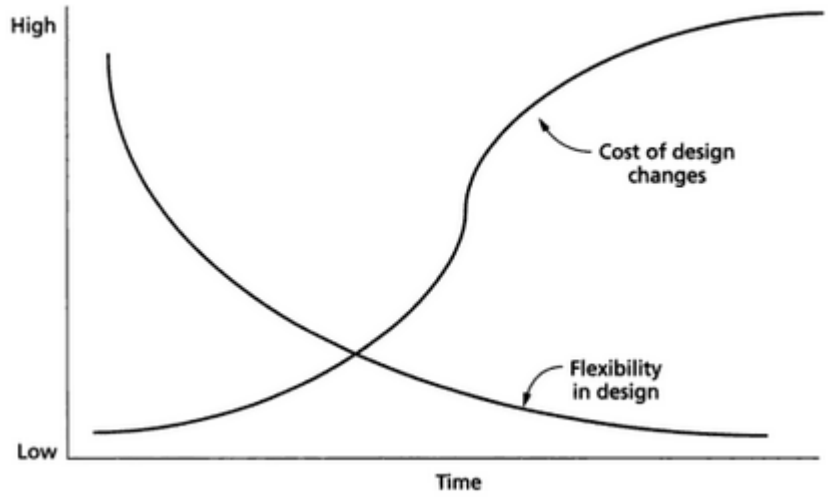


Figure 2.11 *Design flexibility and cost of design changes (Monczka et al. 2000)*

According to the studies in the late 1980's, only one out of four development projects succeeded and 50% of development resources were spent to failure projects (Cooper 1990). Cooper's (1990) response to this was the stage-gate process, figure 2.12. The process has six stages and checkpoints between them. In the stages, all the work is done and the gates ensure that the quality is sufficient. (Cooper & Kleinschmidt 1995) Throughout the process, there are go/no-go decisions where choices are made about the continuation of the project. There is clear evidence that this stage-gate process works and it enhances communication, reduces unnecessary work, improves market launch, reduces cycle times, increases the ratio of successful projects to failures, and facilitates the spotting of mistakes (Barclay et al. 2011). Later, after learning the basics of the stage-gate process, companies started to add different discovery stages at the front end of the process in order to better harness new product development ideas (Cooper et al. 2002).

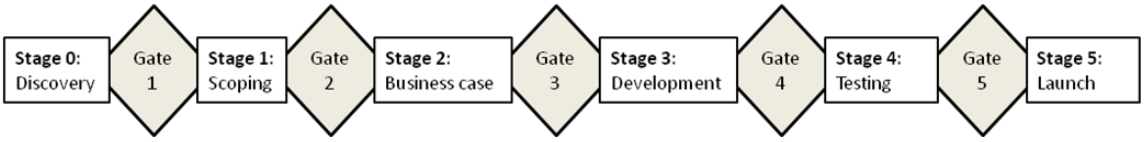


Figure 2.12 *Stage-gate process (adapted from Cooper 1990)*

The success of product development is usually based on the quality of the new product development process. Many NPD projects fail because managing the design process is challenging and can lead to a failure. Challenges in the process management exist because project plans change, they are usually iterative, and each project is unique. Furthermore, product concentric decisions varies throughout the development process since a decision on one product affects to other products because of interfaces that products have between them. In addition, a common and practical tool for monitoring and planning NPD processes does not exist and they are typically done manually, which creates a gap between product and project managers. This leaves the success of product development to the skills and know-how of individual managers. (Karniel & Reich 2011)

One factor that makes the stage-gate process so well performing new product development process is cross-functional teams in it (Cooper & Kleinschmidt 1995, Barclay et al. 2011). Each stage is cross functional and none can own it, and all the decisions in the gates are done by a cross-functional senior group (Cooper 2008).

2.2.2 Cross-functional NPD teams

Lawrence and Lorsch (1967) created a theory that organizations are most effective when they build specialized functional units and integrate them. Later (1986), they found out that effective companies do proper differentiation and integration of functions within the company. All cooperation of integrated teams between functions roots from these findings (Huth 2008). Barczak et al. (2009) found out in their extensive and highly cited research that the best firms emphasize and integrate their innovation strategies in all levels of the company and use different techniques, and experiment them, in order to support new product development. A survey by McDonough (2000) reveals that 97% of the companies in USA have used cross-functional teams and 33% uses them all the time. Wider research was done by Barczak et al. (2009), who reported that 69 % of the firms use formal NPD process with cross-functionality. Many academics have proved that cross-functional teams provide great profitability for a company being the key factor in NPD (Cooper 1990, Kahn 1996, Aronson et al. 2006, Huth 2008, Barczak et al. 2009, Engelen et al. 2012, Enz & Lambert 2012).

Huth (2008) defined cross-functional team as "*A group of people with a clear purpose representing a variety of functions or disciplines in the organization whose combined*

efforts are necessary for achieving the team's purpose". According to Barclay et al. (2011), teamwork is the heart of integrated product development and all interested functions should be included in the design work. A function here represents a distinctive group of specialists responding on one activity inside higher construct, which is a department (Kahn 2009). The rationale for using cross-functional NPD teams is that each member of the team brings in his/her knowledge from one function to the team, and this knowledge combined can leverage each other generating valuable strategic asset as teams create new solutions (Brown & Eisenhardt 1995).

2.2.3 When a cross-functional NPD team is needed?

Even though cross-functionality in NPD team has been recognized as a key factor in NPD project success (Barczak et al. 2009) the relationship between NPD projects and cross-functional teams is far more complex than just "more is better" (Olson et al. 2001, Gemser & Leenders 2011). Relationship is determined by the complexity, newness and volume of the product (Barclay et al. 2011), scope and uncertainty of the task (Kahn 2009), the degree of risk (Gemser & Leenders 2011) and which functions cooperate in which stage of the design process (Olson et al. 2001).

The complexity of products requires in-house design teams to form cross-functional NPD teams in order to deal with the entire product (Kim & Kang 2008). Products have more and more parts, technologies, interfaces and functionalities which make integration of functions mandatory in order to success in development. (Barclay et al. 2011) Furthermore, if the product is new for the company or it will be manufactured in high volumes, cross-functional NPD team has its rationales.

Complexity itself increases the uncertainty of the design tasks and requires additional input also from other departments than design. (Barclay et al. 2011) When complexity increases, more functions should be involved in the design process. This combined to the scope of the design task creates the dimensions when the cross-functional NPD team is needed. Kahn (2009) divided the combination of task scope and task uncertainty and represented a graph, figure 2.13. Before cross-functional teams in NPD are needed, "lighter" tasks can be handled by multifunctional teams. (Kahn 2009) Multifunctional teams consists of those departments that have the necessary skills to complete the design objective, e.g. marketing and design, whereas cross-functional teams include personnel from different departments who are somehow related to the task. Using cross-functional teams reduces uncertainty of the task in overall (Kim & Kang 2008).

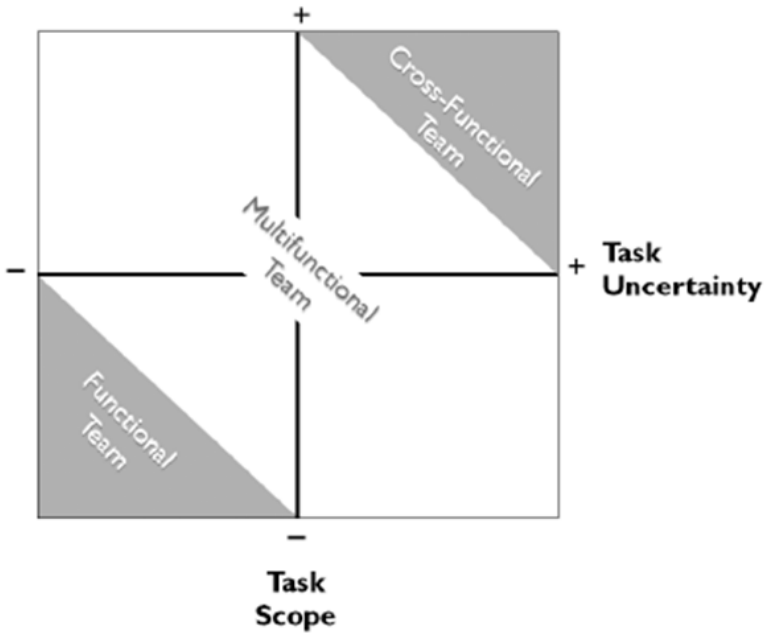


Figure 2.13 *Task scope, task uncertainty and type of interfunctional initiative (Kahn 2009)*

Integrating functions in NPD is based on the resource dependence theory. (Engelen et al. 2012) Since each function has function specific information, functional department needs the resources of the other functions in order to make a successful design in every aspect. Based on this resource dependence theory, Olson et al. (1995) argued that cross-functionality should be used in highly innovative projects and in situations where broader set of expertise is needed. Huth (2008) added that incremental innovation with low levels of uncertainty can be done by one function. Gemser & Leenders (2011) approached this same matter comparing degree of cross-functional integration into degree of risk, figure 2.14.

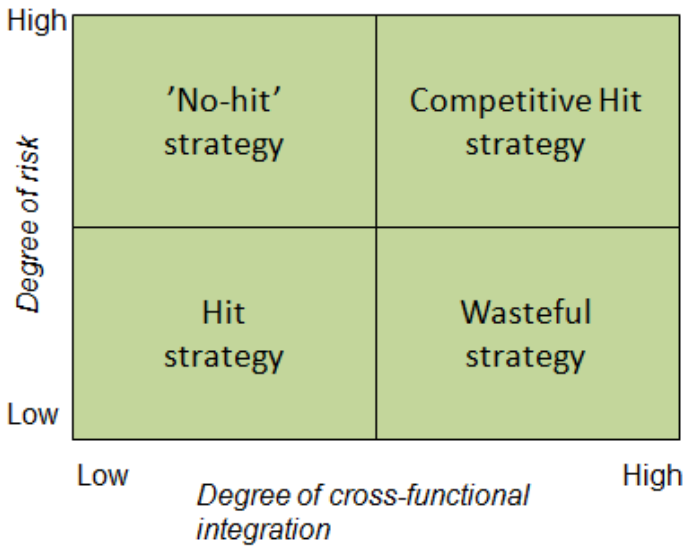


Figure 2.14 *Degree of risk and cross-functional integration (Gemser & Leenders 2011)*

According to Gemser and Leenders (2011), cross-functional cooperation is a resource investment decision and it should be carefully done because cross-functional cooperation will not pay under all circumstances. They recommended that it should be done in risky NPD projects. Cross-functional cooperation strengthens risky NPD projects, which ultimately have higher pay-offs. Using cross-functional NPD team in less risky projects may be only waste of resources. (Gemser & Leenders 2011)

2.2.4 Success factors and best practices in NPD

Leading organizations rely on cross-functional teams throughout the entire NPD process and they have centralized NPD function in the company (Cooper et al. 2002). NPD projects are led by steering committees that function as a formal platform for cross-functional conflict solving. (Huth 2008) They also set milestones for projects, guide different projects and are responsible of the company's NPD. This is supposed to be done only on certain level since too much intervention on projects may exert negative effects on keeping the teams from exploring new ways or technologies (Huth 2008).

For teamwork to success, it requires openness inside the team (Gemser & Leenders 2001), management and an effective team leader (Barclay et al. 2011, Barczak & Wilemon 2011). Team leader has to empower team members to make decisions without losing the power in the team (Barclay et al. 2011). Unsuitable team leader may affect to the team and the project negatively (Aronson et al. 2006). Team leader has to be able to coordinate and support team members in their efforts (Barczak & Wilemon 2011), and also he/she has to create the environment of trust, creativity, and collaboration (Aronson et al. 2006). A couple of ways to create a proper environment for cross-functional team is to have lunches together (Kahn 1996), set up trainings for members of the team, reward them for success, set clear goals, and co-locate the team (Kahn 1996, Barczak & Wilemon 2001). Proper management of the team is crucial since the effectiveness of the team members partly comes from their satisfaction within the team (Barczak & Wilemon 2001).

People from different functions with different views often stick to their own opinions and this causes conflicts between members (Kim & Kang 2008). Team leader or top management can prevent these kinds of conflicts by inter-functional job rotations. (Gemser & Leenders 2011) Rotation of personnel in different functions enhances information and knowledge sharing which prevents conflicts. One other way to prevent conflicts is to bring the customer to the project. (Ogawa & Piller 2006) Then the product comes to the right need because knowledge about what is needed and what is not needed is presented in the team.

Cooper and Kleinschmidt (1995) wanted to improve common understanding of company-level drivers of NPD success, and they found out following elements in their multi-firm benchmarking study:

1. a high-quality new product process
2. a clear and well-communicated new product strategy for the company
3. adequate resources for new products
4. senior management commitment to new products
5. an entrepreneurial climate for product innovation
6. senior management accountability
7. focus on products close to existing ones
8. high-quality development teams
9. cross-functional teams

Kahn et al. (2006), Barczak and Kahn (2012) and Kahn et al. (2012) have put more effort to examine the best practice versus poor practice comparison in NPD elements. Results are gathered in table 2.1. In this context, best practice is defined as a technique/method/process that delivers better outcome than other techniques/methods/processes (Kahn et al. 2012).

Table 2.1 *Best practice vs. poor practice (Adapted from: Kahn et al. 2012, Barczak & Kahn 2012)*

Best Practice	Poor Practice
Strategy	
Clearly defined and company-wide NPD goals	No or unclear NPD goals
The company views NPD as a long-term strategy	The company views NPD only as a short-term tactical initiative
NPD projects and programs are reviewed on a regular basis	A variety of NPD projects are supported with little to no regard for mix appropriateness
There is a ranking or prioritization of projects	No prioritization of NPD projects
There is keen consideration for balancing the number of projects and available resources	No process for undertaking portfolio management
NPD goals are clearly aligned with organization mission and strategic plan	NPD projects may or may not be aligned with company's mission/strategic plan
	Little projects on the side are prevalent with no attachment to bigger ones
	All trade-offs amongst NPD projects are made informally with no set criteria
Process	
A common NPD process cuts across organizational groups	Criteria for evaluating NPD projects are not defined
Go/no-go criteria are clear and predefined for each review gate	Limited documentation exists regarding the NPD process
The NPD process is visible, well documented, clear and adaptable to meet the needs, size, and risk of individual projects	No NPD process exists
	There is no discipline in using the company's NPD process
	There is no NPD process owner or NPD process champion
Culture	
Top management supports the NPD process	All NPD ideas come from within the company
Management rewards and recognizes entrepreneurship	Management is primarily focused on operational efficiency and cost savings
The company actively works with customers to develop new solutions	
Project	
Cross-functional teams underlie the NPD process	No identifiable NPD group
Each project has a clearly identifiable project leader	No project leaders
NPD activities between functions are coordinated through formal and informal communication	NPD personnel are involved in too many projects

Since the most of the costs of a ready product come from purchased parts and materials, purchasing function is an important factor in NPD process (Barczak & Wilemon 2001). During NPD projects, sourcing decisions are made which is why there has been increasing interest to take purchasing into NPD (Wynstra et al. 1999). Purchasing function is able to bring the supplier into the development process and already start checking the sourcing alternatives (Barczak & Wilemon 2001).

2.3 Involving suppliers in new product development

The need to do design collaboration with suppliers emerged from automotive industry, when cross-functional teams became a normal approach to NPD (Das et al. 2006). Collaboration with suppliers is increasingly cited in research literature as the "best practice" in new product development (Danese & Filippini 2010). This is because many firms want to enhance their NPD capabilities by relying on their suppliers for product development contributions (Petersen et al. 2005). Literature recognizes this concept as *early supplier involvement (ESI)* (e.g. Ragatz et al. 1997, Petersen et al. 2003) or as *supplier integration* (e.g. Das et al. 2006). However, supplier integration can mean also deeper relationships with completely common ownership of resources (Cooper & Gardner 1993). This is why in this thesis early supplier involvement means the same as supplier integration and they are defined in section 2.1.3.

Because of rapidly changing business environments, suppliers are increasingly important sources of product and process innovations for companies (Monczka et al. 2000, Wagner & Hoegl 2006, Azadegan & Dooley 2010, Yeniyurt et al. 2014). Supplier integration in NPD means that certain NPD tasks like development of components or subassemblies are on supplier's responsibility to execute (Monczka et al. 2000). Most of the global companies that have tried it have gained significant improvements in NPD success (Monczka et al. 2000) and they say that they will do deeper and earlier supplier integration in the future (Ragatz et al. 1997, Wagner & Hoegl 2006). Point of the supplier integration is to leverage supplier's development capabilities in order to achieve a better product, reduced costs, faster time to market, and to outsource R&D so that the company can concentrate on its core competencies (Petersen et al. 2003, Wagner & Hoegl 2006, Yeniyurt et al. 2014). It is best used when the customer company needs a new technology and the supplier already has experience on that technology area (Parker et al. 2008).

Involving suppliers into the customers NPD is costly because of coordination, adaptation and interactions entail costs. (Gadde & Snehota 2000) Still, it is argued to be reasonable due to all the benefits it brings. It is mandatory for the customer company because its resources cannot be sufficient for all the development areas needed (Parker et al. 2008). On the other hand, supplier might want to be involved because it opens new potential business opportunities and eases the planning of future investments for it. (Ye-

niyurt et al. 2014) Furthermore, the supplier can better foresee where it needs to put its resources to secure long-term growth potential. Even though the whole concept seems to be clearly positive, it includes two paradoxes that need to be understood (Gadde & Snehota 2000):

1. High-involvement of suppliers can tie the company into its current ways and forced relationships with current suppliers.
2. Both the supplier and the customer usually want to control the relationship to achieve their own goals. If either one is succeeding, the less effective and innovative the whole relationship is going to be over time.

Because of complex and broadening task field for purchasing, management has to realize to change its focus from "buying well" to managing relationships and interdependencies in order to make the most out of relationships instead of focusing solely on prices (Gadde & Snehota 2000). Consequently, purchasing function needs to manage supplier interface that has relations to product development, project development and development management. (Wynstra et al. 1999 & 2003) Relations of supplier interface management to other management areas are presented in figure 2.15. According to Wynstra et al. (1999 & 2003) it concerns:

- monitoring supplier markets for technological development
- pre-selection of suppliers for collaboration
- motivating suppliers to gather specific knowledge for development
- gaining benefit from suppliers' capabilities
- evaluating suppliers' performance in development

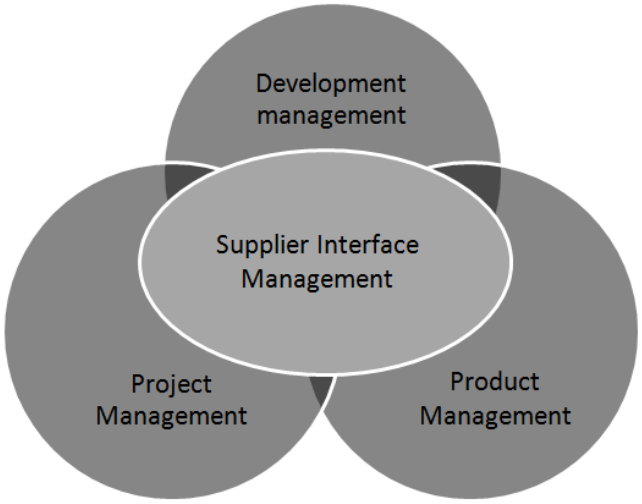


Figure 2.15 *Relations between the four management areas of purchasing involvement in new product development (adapted from Wynstra et al. 1999 & 2003)*

After the turn of the millennium, the focus with strategic component suppliers have turned from manufacture-to-print to more value concentric (Benedetto et al. 2003, Goffin et al. 2006). Customer companies are more interested in TCO, competence, service, financial stability and even organization culture (Goffin et al. 2006). Benedetto et al. (2003) made a three step graph out of this transfer from commercial approach to more value concentric approach, figure 2.16. Stage 1 in Benedetto et al.'s graph is traditional buying with basic characteristics of high volumes, low costs and market oriented view. Stage 2 has low volumes with low prices but long-term relationships. Highest value added category is stage 3 where volumes are low but technology and value for the company are high. This whole concept concentrates on providing value with supplier integration. None of these stages is the best one but they are suitable for different product categories. In stages 2 and 3, purchasing has more responsibilities: forming close supplier relationships, optimizing the size of the supply base (single or multiple source), signing long-term contracts and establishing team-work with suppliers.

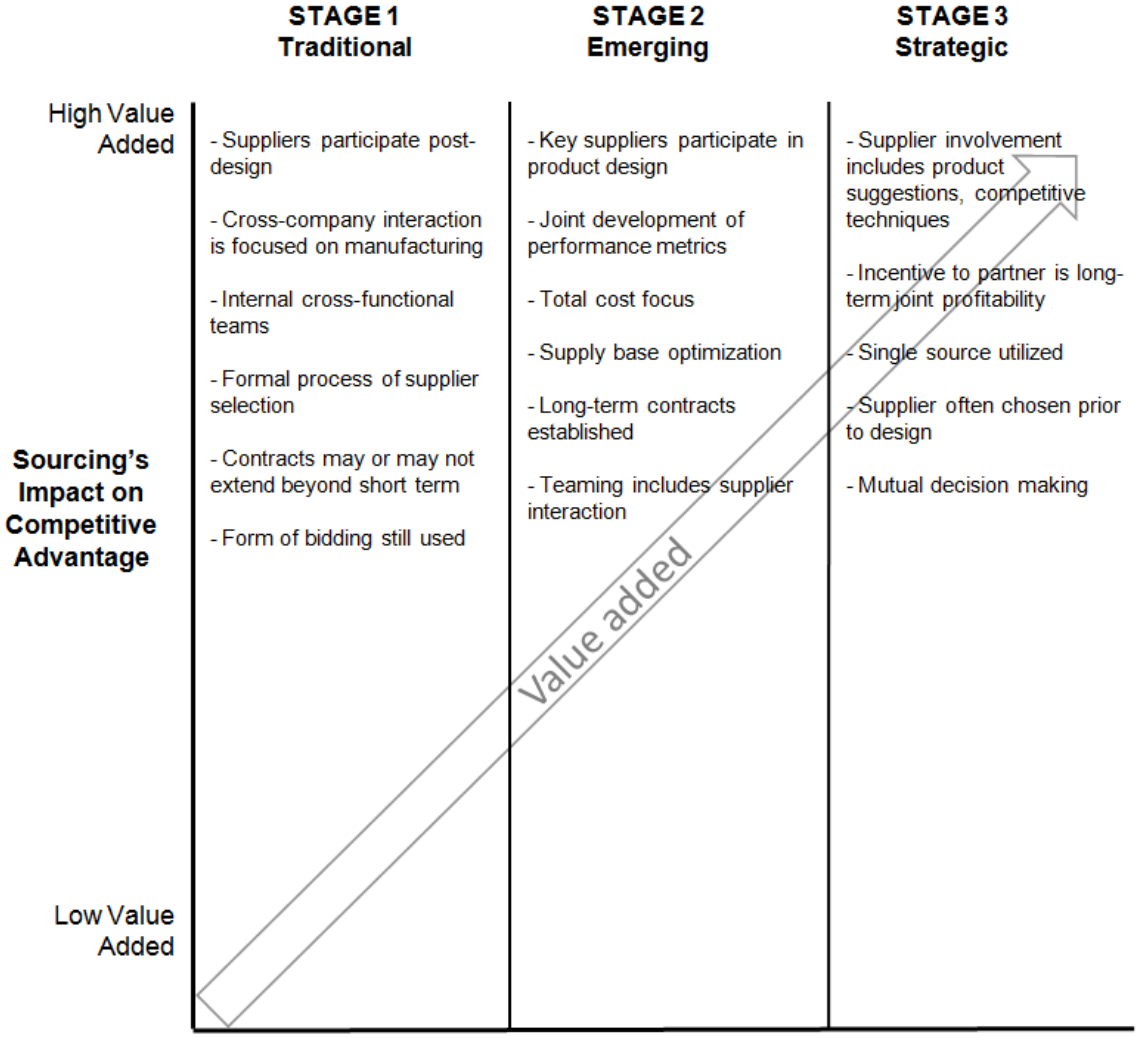


Figure 2.16 *Strategic sourcing decision options for purchasers (adapted from Benedetto et al. 2003). Purchasers impact on competitive advantage increases from left to right.*

It is easier to understand Benedetto et al.'s (2003) stage categorization when compared to Kraljic's (1983) purchasing portfolio matrix. Stage 3 has some of the same characteristics as upper right quadrant of purchasing portfolio matrix. Also, bottom left quadrant reminds of the stage 1.

Supplier integration can exist in different levels of responsibility (Petersen 2005), in different stages of the design process (Handfield et al. 1999) and in different forms/methods (Swink et al. 2007). When to integrate is discussed in section 2.3.4 and different methods for integration in section 2.3.6, different levels below.

One way to categorize supplier integration is Handfield et al.'s (1999) and Monczka et al.'s (2000) way to classify them in four different categories depending on suppliers' level of responsibility: none, "white box", "gray box", and "black box", figure 2.17. In "white box" integration the buyer is totally responsible of the design but consults the supplier and asks supplier's opinions concerning the design. (Petersen et al. 2005) Responsibility is more even divided in "gray box" integration. Customer and supplier can enter into an informal, or sometimes formal, joint development effort, where information and technology can be shared and decisions are made in consensus. (Petersen et al. 2005) Involved supplier provides its expertise, opinions and other relevant input to product development but is not totally responsible of the design. Finally, "black box" integration means that the customer informs the supplier about product specifications and gives almost the complete responsibility of the design to the supplier (Petersen et al. 2005).

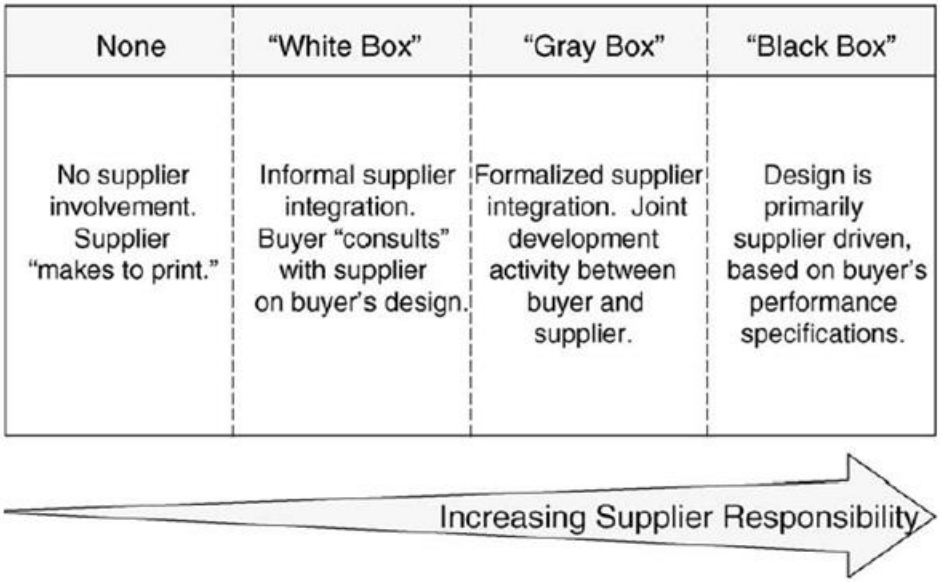


Figure 2.17 *Spectrum of supplier integration (Handfield et al. 1999)*

2.3.1 Benefits of supplier involvement in NPD

Clark (1989) made a significant finding when he stated that one key factor of Japanese manufacturers' advantages, such as fast lead times and cost reductions, was supplier involvement in engineering. Because of this finding researchers interested in the benefits of ESI (Parker et al. 2008). Depending on what benefits a firm is looking for, goals of supplier integration can be divided in two: short-term and long-term. (Wynstra et al. 2001) Short term goals can be development efficiency, a better product, a more innovative product or faster time to market. Goals can also be: reduced costs in production and material flows, flexibility and service improvements, or better end product quality through supplier's skills (Gadde & Snehota 2000). Ragatz et al. (1997), Monczka et al. (2000) and Petersen et al. (2003) have done surveys to find out the real benefits of supplier integration. These researches are summarized in table 2.2. As can be seen from the table, it is also possible to fail and gain disadvantages through supplier integration. According to Wynstra et al. (2001) there is evidence that supplier integration can increase costs when supplier tries only to get more money out of the relationship. However, positive sides seems to be more extensive in literature, as McGinnis & Vallopra (1999) stated, new product development success rate was higher when suppliers were included (58,1 %) than when they were not (44,6 %). Still, according to Handfield et al.'s (1999) survey, 10 % of the companies that had tried supplier integration had failed in it.

Table 2.2 *Benefits from supplier integration in NPD (adapted from Ragatz et al. 1997, Monczka et al. 2000 & Petersen et al. 2003)*

	Petersen et al. (88 global companies)	Ragatz et al. (83 global companies)		Monczka et al.	
Improvements	Median *(range)*	Most Successful Cases	Least Successful Cases	Level: Gray box	Level: Black box
Project lead time	42 % *(0-191 %)*	25 %	-30 %	20 %	20 %
Purchased material quality	14 % *(0-52 %)*	40 %	-7,50 %	15 %	20 %
Purchased material cost	11 % *(0-47 %)*	15 %	-5 %	15 %	20 %
*Improvements are relative to similar projects without supplier integration.					

These short term goals emerge when the customer manages to access the expertise of the supplier and get better information earlier in the development process (Ragatz et al. 1997, Petersen et al. 2005). Collaboration allows both sides to identify and solve conflicts at the early stages of NPD process, which reduces the possibility of project failures (Lynch et al. 2014). When major problems are solved at the beginning, it provides possibility to do "first time right" development (Wynstra et al. 2001). This is in line with Monczka et al.'s (2000) graph about design flexibility and cost of design changes,

figure 2.11. A good example of these short-term goals is Chrysler's project in the year 1998. (Hartley et al. 2002) They demanded their suppliers to do cost savings of 5% and all savings over that will be divided between Chrysler and the supplier. Savings were about 2 billion annually, and sources included: alternative raw materials, reductions in packing materials and use of lean techniques in manufacturing. (Hartley et al. 2002) Chrysler continued this even further since it had a great power over its suppliers.

Long-term goals can be organizational learning or acquiring supplier's knowledge and technologies (Wynstra et al. 2001, Tracey et al. 2013). Also, doing multiple types of integration can enhance each other. (Swink et al. 2007) Different types of integration increases organizational learning and knowledge gained from one project may help other ones. Long-term goals can also have positive effects on "soft" benefits. (Ragatz et al. 1997) These "soft" benefits include:

- supplier relationships are closer, trustful, and more open
- clearer focus on what is really important and what is not
- improved communication

Maybe the best way to describe how all of these benefits can be achieved is straight quotation from McGinnis & Vallopra (1999):
"*Firms that develop successful new products involve suppliers in the process when they are needed, involve them in the process at the stage of development needed, and involve them only to the extent needed.*"

Nonetheless, following sections will give an overview of supplier integration characteristics from basic requirements to key factors of success.

2.3.2 Prerequisites for supplier integration

The first tasks to a company before starting to involve suppliers in NPD are to identify if the idea is in line with commodity strategy and to ensure that objectives for the collaboration are linked to the procurement strategy (Monczka et al. 1998). Supplier integration includes risks and use of resources which are why goals have to be clear (Koufteros et al. 2007). However, even if supplier integration is recognized to be necessary, the selected supplier might not want to do collaboration. (Schiele 2012) Research has shown that there is relatively small number of highly innovative and well performing suppliers, about a dozen for one company. All the manufacturers are trying to get these same suppliers, and to do so, the company has to become "preferred customer". (Schiele 2012) This can be done by good communication, removing other suppliers from the same field and having 10-30 % the supplier's turnover. Bigger amount could create overdependence. Not being the preferred customer can cause problems like unreliable deliveries and no support in NPD. (Schiele 2012) Of course, not all suppliers are interested in closer cooperation even if they are really well performing. Their motivation

towards collaboration is shaped by previous experience about communication, level of trust, interdependence and anticipated long-term returns (Yeniyurt et al. 2014). In high levels of integration, "black box", motivational factors has to be in order and they cannot be risked with hidden agendas (Jassawalla & Sashittal 1998).

Supplier involvement requires the participation of purchasing into the project. This brings a new dimension to the concept that now needs management activities, which are not directly connected to managing the involvement, implemented. These activities define the collaboration:

- Development Management: ground rules and guidelines for supplier integration; in which part categories supplier integration will be done
- Supplier Interface Management: infrastructure or network for supplier integration (IT) in order to bring out suppliers input
- Project Management: a team or a person who manages the ESI
- Product management: product specification definition for suppliers

(Wynstra et al. 2001)

Reasons for dividing these different purchasing involvement management activity areas are that they are done in different time horizons and in different hierarchical levels in the organization. Engineers and buyers discuss the part design and monitor the supplier, purchasing and R&D managers may meet the supplier occasionally to introduce new projects, purchasing and R&D directors draw guidelines, and general management decide which areas of R&D will be outsourced completely to suppliers. There is evidence that if all of these management areas are not used in the same company, big problems might occur with deep supplier integration. (Wynstra et al. 2001)

Before starting ESI, all related personnel should be aware of company's internal core competencies, have a vision of new products, know about technology needs in the future and know what the company needs from the suppliers. (Handfield et al. 1999) These factors should be formally specified. Furthermore, teams should be aware of the technology road map of the company and be prepared to share it with the most important suppliers (McGinnis & Vallopra 1999, Schiele 2010). If needed, key suppliers can be involved in creating the technology road map (Schiele 2010).

Not so much as a requirement for supplier integration but as something to be held in the reserve is the role of purchasing managers. Walter (2003), Lynch et al. (2014) and Yeniyurt et al. (2014) state that in close cooperation of the supplier and the customer, a crisis can take place because of e.g. different organizational cultures, too little communication, different expectations or mismatching personal relationships. Crisis can have severe negative influences on development projects but, if properly handled, it can also benefit the project because the crisis usually points out the key problem (Lynch et al. 2014). Purchasing managers, or other individuals, who are capable of committing inter-

vention and go over organizational boundaries should try to identify crisis and function as relational promoters when needed (Walter 2003, Lynch et al. 2014).

2.3.3 Which suppliers to integrate?

A company's supplier base should be managed as a portfolio, divided to different kind of supplier relations (Petroni & Panciroli 2002) or product categories (Kraljic 1983). After proper classification of supplier base, a company should decide in which product categories it will invest its resources in order to establish supplier integration. (Koufteros et al. 2007) Building such relationships takes a lot of resources and time which is why only a few suppliers should be involved in NPD. Rule of thumb is that suppliers of high value and complex items should be involved early in the development process (Johnsen 2009). Trying to involve suppliers with low priority parts and standard components is only inappropriate waste of resources (Petroni & Panciroli 2002).

Supplier, that will be involved, should have the best technology (Wagner & Hoegl 2006) and right development skills and capabilities to support the buying company (Gadde & Snehota 2000, Petersen et al. 2005, Koufteros et al. 2007). Since the designs related to company's core competencies are usually done in house, suppliers design capabilities should take care of the complex design tasks that the customer company is not able to do so well. (Zhao et al. 2014) These design tasks done by suppliers should increase the speed of NPD.

To gain advantages from supplier integration, there has to be a match between the supplier and the customer (Choy et al. 2012). Besides technical capabilities, the culture of the supplier should be convenient for the customer. According to Peterson et al. (2005), the culture of the supplier has an impact on customer's ability to interact with the supplier. Culture has thus an effect on performance, regardless of the level of supplier's responsibility and the stage of the NPD process (Petersen et al. 2005). To support this argument, Wagner & Hoegl (2006) made a survey about customers' expectations on supplier integration. Results showed that three most expected criteria were:

1. competence
2. trust & reliability
3. openness & mutual support.

Several studies have shown that early supplier involvement is best done with long-term relationships when the company has experience on the supplier (Gadde & Snehota 2000, Petersen et al. 2005, Wagner & Hoegl 2006, Parker et al. 2008). Customer company should see which suppliers do have the biggest potential to contribute to NPD and which ones do not (Schiele 2006). Prior experience and targeted set of supplier selection criteria may improve the collaboration in NPD (Schiele 2012).

Handfield et al. (1999) did a wide research with 255 companies in order to create a process model for selecting suppliers to be involved in NPD. It starts with the cooperation

of the product development team and the commodity team. Suppliers are tested with prior experience, technology roadmaps and design expertise. The model is illustrated in figure 2.18.

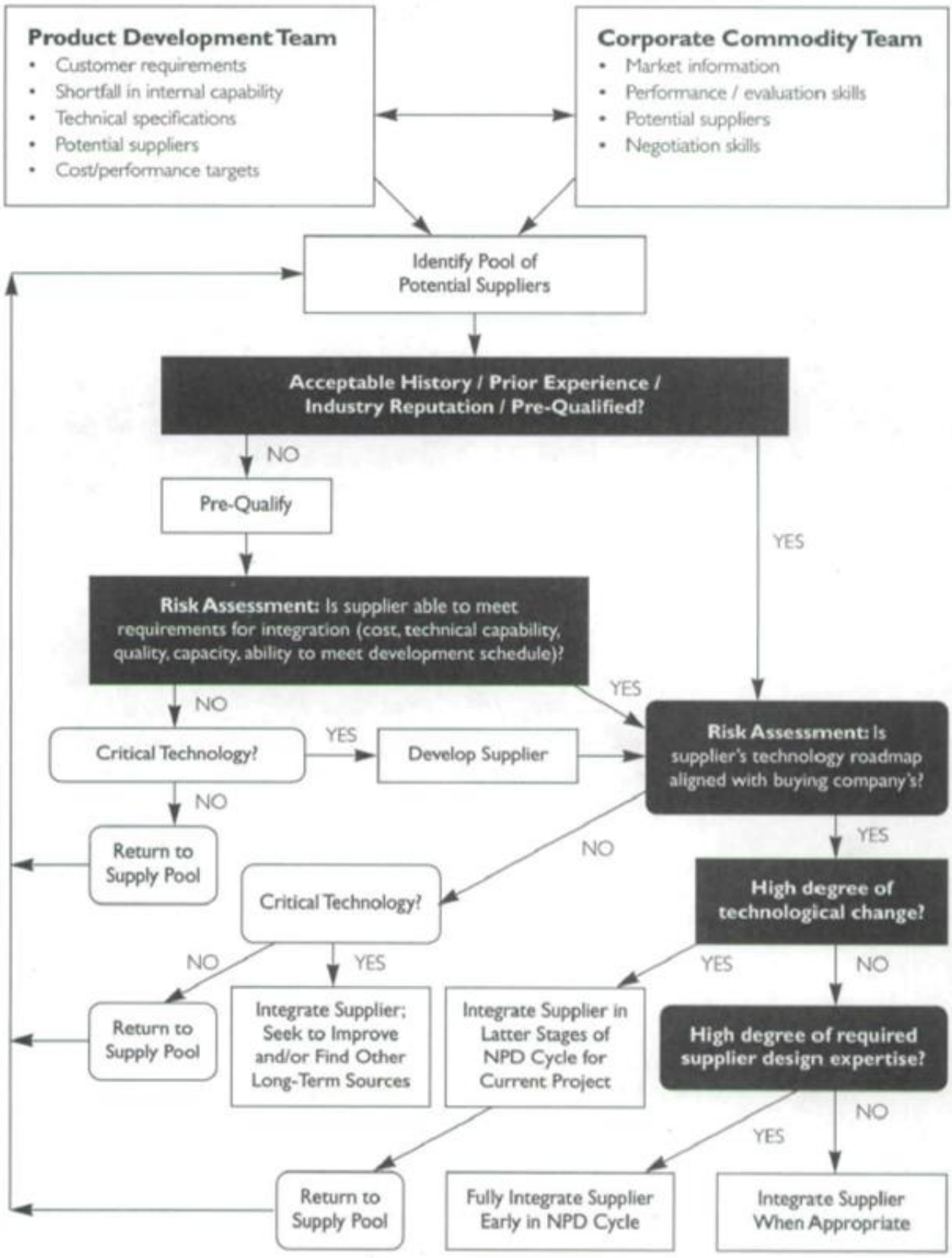


Figure 2.18 *Process model of supplier selection for supplier integration (Handfield et al. 1999)*

The customer firm has to understand, that no matter how good relation it builds to some capable supplier, competing firms might be trying to achieve the same with that same supplier (Takeishi 2001). Often the same suppliers are interesting partners for the competing firms because of their skills and capabilities (Zhao et al. 2014). Being the "preferred customer" helps getting an input from the supplier before the rivals and, according to studies, it also assists in getting fair pricing policy (Schiele 2012). In Hartley et al.'s (2002) Chrysler case, suppliers stated that they wanted to give the best prices to Chrysler because good communication and cooperation had proved "preferred customer" status to Chrysler.

2.3.4 When to integrate?

When involving a supplier in NPD, two basic questions arise: in which extent to involve ("white-, grey-, and black box") and when to involve (Petersen et al. 2005). Most of the current theories assume that the extent and the moment are related: the more complex the part is, the earlier and deeper the involvement should be done (Handfield et al. 1999, Le Dain et al. 2010). Of course, the need always depends on the situation, the supplier and the NPD program (McGinnis & Vallopra 1999). Still, researchers argue that earlier is better if talking about critical and complex items (Wagner & Hoegl 2006). This is because ESI is a key factor in coordinating process in product design, process design and supply chain design (Petersen et al. 2005). ESI targets, such as deadlines and prices, can be agreed with the supplier, which ensures that they can be achieved (Wagner & Hoegl 2006). This is possible when the supplier's technology and expertise are enough to enable contribution into the development process (Handfield et al. 1999).

Handfield et al. (1999) developed a framework when the supplier should be involved, figure 2.19.

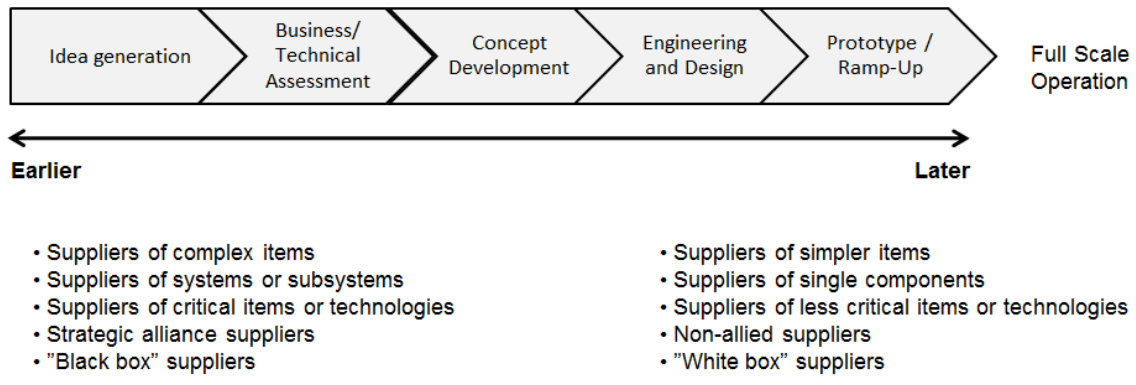


Figure 2.19 *Supplier integration in different stages of the development process (adapted from Handfield et al. 1999)*

According to it, critical nonstandard commodity suppliers should be involved early in the process and start face-to-face discussions with the supplier's engineering. Suppliers of noncritical and standard items are integrated until the final stages of the development

process. In the latter case, the communication can be done by computer, using CAD-models and other tools/methods. (Handfield et al. 1999)

2.3.5 Methods for supplier involvement in NPD

Supplier integration should be understood as a social process; it is done and managed by people but the relationship is company-wide (Petersen et al. 2003). The relationship is based on social exchange, resource interdependencies, and it constructs of informal and implicit connections, shared activities and relational bonds (Lynch et al. 2014). Consequently, it can take many forms such as partnerships, co-development activities, joint planning meetings, and shared information systems (Swink et al. 2007) which consists of more technology concerned mechanisms, e.g. electronic data interchange (EDI) and web-based integration systems (Das et al. 2006). Still, it is said that quite simple cross-functional, intercompany communication is the most favored technique for supplier integration (Ragatz et al. 1997). This argument got its support later, when Rupak et al. (2008) stated that successful supplier integration requires cross-functional collaboration between the buyer and the supplier. Maybe this is why Das et al. (2006) recommended firms to start with internal integration practices before establishing supplier integration.

Fliess & Becker (2006) stated that co-development projects usually start with a kick-off meeting in the concept stage. That meeting should be attended by all related personnel, technical and commercial, from the customer's and supplier's side. The purpose of that meeting is to set goals and milestones, and to let people to get to know each other. Also, interfaces between companies should be made clear, so that the situation, where customer company asks for more features from engineering at the same time when purchaser request price reduction, cannot happen. Later on, coordination meetings can be hold regularly or in certain milestones. Meetings on milestones are clearer but regular meetings give more pressure to the project because participants want to be ready with their activities by the next meeting. Supplier involvement coordinating tasks and coordination instruments are gathered to table 2.3. (Fliess & Becker 2006)

Different means of coordination, such as kick-off meetings, are socialization mechanisms for knowledge sharing situations that lead to improved performance. These mechanisms, which include team meetings, cross-functional teams and joint workshops, create a network of interdependent social exchanges, resulting to increased trust between members. Lawson et al. (2009) divided different socialization mechanisms, which are used in product development, to informal and formal. Formal socialization mechanisms include cross-functional teams, collocation of parties, regularly scheduled meetings and conferences, matrix-style reporting structures fairs and requests for information, whereas informal socialization mechanisms are communication guidelines, social events, joint benchmarking researches, visits to facilities and product demonstrations. In their research, Lawson et al. (2009) found out that informal socialization mechanisms are the most important means to facilitate knowledge sharing in teams, both in

internal teams and teams spanning organizational boundaries. Knowledge sharing affects to supplier's contribution positively, which improves NPD performance. Biggest insight here is that informal socialization mechanisms are the most important ways to facilitate the knowledge sharing and they mediate the relationship between formal socialization and the level of knowledge sharing. (Lawson et al. 2009)

Table 2.3 *Stage specific coordination tasks and coordination instruments (adapted from Fliess & Becker 2006)*

Stage	Coordination task	Instruments/means of coordination
Concept stage	Define interfaces (personally and technically)	Meetings
	Coordination of expectations and possibilities	(Written) proposal
	Shaping property rights	Patent analysis
Detailed engineering stage	Coordination of activities according to goals and costs	
	Early warnings on cost deflections or matching costs and target price	Concurrent calculation, project monitoring
	Coordination of activities according to product quality. Early warning on product functionality/quality deflections	Checklists Product audits FMEA Function tests Prototype
	Coordination of activities according to time. Early warnings on time deflections	Activity list Milestones Project plan
Process engineering and product introduction	Avoiding or minimizing risks during regular production	Know-how transfer by product documentation and training Estimation of lot size First sample examination

One way to implement deep formal socialization mechanics is to do process alignment between the supplier and the customer. There is evidence from automotive sector that generally in NPD they gained 30% faster development time and 40% reduced development costs by process alignment. Customer and a supplier checked each other's NPD processes, aligned them closer to each other and agreed merging points of their processes. (Evans & Jukes 2000)

Target price of the new product should be given to the supplier as early as possible (Fliess & Becker 2006). If the supplier is able to reach the target without problems the customer should not try to negotiate any lower price. (Womack et al. 1990, Handfield et al. 1999) Letting the supplier to keep the price requested creates trust and benefits future collaboration. If the supplier is not able to reach the price, it should inform it's customer as early as possible (Handfield et al. 1999, Fliess & Becker 2006). In this case, negotiations on what can be done should be started immediately (Handfield et al. 1999). Supplier may also try to get high prices through collaboration. (Womack et al. 1990) Then it is possible for the customer to send request for quotation to some other suppliers and check the price. This can be done at the end of the design process when the preferred supplier has given input to the design and now realizes that it has not gotten the business yet. (Womack et al. 1990) Of course, this has negative impact on trust and the supplier might not want to do any future co-development. According to Hartley et al. (2002), the most of Chrysler's annual savings of two billion dollars was achieved with suppliers that thought Chrysler as "preferred customer". This proved that good relationship management affects to prices also.

2.3.6 Purchaser's role in supplier integration

Sourcing decisions are typically done jointly by NPD team and purchasing commodity team (Handfield et al. 1999). This is because NPD team has the best knowledge about the product and the purchasing function provides an important link to suppliers communicating future needs and plans to them while providing information about supplier's technologies, capabilities and limitations to internal groups (Das et al. 2006). Burt & Soukup (1984) suggested that purchasing has to become an information forwarder in new product development. McGinnis & Vallopra (1999) went further by stating that in NPD concept with cross-functional cooperation with the supplier, purchasing department has to take the role of leadership.

Expanded role of purchasing requires purchasing managers to become "commodity experts" and to develop specialized knowledge about products and their product families. (Handfield et al. 1999) Taking the leadership role requires them to put greater focus on relationship management, negotiation skills and to develop presentation and leadership skills. Because of the complex nature of the task it requires highly trained and capable personnel in purchasing (Handfield et al. 1999). As we can see from everything above, purchasing function is responsible of many tasks from supplier selections for future collaboration (Koufteros et al. 2007) to leading the cross-functional team (McGinnis & Vallopra 1999, Handfield et al. 1999). To survive with this enormous workload, purchasing department can delegate some of the relationship building to engineering (Brattström & Richtner 2014) or divide the department into advanced sourcing team and life-cycle team (Schiele 2006).

Purchasing department can use engineering in supplier relationship management by playing "good cop – bad cop". Brattström & Richtner (2014) compared formal control to trust over supplier and found out that engineering should build and maintain close and trust-based relationship with the supplier. Then purchasing functions as a supervisor that holds formal control. This framework works when engineering and purchasing functions are not integrated, they coordinate each other's work, the roles are clearly defined and everybody understands the arrangement. This also creates better relationship internally between engineering and purchasing, allowing trust and formal control exist at the same time. (Brattström & Richtner 2014)

Schiele (2010) studied six "best practice" firms in early supplier integration finding out that by dividing purchasing department into advanced sourcing team and life-cycle team companies enabled purchasing to manage its dual role: contributing to NPD while managing overall costs. Advanced sourcing team consists of engineers or purchasers with technical background and it is involved to all NPD projects whereas life-cycle team, purchasers, manages all the products after the start of production. Figure 2.20 illustrates the split. Supplier selections are done jointly by the both teams but the life-cycle team preselects the suppliers. The advanced sourcing team communicates more with engineering and R&D, whereas the life-cycle team concentrates on commodity sourcing strategies and company-wide sourcing strategies. Without this structural reorganization, purchasing function may find it hard to contribute to NPD while managing overall costs. (Schiele 2010)

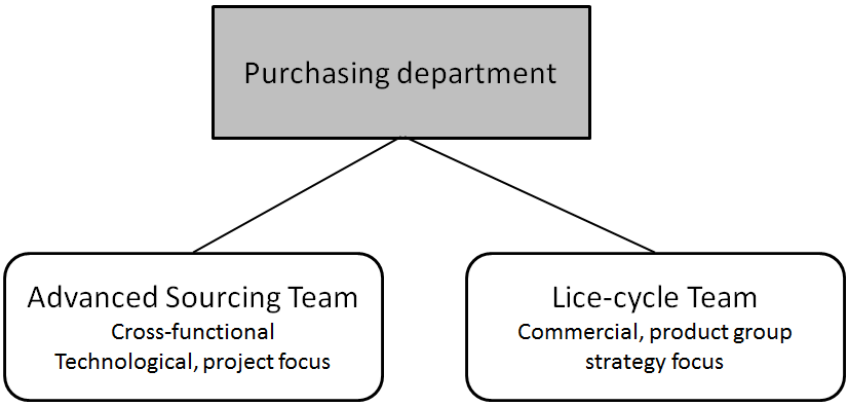


Figure 2.20 *Dividing purchasing function into advanced sourcing team and life-cycle team (Schiele 2010)*

2.3.7 Should cost analysis in purchasing

Since the target cost should be given to the supplier as early as possible (Fliess & Becker 2006), and to create trust suppliers should have the right to keep the profit when able to beat the target (Womack et al. 1990, Handfield et al. 1999), there has to be a way to estimate the price as accurately as possible before involving the supplier. For this need, should cost analysis was created (Mendelbaum 2011).

Should cost analysis is a process that estimates the cost of a part based and the raw materials used, manufacturing costs and operative costs of the production (Kauthekar 2010). It considers manufacturing processes, dimensions, tolerances, supplier cost information and cost database, and generates an estimated cost of a design (Mendelbaum 2011). However, cost calculation during the development phase can be challenging because of inaccurate information (Chwastyk & Kolosowski 2014). Nonetheless, managing costs during development is much easier and cheaper than after the design phase (Afonso et al. 2008), figure 2.11. The goal of should cost analysis is to provide information to designers and purchasers, informing expensive features and cost reduction possibilities of the part, or cost estimate for price negotiations (Kauthekar 2010). This can be done through expensive laboratory tests by relying on experts' knowledge and experience, or using analytical methods that require historical data to estimate the cost of the part based on previous but similar parts (Chwastyk & Kolosowski 2014). Already since the 1990s these kinds of methods have been adopted in assembly industries (Afonso et al. 2008), especially in situations when the cost of the part is high and there are relatively small number of supplier available (Mendelbaum 2011).

Should cost analysis is usually done with cost models (Kauthekar 2010) and it includes cost structure breakdowns which require suppliers to open their books. (Zsidisin et al. 2003) These might not be so easy to get because suppliers consider this information highly confidential. According to Zsidisin et al. (2003) and Kauthekar (2010), manufacturer and supplier should together find the expensive features to look for cost reduction possibilities and to eliminate waste from the process.

According to Everett (2014), should cost analysis benefits the company in three different ways:

1. Power in price negotiations – agree the profit margin to the supplier
2. Supplier selection can be made according to the value, not price – lowest bid is not the best but who is the most competitive with acceptable price
3. Focus on cost reduction – clarify key cost drivers and guide cost reduction priorities

Everett (2014) meant that, by doing good quality should cost analysis, the company can partly free itself from adversarial relationships and move towards strategic relationships.

2.3.8 Key factors to success in supplier integration

"*Ask not what your suppliers can do for you; ask what you can do with your suppliers.*" (Takeishi 2001)

Managing supplier integration in NPD is a complex task because of varying products and people in the projects, and because of limited control over a supplier (Gadde & Snehota 2000). Even though successful supplier integration is not easy to achieve

(Wynstra et al. 2001), there are some key points to success that can be highlighted, such as: quality of buyer-supplier collaboration (Wagner & Hoegl 2006), learning cross-functionality in decision making internally before supplier integration (Das et al. 2006), and creating a proper environment for the supplier to perceive that it can have long-term returns by involving in its customer's NPD (Yeniyurt et al. 2014). Even though there is a lot of research around supplier integration, consensus on what makes it successful does not exist (Johnsen 2009). In order to comprehend the essence of the subject, this final section of the theory of the thesis concentrates first on failures and possible problems of supplier integration. Possible sources of problems are gathered from literature to table 2.4. After that, key factors to success are identified.

Table 2.4 *Possible sources of problems in supplier integration*

Key factor	Possible source of problems	Reference
Strategy	Manufacturer does not know what it wants from the supplier.	Wynstra et al. 2001
	Module suppliers may be shared with competitors ➔ lost differentiation.	Takeishi 2001
	Manufacturer's ownership of supplier's stock has a negative impact on collaboration.	Takeishi 2001
Communication	Manufacturer does not tell the supplier what it wants from it.	Wynstra et al. 2001
Supplier selection	Supplier not interested in collaboration because the manufacturer has only a small part of its turnover.	Wynstra et al. 2001 Schiele 2010
	Involving supplier in new product development may raise expenses if supplier exploits the situation.	Wynstra et al. 2001
	Supplier is selected focusing on price ➔ Supplier might not be capable of product development collaboration	Wynstra et al. 2001
Level of integration	Too much integration makes suppliers feel that their business is secured and they are not motivated to provide high levels of performance.	Swink et al. 2007
	Too much integration makes the manufacturer less open to new suppliers.	Das et al. 2006, Swink et al. 2007

Supplier integration starts with trust between the supplier and the customer (Monczka et al. 1998). Usually, trust is gained from previous experiences and, according to Schiele (2006), relationships in supplier involvement cases are more than 10 years old by average. To sustain trust, manufacturer has to use joint problem solving and avoid using tactics that can create conflicts (Monczka et al. 1998). One way to quickly create trust and suppliers commitment is supply base rationalization which works best in gray-box integration. (Koufteros et al. 2007) Removing competitors makes the supplier feel more secure. Furthermore, customer knowledge of the manufacturer can be told to the suppli-

er. (Ragatz et al. 1997) Telling uncensored market information about what customers want, and when, is commonly used management practice in successful integration cases.

Monczka et al. (2000) introduced the execution process for successful supplier integration, figure 2.21. It gives the overall idea of how to involve suppliers in new product development successfully.

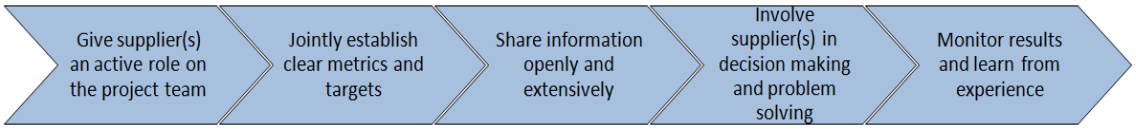


Figure 2.21 *Supplier integration execution process (adapted from Monczka et al. 2000)*

In Monczka et al.'s (2000) process the supplier is taken into the team and given a role in the project team. The team to be successful, its size and communication in it must be in order. (Wagner & Hoegl 2006) Each member of the team creates an interface between others. It is known that a team works better when there is minimum number of interfaces in it. (Wagner & Hoegl 2006) Between firms there should be 1-2 interfaces to enable manageable and on time communication. Ragatz et al. (1997) found that, among managers, open and direct communication is identified as a critical factor to rapidly see and solve problems. Of course, the role of the supplier and quality of communication are determined by how the project is managed and "lived" between interfaces (Wagner & Hoegl 2006). In the end, collaboration of individuals defines the project success (Wynstra et al. 2001, Wagner & Hoegl 2006). It mainly concerns in which extent engineers are able to communicate to each other, and how proactive are the purchasers that are involved. (Wynstra et al. 2001) It has been found in researches that purchasers tend to focus mainly on easier tasks in operational level which is not good for supplier integration.

Monczka et al. (2000) suggested that the next step should be establishment of clear metrics and targets. These should be done together with the supplier to further support the effectiveness of the project team, at least when supplier has high level of responsibility in the project (Petersen et al. 2005). Targets and metrics can also be enhanced with formalized risk/reward sharing agreements. (McGinnis & Vallopra 1999) That facilitates open communication between members. Monczka et al. (2000) finished their supplier integration execution process to learning from experience. They said that whatever a firm tries with its suppliers, it should be recorded and analyzed.

Overall, proper supplier integration calls for purchasing upgrades. (Das et al. 2006) A new set of skills and capabilities are required from purchasers when they are increasingly involved in design, manufacturing and relational responsibilities. Previously, it was mentioned that Handfield et al. (1999) stated that purchasing managers must become "commodity experts". This theoretical concept might need some serious changes in or-

ganizational mechanism, such as restructuring the organization (Wynstra et al. 2001) or new product development process (Monczka et al. 2000). The key strategic elements of the new product development process from Monczka et al. (2000) are in table 2.5.

Table 2.5 *Structuring the new product development process: key strategic elements (adapted from Monczka et al. 2000)*

Traditional Structure	Reengineered Structure
No critical review/analysis of the current new product development process for continuous improvement opportunities	Culture that encourages and supports change not just for the sake of change, but for making continuous improvement even when there is no apparent problem
Internal design and development of all key components, subsystems, and systems	Focus on core technology development, allowing supplier integration into noncore, yet critical, systems
Emphasis strictly on negotiating skills in the purchasing organization	Development of technical competence in the purchasing organization
Limited or no support for supplier development	Company dedicated resources to develop key suppliers' capabilities for integration into new product development
Limited long-term information-sharing with supplier	Alignment of key suppliers' long-term goals and technology plans with the buying company's long-term needs
Blind commitment to see the development effort to completion once the process has reached a certain point (e.g., dollars spent)	Stage gates at each step in the development process, which yield a "go or no-go" decision
No strategic supplier alliances to identify customer requirements and develop new product ideas	Formation of strategic alliances, joint identification of customer requirements, and development of product concepts

Theory part of this thesis can be put into one figure by combining the model loaned from the House of Lean (Dennis 2002) and motivation gained from the second rule of Schwarzenegger's (2009) speech, "Six secrets to success", creating the house of supplier integration in new product development, figure 2.22.

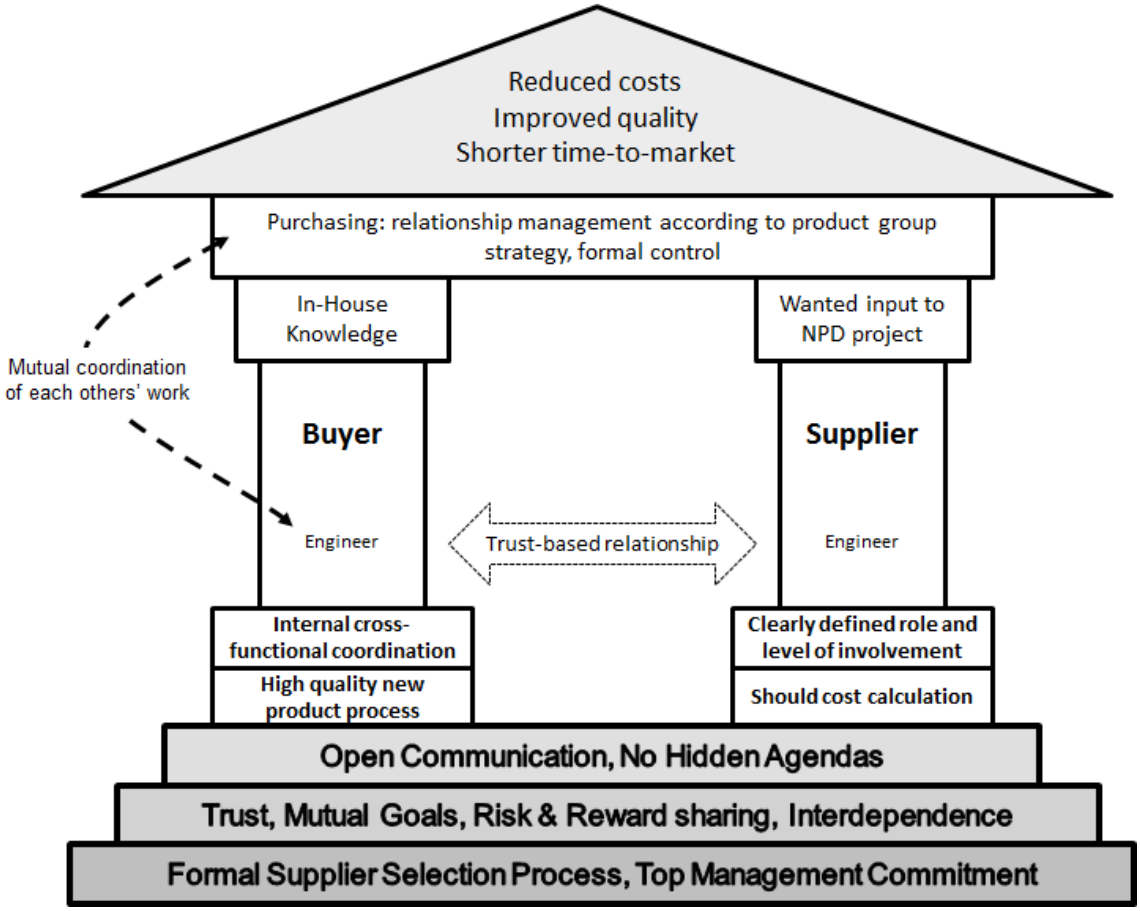


Figure 2.22 *House of Supplier Integration in New Product Development*

3 RESEARCH METHODOLOGY

After researching the literature of the subject, focus was turned to the research. Literature concerns mostly theories, frameworks and models that are created from practice, but it does not have a straight contact to daily life. Therefore, a survey and an interview were conducted internally in the case company to connect theory to practice.

Most of the questions in the survey were set to answer to the original research question or build a framework for it. In principal, the answer for the research question can be found from the literature. Because of this, the research part of the thesis gave more focus to current state of the company's NPD and issues relating to the ESI. The purpose of the study was to find out how well suited the company was for supplier integration and which factors should be corrected. The research question was reframed to:

"What should be changed in the company's new product design policies, in order to better support supplier integration in new product development?"

3.1 Research strategy

This research concerned one company and a survey was conducted internally. Eventually, it means a single case study research, since a case study focuses on understanding only one setting (Eisenhardt 1989). To gather data, an anonymous survey and an interview were conducted with all participants in the early fall 2014. Both methods, a survey with closed questions and an interview with semi-structured open questions, were selected because both mechanisms have their own benefits and disadvantages. A survey with closed questions is easy to analyze but the questions might be wrongly adjusted. (Marsden & Wright 2010) Open questions do not suffer from this, allowing deeper and wider answers. However, qualitative answers are much more complicated to analyze. Focus in the research was more on the qualitative data since the number of respondents was too small to draw justified conclusions out of the quantitative data.

Interviewees were selected from engineering, purchasing, quality, sales and executive committee. In order to avoid the interviewer's impact on the interviewees' answers, the survey was sent to interviewees before the oral interview. This allowed them to answer by their own understanding with minimum guidance from the interviewer. Also, much wider interview was conducted with one manager from the case company in order to find the baseline for the project.

Since some points from the theory are mostly connected to automotive sector, one company, which was in same kind of industry area as the case company, was benchmarked. The purpose of this was to learn what can happen with supplier integration in the same kind of business environment.

3.2 Data collection

Empirical data was collected from 31 respondents with a structured survey and interview that were tested with two pilot interviews. Data from interviews was written down as the respondents spoke. None of the interviews was recorder so that the respondents could feel more anonymous and free to speak. Totally, there were 34 questions, of which 26 were closed questions in the survey, and 8 were open or semi-open questions during the interview. Survey-interview is illustrated in appendix 1.

Five different departments within the case company took part to the research, but the main focus was within purchasing and engineering. Respondents were requested not to speak to each other about the research in order to avoid the spreading of personal opinions. Table 3.1 illustrates where the data was collected from.

Table 3.1: *Respondents that were involved in the research*

			Other departments			
Department	Purchasing	Engineering	Quality	Sales	Financial	Total
No. of respondents	8	15	3	3	2	31
of which managers	1	4	1	1	0	7
Time, average (min)	23	23,5	20	34,5	21	24,4

3.3 Data analysis

To evaluate the results, the respondents were categorized to groups based on the department where they worked at. Groups were “purchasing”, “engineering” and “other departments”. Engineering included design and R&D functions entirely. Different functions in engineering were divided to R&D and Base Engine Development to better assess variations in opinions. Grouping them generally into “engineering” was preferred more often because the theoretical framework concentrates on purchasing and engineering. The last group was “other departments” which included sales, financial and quality departments. This group was created to have an outside view to the cooperation of purchasing and engineering. They could not have been taken as own departments due to the small amount of respondents. In some questions, managers were considered as their own group because their answers clearly differed from the rest. Their group was not preferred in every case, since most of the managers came from the same department giving too much value to that department.

4 RESULTS

In the following section, results of the research conducted are illustrated. Differences between departments or between managers and employees were compared in order to find possible points of disagreement or differences in ways of thinking. Findings are discussed in chapter 5. Results are illustrated partly in the same order as the theory was described. In this way they can be presented from top to down, moving from basic questions about personal views to details of cooperation.

Respondents were given a code name: purchasers are (#PX), base engine development engineers are (#EX), R&D engineers are (#RX), managers are (#MX), and other departments are (#OX), where "X" is a number. In this way quotations can be individually used without revealing the identity of the respondent.

First, company's current state of NPD, and establishment of ESI, are introduced. It is based on an interview of one manager who was a part of the establishment of supplier integration in the ongoing project. At the end of the results, there are summaries from two interviews: a manager from the benchmarked company and a key person from a successful supplier integration practice in the case company.

4.1 Establishment of ESI

Before the current project, the case company had not had properly managed supplier integration. Some design cooperation with suppliers did exist, but it was assorted and without specific instructions or processes. In the new project it was decided to use the suppliers' expertise in their respected areas, because the main goal for the project was to achieve cost savings. The baseline for the project was constructed by benchmarking products of two competitors. Based on the results, target costing was done to figure out the cost of the new products. Target cost was formed for the functional groups but it was not executed to component level. (Anonymous A 2014)

Strategically, the purchasing department was not fully developed. Kraljic's (1983) categorization of products to four product groups was acknowledged, but not thoughtfully executed or communicated. This was also the case with interdependencies with suppliers. Some information about this did exist, but nothing was organized or written down, or at least it was not communicated to the personnel. Many tasks in purchasing were in the hands of a single purchaser who had his/her own ways of acting, which was a big benefit with some issues. When examining Schwientek & Schmidt's (2008) maturity

steps at purchasing organization, it was stated that too much of the purchasing function's focus was on step zero, getting the part on time, and the rest divided almost evenly to price negotiations, volume concentrations, and TCO. TCO was on theoretical level and it was a target to get it more and more into practice. Focus for it was pending because of limited resources. (Anonymous A 2014)

Purchasing function in the company was linked to global lead. All the components belonged to a functional group that belonged to a product group which had a global commodity lead. These global commodity leads were sitting in the corporation's offices around the world and the locations cooperated when needed. However, this was somewhat a new alignment, arranged only in 2013. (Anonymous A 2014)

The supplier base included more than 200 active suppliers. Supplier selection was done using case-by-case –principle. There was no set process for it, as was the case for the supplier selection for design cooperation as well. More scientific criticality examination has been done to components, but it mostly concerned empirical opinions of a purchaser and one global commodity lead. As can be seen, procurement department knows the way it is going but, due to lack of time, it is going there quite slowly. (Anonymous A 2014)

Previous Master of Science Thesis done in procurement department was by Anttisaari in 2013 about the procurement strategy. Anttisaari (2013) found out that other departments would like purchasers to have congruent policies inside the function. It was discovered that current procurement department was not working on a strategic level, rather than operative, or at most on tactical level without a properly communicated strategy. In that thesis it was also suggested that procurement should start to use Kraljic's (1983) purchasing portfolio as a baseline for its strategy that should be created. Anttisaari (2013) stated that procurement strategy should be built on the company's strategy, which, unfortunately, is meant to be seen only by the executive committee and not communicated to personnel in the case company. Overall, that thesis is in line with above described situation based on the interview with Anonymous A (2014).

When the case company started the new product development project, it wanted to involve purchasing function and suppliers into the NPD process. There were clear project leads, and each functional group was given an engineering lead and a purchasing lead. Each component in the functional group had its engineering responsible and purchasing responsible as well. They were supposed to cooperate by their own will. Responsibility of the design and costs of the design were given to engineering. Leading of design cooperation with suppliers, and communicating to them, were on purchasers' responsibility. This was a new arrangement. Tasks were given and participants were instructed to be initiative, however, written guidelines did not exist. (Anonymous A 2014)

Ground rules for supplier integration were written and relevant personnel had access to it. It included information about which products are going to be developed in design cooperation with a supplier and what are the strategies for those. Guidelines for the methods of ESI were discussed but not written. Both were created in some level but awareness of how the information was distributed to the personnel was unclear. There was no common infrastructure or IT system for supplier integration. One web-based system was in use, but it was the supplier's own. Methods were mostly on practical level in personal ways of acting. Nevertheless, the company had started to use cross-functional meetings during design processes in order to give other departments the opportunity to affect to the design. This was done with two components with the idea to broaden the habit in the future. (Anonymous A 2014)

4.2 Starting point for supplier integration

Participants' opinions from different functions of the case company agreed with the existing level of collaboration between departments in the company, and the level in which the suppliers are currently involved in the design process, table 4.1. The table includes also information about how much different functions think they know about suppliers that are related to their work, and opinions of the level of cross-functional design in the company.

Table 4.1 shows that the company had very little cross-functional design but there is some design cooperation with its suppliers. Table also shows that respondents agreed that suppliers of strategic and critical items should be involved quite much in the company's design process. There were not big variations between functions in questions 1-3, 5 and 6.

Respondents were also asked if the company was tied up to its old suppliers, and which issues are the main criteria when selecting a supplier, table 4.2. Opinions on the first question divided evenly to "yes" and "no". Personnel in purchasing and in other departments thought that the company is tied up to its suppliers and suppliers are exploiting the situation. Participants from engineering, and managers, answered mostly "no".

Table 4.1: *Results to the questions 1-6*

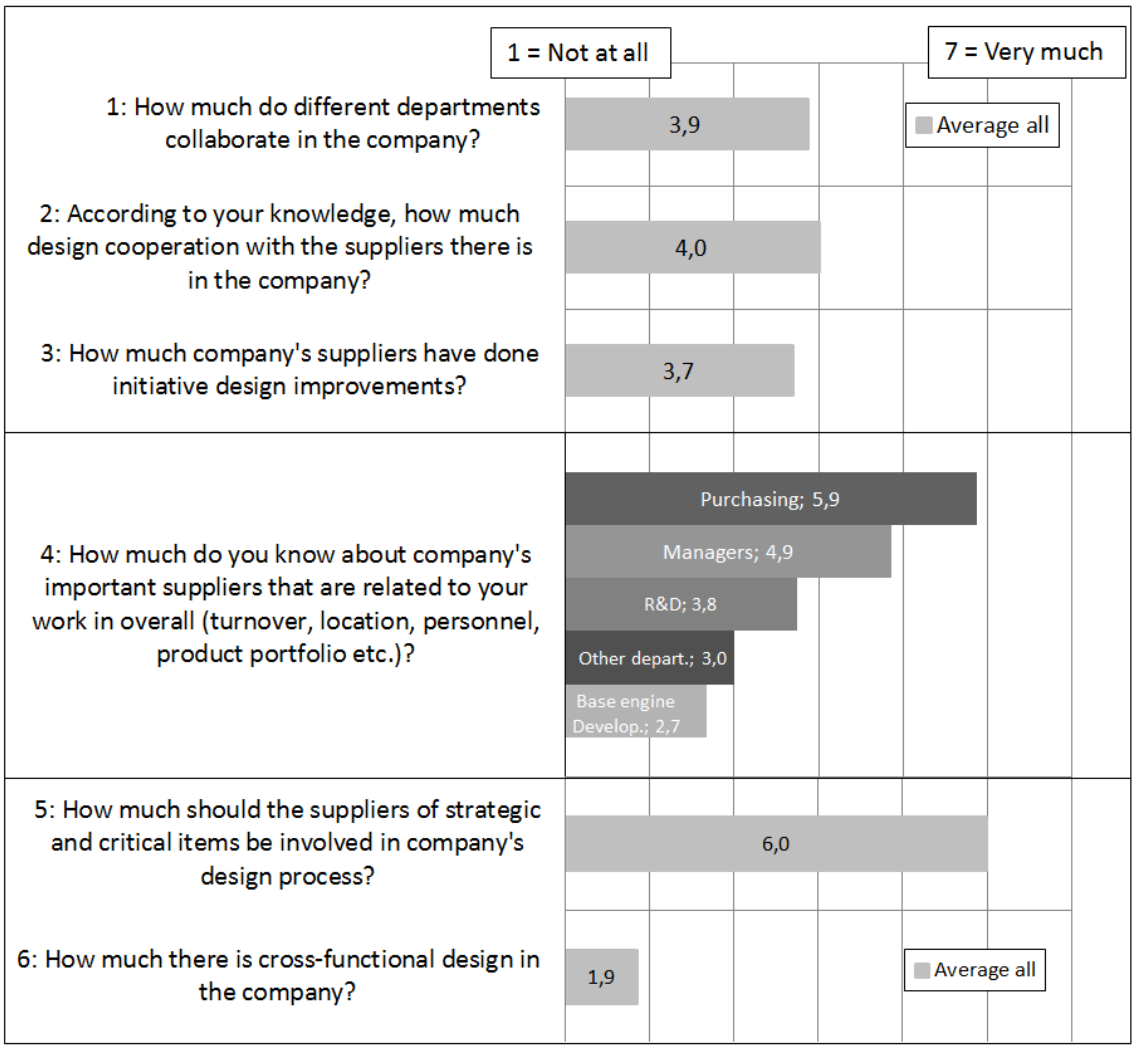
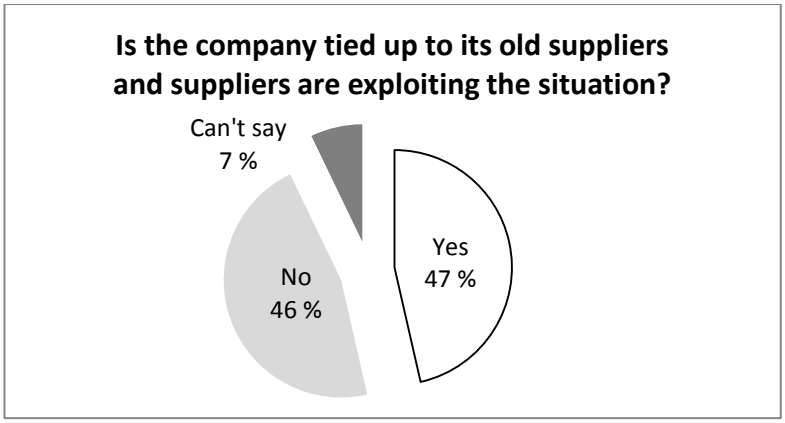


Table 4.2: *Interdependence between case company and its suppliers*



Some respondents had quite clear and negative opinion on suppliers of the company.

> *"Some big suppliers use us as a beta-testing customer. We get new products, which are not completely ready, to "test-use" before supplier's more important customers. We basically do R&D/prototype testing for them for free."* (#O3)

Power relation between the case company and its suppliers was thought to be almost evenly divided, figure 4.1. Total average was 3,7 in scale where four was exactly 50/50 situation. A couple of respondents wanted to add, that the power relation is usually between the case company and 50/50 situation, depending on the supplier.

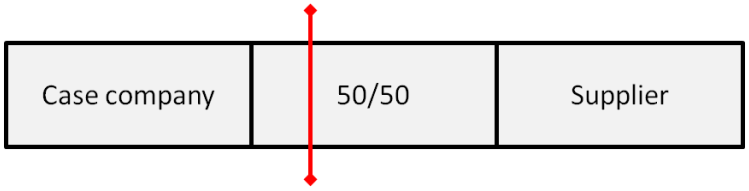
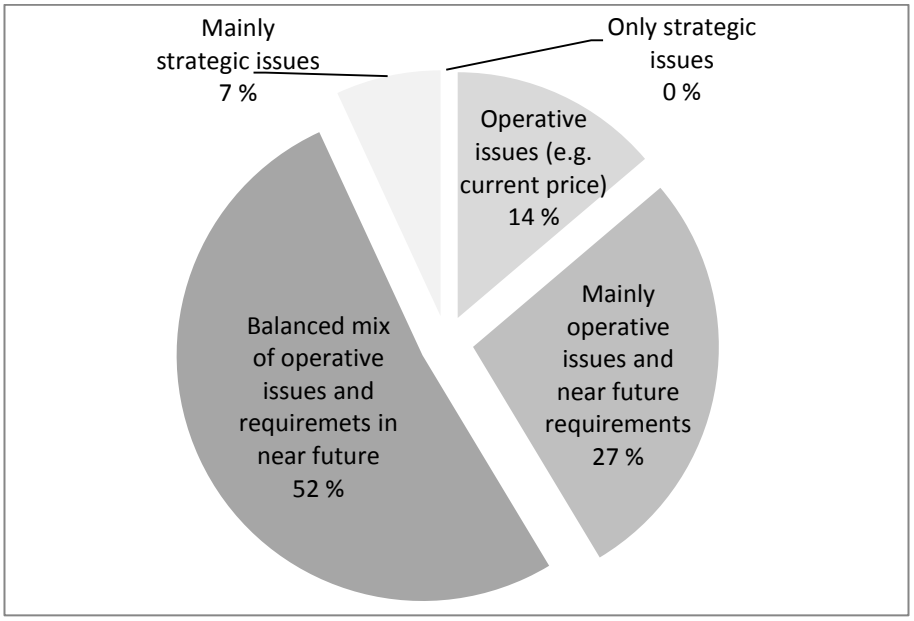


Figure 4.1: *Average answer to the power relation between the case company and its suppliers*

Opinions about supplier selection criteria emphasized more the operative side. Mostly answered was that the criteria consists of balanced mix of operative issues and near future requirements. Other departments chose more operative issues than a balanced mix. Option "c" in this question included a term "balanced mix" which can have a positive image in respondent's mind. It means that the question should have been assessed differently in order to avoid affecting to the respondent.

Table 4.3: *Which issues company's supplier selection criteria mostly consists of*



Results to the question 25 about respondents' awareness of procurement strategies are illustrated in figure 4.2. There were big variation in answers in purchasing, i.e. purchasers answered to both ends; some answered that they know everything and some stated that they did not know that procurement had strategies. Engineering and other departments had quite homogenous opinions.

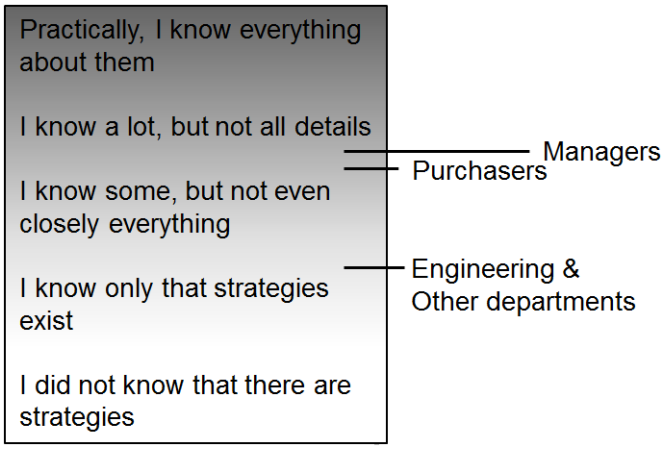
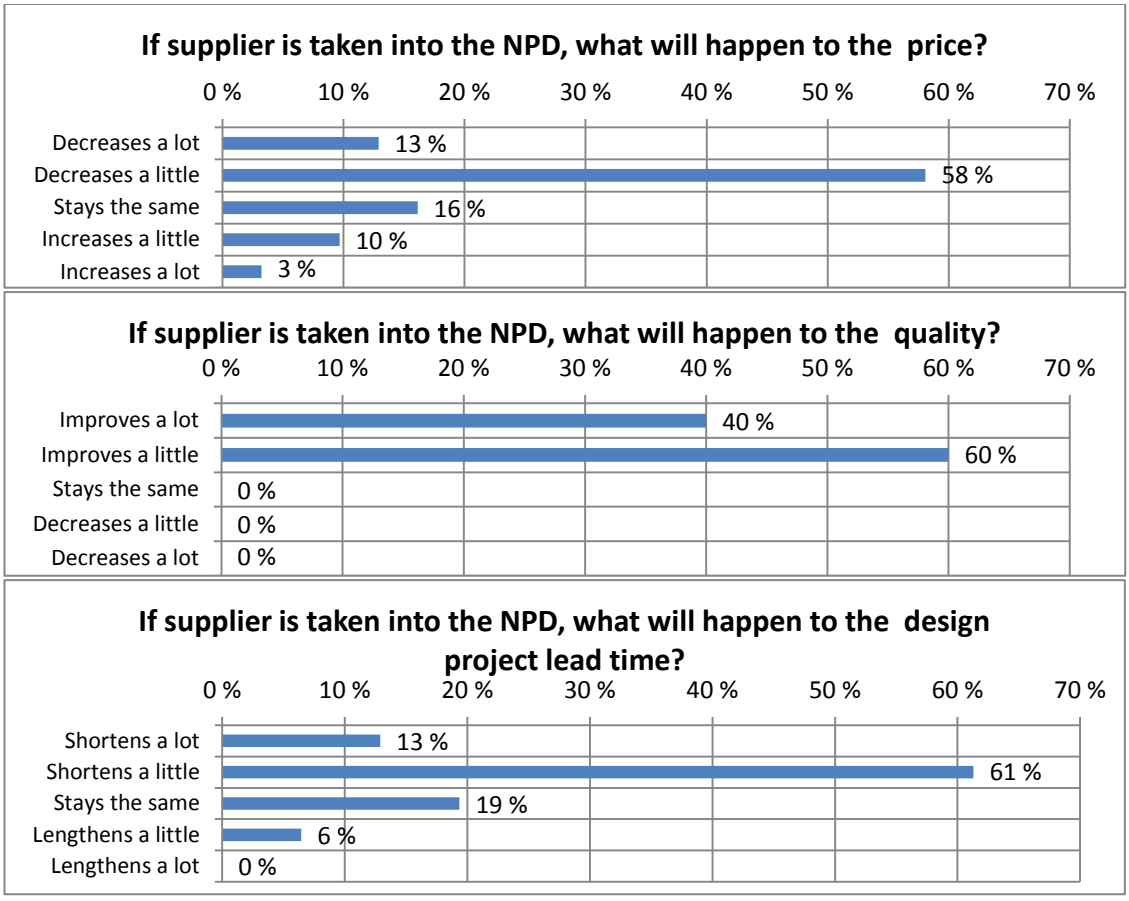


Figure 4.2: *Average answers of functions to the question about how much respondents think they know about procurement strategies*

Most of the respondents thought that involving suppliers in company's new product development will decrease the costs a little, improve the quality a lot or a little, and that project lead time will be a little shorter. Basically, this gives the image that personnel's attitude is positive towards the supplier integration but they are not waiting too much from it. Most positive answers were given from purchasing and R&D.

Table 4.4: *Expectations for supplier integration*



When respondents were asked to openly describe why a supplier is brought in the company's NPD and what is expected to achieve by doing so, following answers were received, figure 4.3. Mostly answered description was that supplier knows the technology of its products better than its customer do, and customer should respect that knowledge. Getting technical expertise and fit between customers design and suppliers manufacturing could bring great benefits for the company. Getting innovations and better designs were also mentioned many times, not to forger the technology road map, which can be received through cooperation. All issues that were answered many times are gathered in figure 4.3.

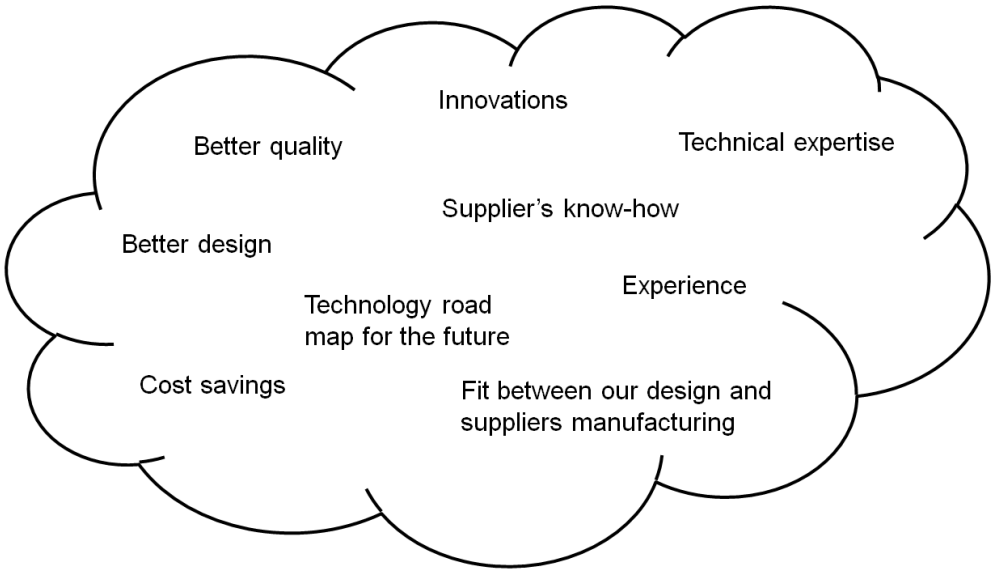


Figure 4.3: *What respondents expected from supplier integration*

As stated, involving suppliers in NPD was seen as a positive method. Among managers, this question awoke wider explanation of how the case company had evolved a lot in the last five years.

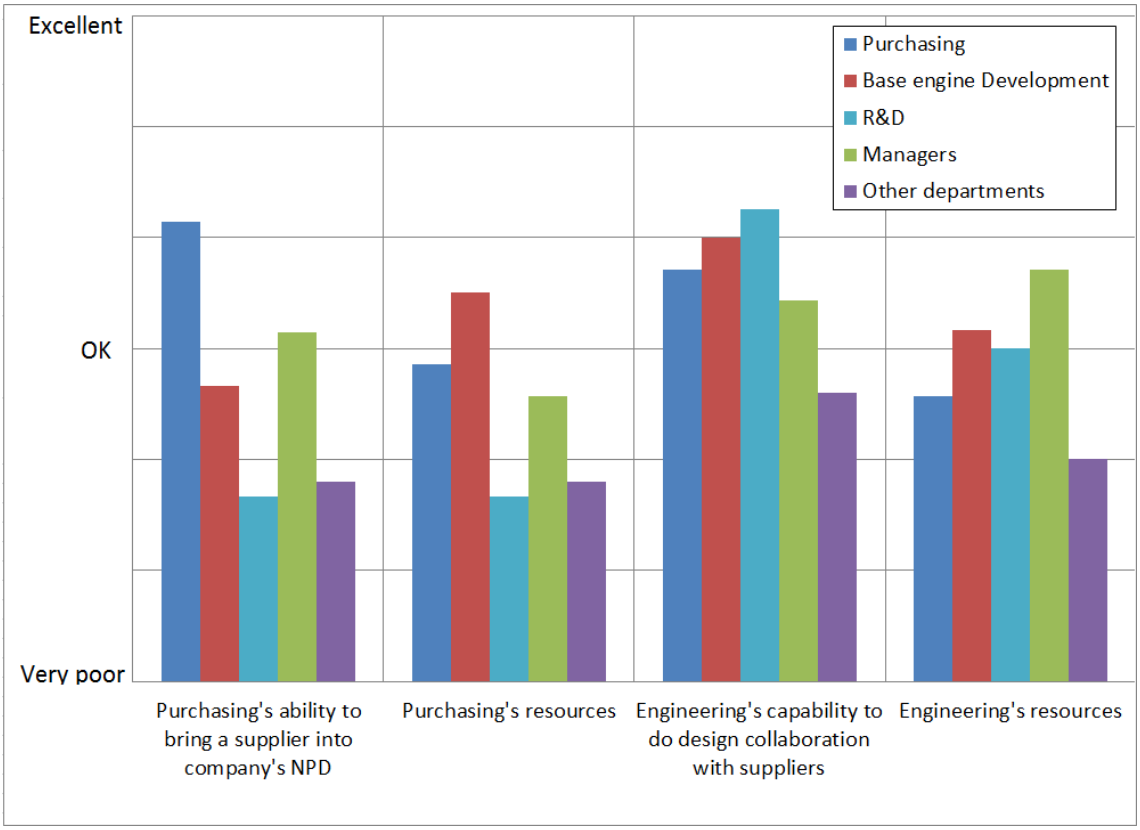
> *"In our company, there is going on a huge change from old habits to new ones. Purchasing has shown its capabilities and now their role is understood in engineering. However, organizational learning takes a lot of time."* (#M5)

4.3 Know-how, resources and prerequisites for ESI

Respondents were asked to rate capabilities and resources of purchasing and engineering. Outcome is illustrated in table 4.5. Most variation came when asked about purchasing department's capabilities. Purchasers gave much higher score to their department than any other. Manager's also respected it with a score above average but the total average stayed below "OK" –level. Other departments gave the lowest grade for all of the questions. It can be read from the answers that they think that resources in purchasing and engineering are not sufficient but neither is their capabilities.

"The whole company has way too little resources. For example, engineering cannot master all the technology areas with their personnnel, which is why we really should consult our suppliers much more than we do now." (#O3)

Table 4.5: *Opinions on capabilities and resources of purchasing and engineering*

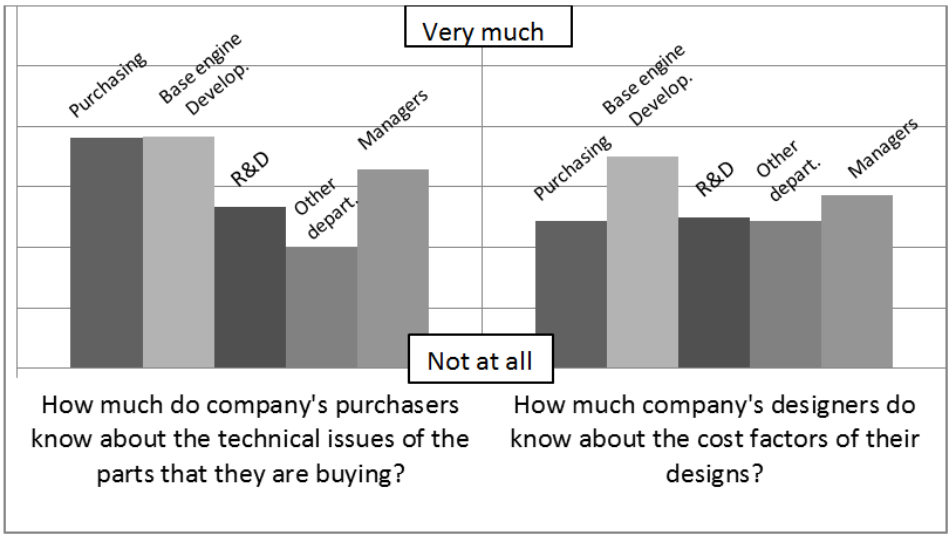


During the interview, many respondents wanted to comment that these kind of overall question do not give enough alternatives to answer. They include different personnel and different issues which makes it quite difficult to give a total score.

"There are huge differences between purchasers. Some of them are able to manage their work assignments with great transparency, whereas some of them are not able to cope with their jobs at all. These latter cases are like black boxes: we can give them input but we will never hear what is happening to the input. Which makes this even worse is our current ERP-system that gives no kind of support. In overall, we should get more transparency into our actions." (#O3)

Total grades for purchasers' knowledge about the parts they are responsible of and engineers' understanding of cost factors of their designs are illustrated in table 4.6. Purchasers respected designers' ability to understand cost factors of their designs less than designers respected purchasers' knowledge of their parts. Other departments and R&D gave the smallest grades to these questions by average.

Table 4.6: *Purchasers' knowledge of the parts they are responsible of, and designers' knowledge of the cost factors of their designs*



Other departments rated many other questions also lower than engineering and purchasing. This can be seen from table 4.7, which presents purchasers' motivation to do collaboration with engineering and vice versa. Managers seemed to think in more positive way than the rest. Their average is higher than any others'. Same phenomenon continued when asked opinions about company's NPD process. Managers saw it in "OK" level whereas others rated it lower, table 4.8. Still, not all managers agreed.

> *"There should be a clear NPD process with gates where decision are made and reported. Then we could go back and see where we failed."* (#M7)

Question 15 about how good is the NPD process of the company may have confused the respondents. Respondents might have thought of the final product NPD process or the NPD process of a single purchased item.

Table 4.7: *Purchasers' and engineers' motivation to cooperate with each other*

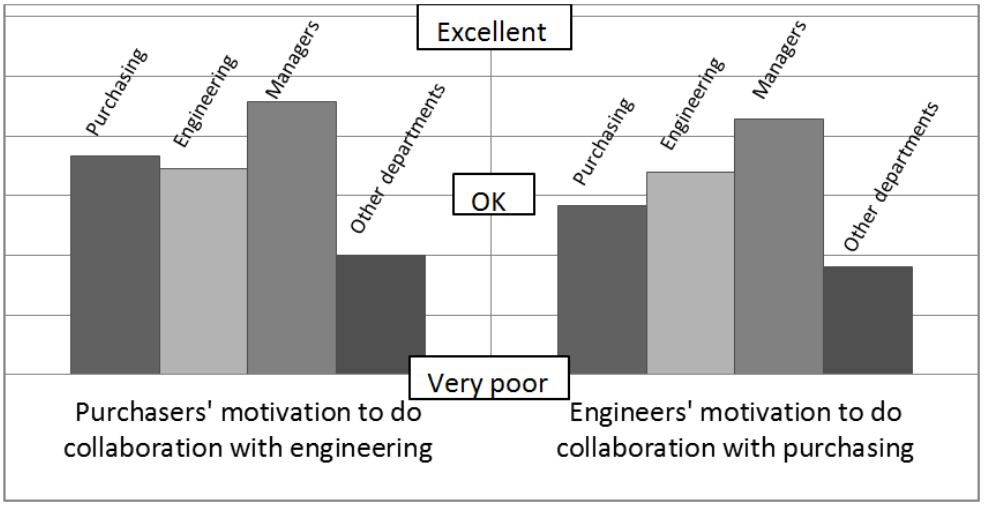
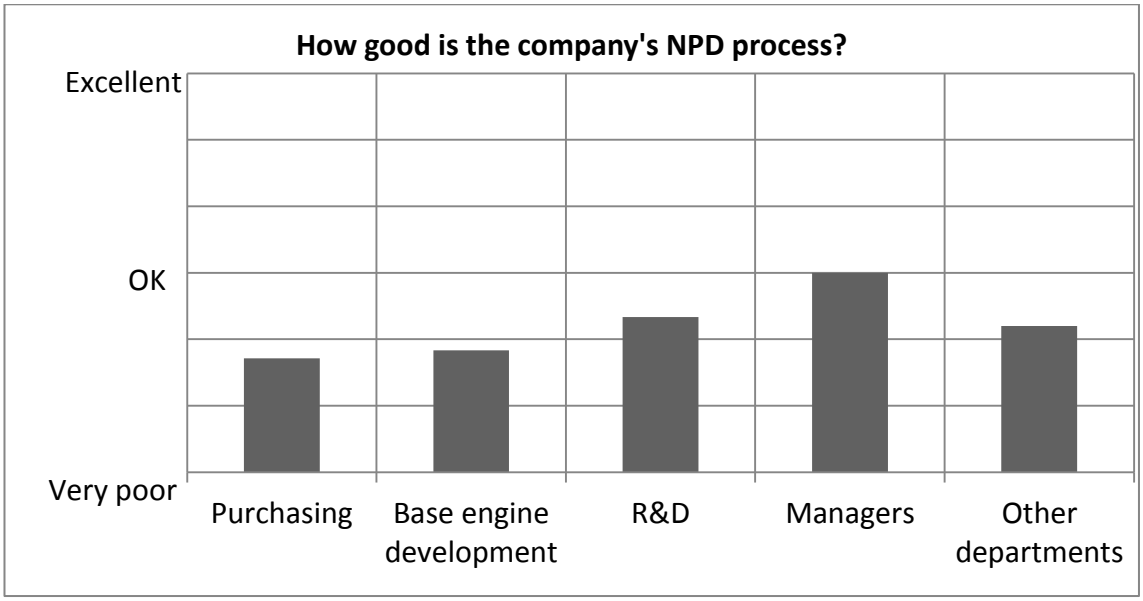
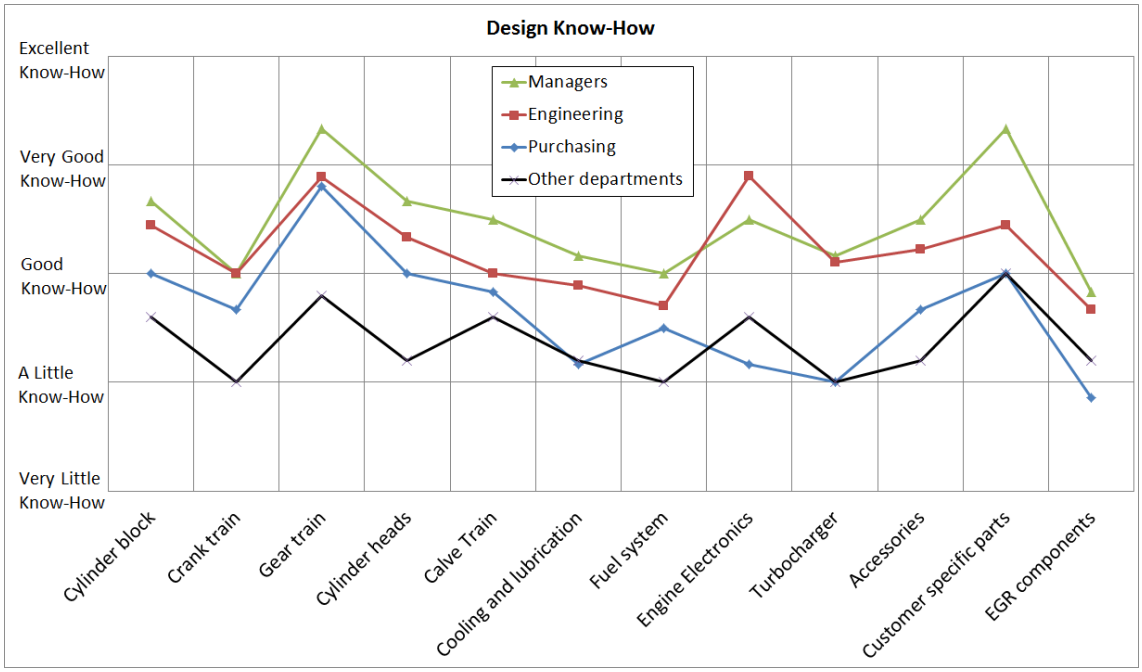


Table 4.8: *Opinions on how good is the NPD process of the company*



Almost all of the respondents agreed that question number 18 was the hardest since it required much knowledge of engineering's capabilities. Many participants told that they had to trust to their experiencies since they did not possess facts or any knowledge about which technology areas are the core design competencies of the company. Functional groups of gear train, engine electronics and customer specific parts were the most highly rated by the all functions, table 4.9. It can be seen that managers and engineers respected engineers' know-how with bigger grades than purchasing and other departments did.

Table 4.9: *Design know-how in different functional groups*



Technology know-how question awoke a lot of opinions.

> *"Purchasing is not involved in making the technology road map but it knows about it."* (#R3)

> *"We are quite dependent on our suppliers because our own resources are not sufficient to be the technology expert in all areas."* (#M5)

4.4 Opinions about ground rules

There were not big differences between departments in responsibility questions. Respondents agreed that, between designer and purchaser, the responsibility of the success of the design in supplier integration cases should be on designer but not too far away from 50/50 –situation, figure 4.4. This closed question, number 17, offered options 1=purchaser, 4 = 50/50, and 7=designer. Total average was 5,5. This means that purchasers should be able to affect and give some input to the design so that designer does not work solely alone. Question did not specify what "success of the design" really means.

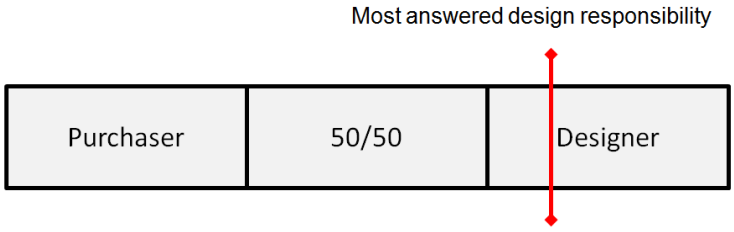


Figure 4.4: *Responsibility of success of the design between purchaser and designer*

Requesting to set responsibility to the right position between the case company and the supplier gave almost same kind of result. Options were 1=case company, 4 = 50/50, 7=supplier, and the result was 2,7. This means "white box" integration, figure 4.5.

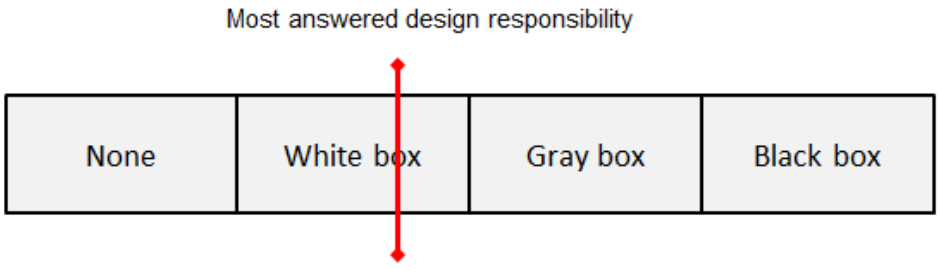


Figure 4.5: *Responsibility of the success of the design between the case company and its supplier*

Answers inside functions varied quite much in question number 20 in table 4.10. Only category which had a clear opinion was managers. Their simplified opinion was that the NPD process starts with sales and engineering in the requirement definition phase.

Straight after that phase, in concept creation, purchasing, quality, and production departments should jump into the process to form cross-functional design. Managers also wanted the supplier to be involved in the concept creation. Average opinion in purchasing and in engineering was that cross-functionality and early supplier involvement starts in the initial design phase after the concept creation.

Table 4.10: *In which design phase should the mentioned departments join the NPD process? Also, in which design phase should the supplier be involved?*

Departments	Purchasers' average opinion	Engineers' average opinion	Managers' average opinion
Purchasing	Concept creation	Initial design	Concept creation
Quality	Initial design	Actual design	Concept creation
Production	Actual design	Initial design	Concept creation
Sales	Initial design	Requirement definition	Requirement definition
Supplier	Initial design	Initial design	Concept creation
Requirement definition →	Concept creation →	Initial design →	Actual design

Asking about when different departments should be involved awoke strong opinions on certain people. Some were really keen to be allowed to contribute to the designs.

> *"Currently, quality department joins way too late into the process. Their improvement suggestions cannot be noticed since it would cost too much to do the changes that late." (#M7)*

> *"There is a lot of good in our R&D. They just should have clear processes with purchasing and quality so that the whole project could success. Single engineer should focus more on what other departments think."* (#M7)

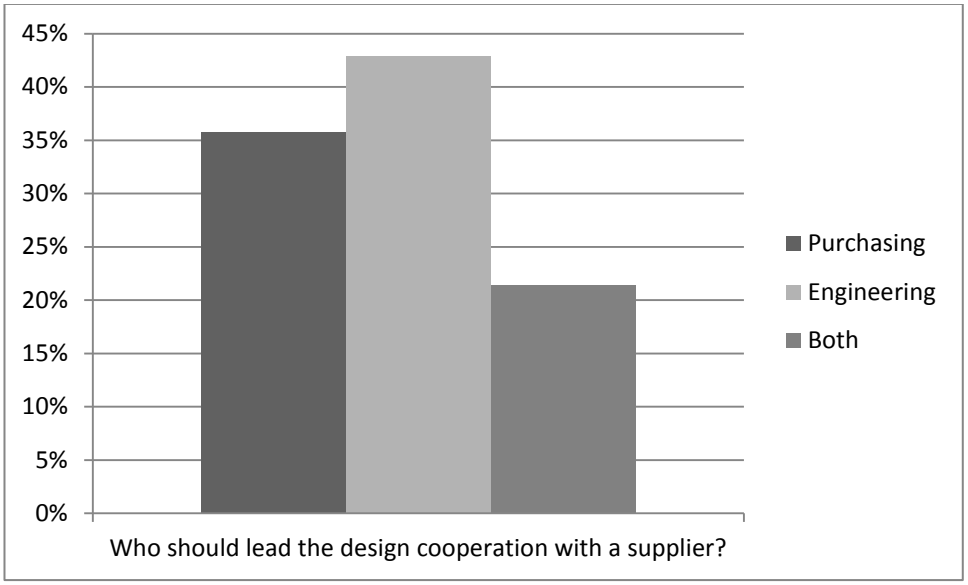
> *"Designers are not able to consider maintenance aspects. In some cases you have to do unnecessary disassembly work for one day in order to do some adjustment to the engine for 15 minutes."* (#O4)

4.4.1 Leadership & Communication

Biggest dissensions were in the results of the open questions. In question 28, the only category which agreed internally was managers. Five out of seven said that engineering should lead the design cooperation with a supplier in order to succeed in the project. Opinions in other departments divided, table 4.11. In the question, it was emphasized that the focus is on one purchased item, not the whole final product. Amongst managers

and engineering, there came up many times that the engineering should lead the design cooperation but the responsibility of costs and time schedule is on purchasing.

Table 4.11: *Opinions on who should lead the design cooperation with a supplier: purchasing, engineering or both*



Almost every respondent had a clear vision on who should lead the design cooperation with a supplier if wanted to succeed in it.

> *"Engineering should lead. It is in closer cooperation for example with global R&D and global sales. Purchasing comes always a little behind because it is a bit separated from everything else."* (#R3)

Even though strong opinions were found, they did not agree with each other.

> *"Purchasing should lead the design cooperation but their resources are not sufficient for that."* (#O3)

Third party leader also came up.

> *"Current organization structure is out dated. Sales should provide project management so that neutral third party could lead. Choosing leader between engineering and purchasing is impossible because they have to walk hand-in-hand. To be precise, leading is not the issue but the starting point: all the successful cases have included should cost calculations."* (#R4)

> *"Engineering and purchasing cannot see the big picture. They can do small changes to get a slightly better quality or reduced price without knowing that this*

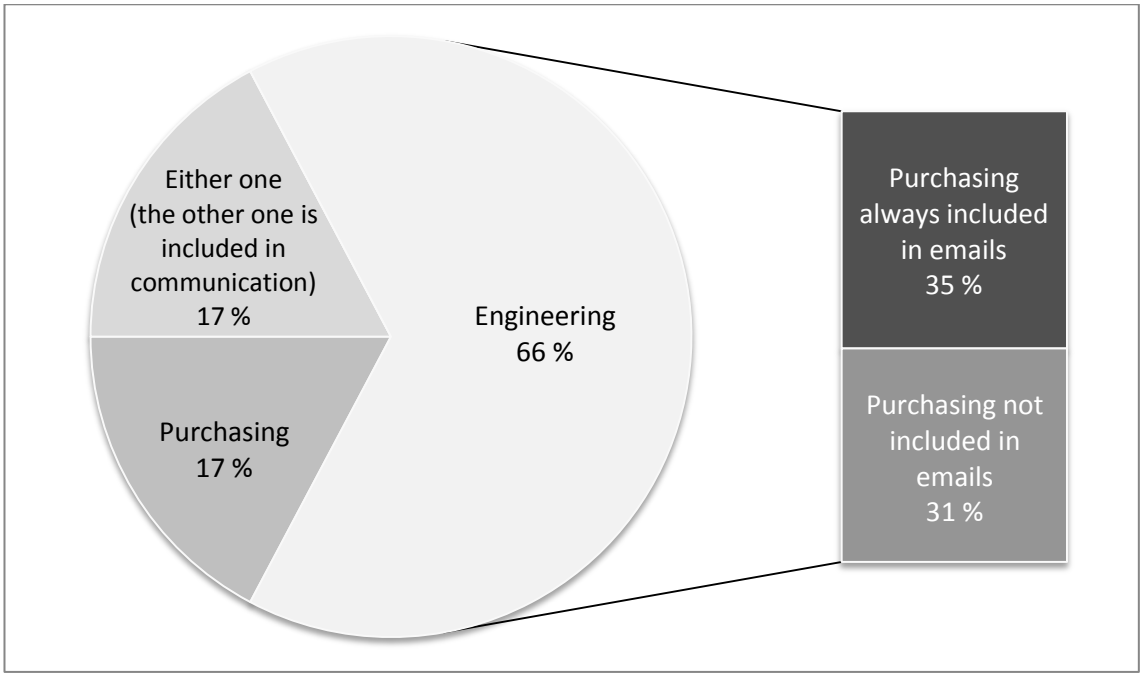
minor change can cause huge costs of changes to our customers. This is why former sales department should lead the whole design cooperation." (#O3)

Many of the respondents saw that the responsibilities of purchasing and engineering are overlapping with each other, even amongst managers.

"Leading of the design cooperation has to be in engineering but all the cost issues have to be on purchasing's responsibility. There is a lot of overlapping in responsibilities which means that we really have to have clear rules for the game." (#M5)

Besides leadership, respondents did not agree on who should communicate with the supplier during design process, table 4.12. Answers varied inside every category also. Some saw that it must be done by purchasing in order to control the costs and the supplier, while others thought that engineering should do it and inform the purchasing when the design cooperation is finished.

Table 4.12: *Which department should communicate with the supplier during design cooperation?*



Many respondents stated that it would be nice if purchasing could lead the design cooperation but, if they would do it, the design process would take too much time. These participants told that this is the reason why engineering should do the communication themselves. However, more extreme opinions were also found:

"In an extreme situation, one old sales guy had to contact the supplier because purchaser would not do that and engineering was not interested. These cases have

not happened lately but it is a good example where we were a couple of years ago." (#O4)

Different suggestions were given for purchasers' role in ESI, such as: helping role, supporting role, leader's role, and "staying in the own locker" –role. Purchasing was seen as a part of the whole project or wanted to be kept far away from it.

"Purchaser's responsibilities start when the design is ready." (#E1)

"Once, a customer wanted a part with any costs necessary. Our purchasing could not get the part on time because it was too expensive." (#O4)

A couple of respondents from other departments explained that there is a huge wall between engineering and purchasing, which destroys all internal cooperation efforts. Same issue was seen in engineering and purchasing as a part of history already.

In overall, responsibilities of the purchasing function varied between respondents, question 29. Besides leadership and communication tasks, participants disagreed if purchasers should take the responsibility of costs and time schedule or not. Most of the engineers said that purchasers are not leading but they are responsible of costs whereas most of the purchasers saw that whoever leads is responsible of the costs.

59 % of the respondents said that a regular meeting that is bound to a process and have certain milestones in it is better than weekly or monthly meeting, question number 33. 17 % wanted to have a meeting on certain time intervals, 10% could not decide which is better, and 14% thought that regular meetings are not needed.

4.4.2 Open communication + Clear targets for NPD

59% of the respondents would use totally open communication when doing design cooperation with a supplier, meaning that information is shared openly without secrets on the background, table 4.13. Many of those who answered "Yes" added that this is the requirement for good collaboration.

Regarding to open communication, almost all of the engineers would like to know their counterpart from the supplier's side better than they do now. They consider it beneficial for the cooperation.

"When you have personally met your counterparts from the supplier's personnel, you can have more flexible support from them when needed. It works the other way around also." (#R4)

Table 4.13: *Should open communication be used when starting design cooperation with a supplier?*

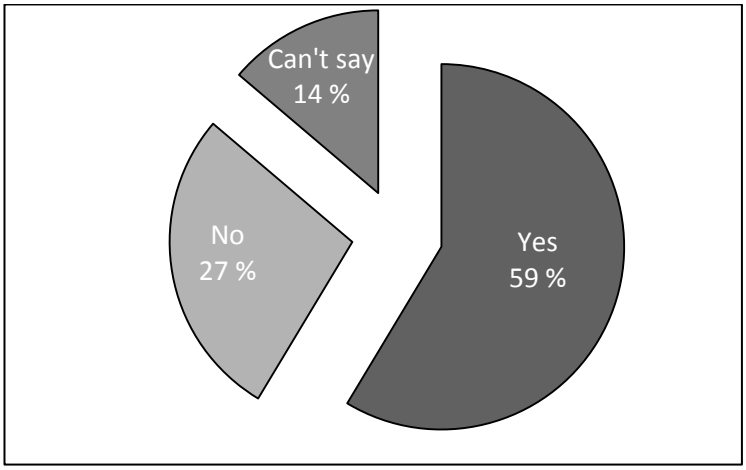


Table 4.14: *Are there clear targets for a component at the beginning of its design process?*

No	76 %
Yes	14 %
Can't say	10 %

> *"There are no clear targets for the design of a new component. If there were targets, critical issues clarified and cost level defined, working in the purchasing function and design cooperation with suppliers would be much easier."* (#M7)

One engineer saw it challenging to keep up good collaboration with suppliers.

> *"We have to admit to the suppliers that we have problems. That is the only way to keep the supplier interested in our projects. A couple of times a supplier have notified us that it wants to step out of the project because of too many unclear issues."* (#R3)

4.4.3 Benchmarking

In order to have a deeper understanding of supplier integration in NPD, one company was benchmarked. Its industry area was quite close to case company's area which made benchmarking possible. Benchmarked company had tried supplier integration but partly failed in it. Their information was collected through an interview with one key manager, Anonymous B (2014). Three things can be learned from them: who should own the drawings, how NPD process should be like, and how to align personnel correctly.

Benchmarked company started "grey box" integration without clarifying the owner of the drawings. Situation evolved, and without purchasing's control, engineering accidently let the supplier pull the drawings to its property. Later, this became a problem

because one supplier raised the prices but benchmarked company could not do anything since it did not own the drawings. It was really hard for them to find a new supplier, and because of this case, all supplier integration was terminated for two years. (Anonymous B 2014)

When asked how purchasing and engineering cooperate, answer was really simple: through strict process discipline. There was a very clear process for NPD with gates in it. All the decisions were registered, so that decisions could not be done without a record out of it. Engineering led this entity because purchasing function did not have the resources for it. According to Anonymous B (2014), achieving processes that really work took about two years. There were a lot of disagreements between departments but they were won because of highly motivated managers who decided to establish strict process discipline. Their process graph has certain merging points for purchasing and other functions. Two years, that they spent moving to this process thinking, started from a situation where the idea in engineering was that they design the part, select the supplier, and then the purchasing function will negotiate the price for the product. No cooperation was needed in the old process model. (Anonymous B 2014)

In the new process model, there are two project sourcing managers that work constantly with engineering/R&D. They work in the interface between purchasing and R&D, operating over organizational boundaries. Their responsibility is that purchasers and relevant suppliers are included and/or aware of the current state of the R&D. It was noticed that these two project sourcing managers were the best ones to push the projects forward. (Anonymous B 2014)

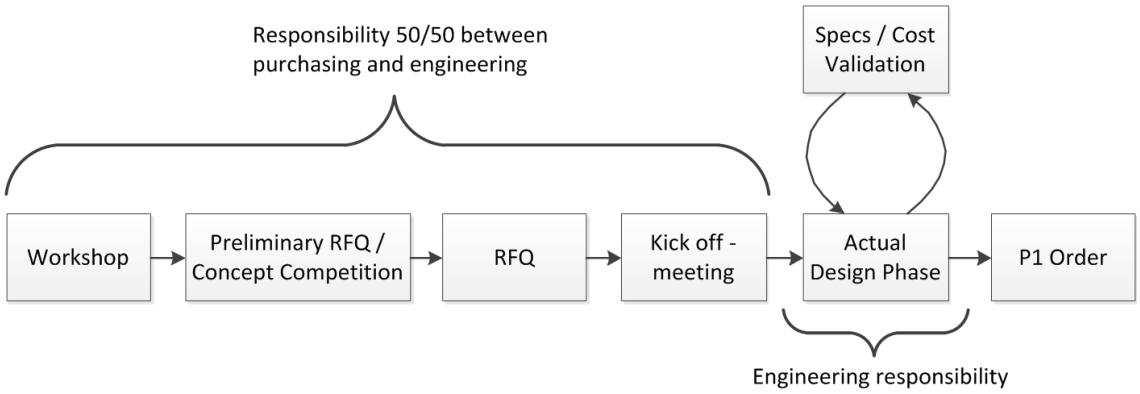
What really aided supplier integration in the benchmarked company was their supply base rationalization from 400 suppliers to little over one hundred suppliers. 20 of their suppliers were involved in the design but the amount is supposed to drop to 10. Also, the benchmarked company is trying to own 10-30 % of the sales of its every supplier. (Anonymous B 2014)

4.4.4 Role to break organizational boundaries

There was a person in the case company who worked partly in the interface between R&D and purchasing. During interviews, three managers recommended examining this person's cooperation with purchasing function because it was recognized as the company's internal best practice. Function was still unclear because alignment had not existed for long. (Anonymous C 2014) However, this person worked over R&D's departmental boundaries partly because of limited resources in purchasing. Meaning was to be a project coordinator between R&D and purchasing, but also between management and team leaders, while working as a research engineer at the same time. (Anonymous C 2014) Situation had evolved to that because of personal interest to coordinate projects.

This project coordinator, together with relevant purchasing manager, took care of supplier selections and costs management. Purchasing's responsibility was to manage supplier interface but to do the rest of the tasks in cooperation with the project coordinator. In overall, cooperation between purchasing and R&D in this case had evolved because of supplier involvement in that technology area. Design and development work was done together with the supplier, which required purchasing's presence during the process. Alignment can be copied to other technology areas also but only for the ones that are enough complicated. Responsibilities between different phases of the project are illustrated in figure 4.6. (Anonymous C 2014)

Figure 4.6: *A process for supplier integration with responsibilities of purchasing and R&D in it (Anonymous C 2014)*



The process starts from workshops with potential suppliers. After defining the concept that is preferred, preliminary requests for quotations (RFQ) and real RFQs after those are sent in cooperation of R&D and purchasing. Now, framework for what is wanted from functionalities, costs and specifications of the product should be clear and a kick-off meeting will be hold. That is attended by the all relevant personnel from supplier's and customer's side. Project organization, interfaces, reports, should costs, formal agreements, and other aspects are defined/communicated in that meeting. After the meeting, supplier and responsible engineer can start design cooperation to meet the targets. Responsibility moves from 50/50 –situation between purchasing and engineering to engineering. Surprises concerning costs or functionalities should not arise because of already created framework. This process works with complex products. If a proper cost calculation could be given in the beginning, engineering would be able to step into design cooperation earlier. (Anonymous C 2014)

5 DISCUSSION

All notable findings from the research are discussed in this chapter. Some of the questions were framed to test if there were clear variations between departments. These questions are not all mentioned or introduced any further because there were no notable results. This part of the thesis focuses on comparing the research findings to the literature.

Conclusions from the discussion chapter are summarized to the sixth chapter.

5.1 Fit of the case company's starting point for ESI requirements

Targets for the case company's ongoing project included achieving product and production cost savings. Table 2.2 shows the findings from three different researches, which shows that project lead time and costs will decrease, and quality will increase through ESI. At least this is what different papers argue. Establishing supplier integration for the first time may include startup problems if it is not properly managed. Warning for this can be found in table 4.2, where 47% of the respondents said that the company is tied to its old suppliers and they are exploiting the situation. To compare, the benchmarked company had failed in ESI because their suppliers started exploiting them.

The decision to implement or not to implement supplier integration should be done according to the product group strategy. This strategy comes from procurement strategy, which, in turn, should be linked to the company's R&D capabilities and core design competencies (Monczka et al. 1998). According to the previous Master of Science thesis made in the procurement department by Anttisaari (2013), procurement strategy should originate from the company strategy. This creates a problem with supplier integration because Anttisaari (2013) found that the company's strategy was not communicated outside of the leading board. Because of this, first thing to do before supplier integration should be establishing Kraljic's (1983) purchasing portfolio and figure out different product and/or supplier categories. This is because all supplier integration should be done according to product group strategy (Monczka et al. 1998).

A formal supplier selection process neither existed in the case company. According to Hofmann et al. (2011) supplier selection also chooses the strategy which is why it is recognized as a requirement for establishment of ESI. However, the absence of formal supplier selection process or exact strategies will not stop the whole project. The

benchmarked company neither had established Kraljic's (1983) purchasing portfolio nor had it any strategic categories for suppliers but still had some good experiences from supplier integration efforts. (Anonymous B 2014) However, they had other relevant processes properly in use, such as NPD process and sourcing process.

Cross-functional integration inside the company was recommended as a learning practice before supplier integration by Das et al. (2006). In the case company, they were started almost at the same time but only with two products. Target was to use the practice also with other components after the project goes further. For a total approach to successful design, these cross-functional meetings should get more common when, for example, quality perspective could be better managed. Getting the supplier's view without the company's internal views from other departments may lead to subjective designs not covering all aspects.

5.1.1 Expectations & interests

Attitude towards early supplier involvement was generally positive. This can be seen from table 4.1 and table 4.4. Respondents are waiting for lower prices, faster lead times and higher quality through design cooperation. Also, respondents agreed that suppliers have done initial design improvements, and that suppliers of strategic and critical items should be more involved in company's NPD than they are now. Expectations that are gathered in figure 4.3 are in line with the theory part of the thesis. They all fall under the supplier's knowledge of its own manufacturing and expertise of the technology in the area it is working. Naturally, getting the supplier to share this information requires the supplier's will to do so, which does not come for free. Research did not cover motivation for the extra work or changes in the working habits that supplier integration can cause internally.

Other departments clearly saw that collaboration attitude between purchasing and engineering is not the best possible, e.g. table 4.7. Same issue came up in open questions. Managers, on the other hand, seemed to have a lot more positive image of purchasers' and engineers' motivation working with each other. Reason for this can be missing knowledge of the tasks of other function. Still, the assumption here is that other departments are seeing the past still going on whereas purchasers and engineers see that great wall between the departments is falling down and they could actually cooperate. Consequently, motivation is not an issue when establishing supplier integration. However, purchasers should acknowledge that there might be motivation issues which they have to be able to deal with because of their role as a leader, as we learned from McGinnis & Vallopra (1999) and Handfield et al. (1999).

5.1.2 Prerequisites

Certain factors have been noted as prerequisites for high quality ESI in the literature. They have been found through several researches on the subject. The nature of these factors is that they were present in most of the successful cases. Claiming that they are mandatory would be wrong, they should be thought of as key factors to success.

Comparing key factors to success from literature to the conducted research is easiest with the created figure 2.22, House of Supplier Integration in New Product Development. Bottom level of the figure can be skipped, since formal supplier selection process did not exist and top management commitment was present for this project.

Next step includes trust, mutual goals, risk & reward sharing, and interdependence. Interdependence would require better examination of strategy which, according to Anonymous A (2014), is not done. Idea in the project is to start asking the suppliers about ideas to designs. Selected suppliers are thought case-by-case, and interdependence is thought if possible. (Anonymous A 2014) Strict timeline did not allow considering all the strategic issues. Risk and reward sharing of the same step can also be skipped because those were not established.

Trust is more complicated to evaluate. According to figure 4.5, the company is doing mostly “white box” integration which means holding the responsibility of the design almost completely on case company’s own side, using the supplier as a consultant (Monczka et al. 2000). Of course, there are exceptions that are more complicated, because 47% of the respondents said that the company is tied to its old suppliers and they are taking advantage of the situation. Nevertheless, 59% of the respondents want to do design cooperation with open communication, without hidden agendas. For this reason, the company should make it clear to its partners that it will own all the intellectual property (IP) there is with its suppliers. In the benchmarked company case this was realized too late which affected monetary losses and all design cooperation was terminated for two years.

As stated, supplier integration requires a wide skill set from purchasing because, according to theory, they should take the role of leadership. Since ESI is quite a new idea in the case company, it creates a problem that can be seen from table 4.5. Resources and abilities in purchasing are not respected with high grades. The same table shows that situation is slightly better in engineering. For this reason, it can be suggested that engineering should be allowed to freely cooperate with the supplier as long as the IP rights belong to the case company and a reliable should cost calculation is given to the engineering and the supplier. Support for this can be found also from the opinions which said that responsibilities of purchasing and engineering are overlapping in the design cooperation. During the thesis, it was suggested to let the engineer and the supplier de-

velop the product to the calculated should cost in cooperation. If the supplier can beat the cost it can keep bigger profit. The idea was adopted, but should cost was only given to engineering. Freedom to cooperate with the supplier was not granted, only the responsibility of the cost was given. Of course, it could be done only with certain item groups that had totally reliable should cost calculations.

High quality new product process was recognized as one cornerstone for successful supplier integration in the literature, figure 2.22. Table 4.8 does not give that image from case company's NPD process. Comments concerning the design process of one purchased component were everything but positive. Basically, a process that is in actual use and concerns one purchased item did not exist. Neither did clear targets for the design of a new component. Targets for designs were mentioned to be very important in ESI concept literature, which makes it mandatory in this research to suggest being totally honest with the involved supplier. Supplier has to understand that it is trusted but there are no clear goals for the design of one purchased item. Then it knows to what it is participating into. Efforts will not be wasted with suppliers that do not want to step into this kind of situation. Furthermore, a proper design process should be created so that the design process is not only in the hands of a single engineer. Benchmarked company had the same problem in the past but they defeated it with a clear process and extremely strict process discipline. Consequently, case company should establish well described NPD process for single purchased item, and train personnel to use it.

The case company started to do "white box" integration with almost every supplier of strategic and critical items. There were also some "grey box" but the point is in that no kind of design expertise areas were recognized for strategic use. Table 4.9 shows that some areas are clearly graded with more appreciation from all departments but the level of design know-how in general seems to be unclear. From the theory it can be picked up that supplier integration should be done according to design expertise areas of supplier and manufacturer, and according to product group strategy. This combination is challenging since diverging opinions of the company's internal design know-how exists, and product group strategies are not defined or not communicated to personnel. To fix this, management should find out the real situation of design expertise and figure out in which product group "white box" and "grey box" integration would create the biggest benefits. This knowledge should be combined with procurement strategies. Consequently, R&D and purchasing should do close cooperation in order to make supplier integration strategies. This ongoing project with numerous "white box" efforts will be a great learning process for the company to get familiar with ESI concept. In overall, house of supplier integration is not falling down but it has way too many holes and missing cornerstones.

5.2 Setting up guidelines and roles for supplier integration

Figure 4.4, table 4.11, and table 4.12 combined forms quite differing views to how ESI should be managed on a daily basis. Respondents agreed that the responsibility of the success of the design should internally be on designer but not too far away from 50/50 situation with the correct purchaser. However, opinions gathered into table 4.11 shows that it is not clear who should lead the design cooperation with the supplier. The same repeats with who should communicate with the supplier during design cooperation, table 4.12. Opinions of some of the respondents were that designer should lead and communicate with the supplier but the purchaser is responsible of the costs. Also, opinions that purchasing should lead and communicate with the supplier, while engineering is responsible of the costs, came up. This situation with different opinions may root from the fact that respondents are working with different functional groups that may have different working methods. However, this messy opinion variation is in line with Anttisaari's (2013) finding that other departments would like purchasers to have congruent policies in their working habits. This can be solved in supplier integration by putting up clear rules on how it is done: explain what participants are responsible of and what they should consider as their tasks during the project. Of course, different product groups may have different policies, which mean that permission to create own policies inside the team has to be available. Situation will remain unclear as long as everybody has not agreed with the policies, they are not aware of their roles, and ground rules and guidelines for supplier integration do not exist. Although, informed roles and responsibilities cannot cover the whole situation. Giving more responsibility to people does not remove the fact that processes do not exist, or are not in use. Responsibilities have to be aligned into a process model which gives them a performing sequence. More precisely, after figuring out all the responsibilities of different functions, a clear process model has to be established.

Opinions remained divergent for the roles and responsibilities of suppliers and other departments as well. In the beginning of the project, it should be made clear for all the participants for what reason the supplier is needed in a certain product group's design process, and in which level and when it will be involved. Of course, clearly defined roles for each member of the project are difficult to create, because of missing process description for single component's NPD. Consequently, these issues should be figured out in the first meeting before contacting the supplier. Eventually, supplier's role in NPD should be defined already in the product group strategy.

Purchasing's role in ESI depends on the case. Functional groups vary a lot as well as the supplier's role and level of involvement in them. Eventually, purchasing is responsible for supplier interface and finding new potential suppliers, but, when establishing supplier integration, its function can be divided into two alternatives:

1. Give should cost to engineering and supplier – let them cooperate
2. Use created process description between purchasing and engineering, figure 4.6

These alternatives are related mostly to "gray box" integration. In the first option, product is not that complicated and there is a cost calculation for the design which should be achieved. This requires supplier's help but purchasing does not have other tasks than to bring the supplier close to the engineering, establish a link between company's engineering and supplier, calculate a should cost for them, and monitor the cooperation. Second option concerns much more complicated products, for which the price cannot be exactly estimated in the beginning. In this case, purchaser needs to do close cooperation with the right person from engineering to find out the preferred concept, calculate and negotiate the cost window, after which the responsibility moves to engineering, figure 4.6. Both options require preferred suppliers that want to do design cooperation. In case of "grey box" integration, the company can motivate its suppliers by removing the other suppliers from the same field. Since supply base rationalization has not been done, there is clear potential to do it now.

Second option requires somebody to push the project forward. This might not happen automatically by the purchaser or the engineer since the resources of both departments were graded to a somewhat low level. A change is required to the interface between purchasing and engineering.

5.2.1 Key persons to the interface between purchasing and engineering

Many of the found success factors in supplier integration, both in literature and in the research, are related to the interface between purchasing and engineering, e.g.:

- Decision making jointly by NPD team and purchasing commodity team (Handfield et al. 1999)
- Purchasers' participation into R&D projects requires new management activities (Wynstra et al. 2001)
- Dividing purchasing function into advanced sourcing team, with project focus, and life-cycle team with commercial, strategy, focus (Schiele 2010)
- Processes for NPD including merging points for other departments, e.g. purchasing and quality (Cooper & Kleinschmidt 1995, Barclay et al. 2011)
- Strategies for product groups (Kraljic 1983) and strategies for supplier involvement in product groups (Monczka et al. 1998)
- Project sourcing managers from the benchmarked company (Anonymous B 2014)
- Case company's internal "best practice" in cooperation - project coordinator (Anonymous C 2014)

Furthermore, case company's internal resources in purchasing and engineering were not rated high, neither was their motivation to work with each other. Because of these reasons, managers cannot rely on that putting more responsibilities to both of these departments will make the cooperation work fluently. Better solution would be to establish specified roles for some to work in the interface between purchasing and engineering. Their role is to focus on projects and R&D but their responsibility is to make sure that purchasing and key suppliers have up to date information about projects. Responsibilities would include making sure that supplier selection in overall and supplier selection to design cooperation would be aligned with the technology road map and technology know-how of the company. Also, because of these persons, purchasing could focus more on supplier interface.

New alignment would be close to the benchmarked company that had two project sourcing managers working in the interface between purchasing and R&D, while sourcing engineers handled strategic purchasing. Advanced sourcing team, figure 2.20, had same kind of features as well. This thesis suggests that as long as a clear and high quality NPD process is not in component level, company needs a couple of people with technology focus to coordinate the cooperation between engineering and purchasing. Other recommendation would be to establish strict process discipline when designing and sourcing one purchased item would not be in the hands of dozens of people with their own personal ways of working.

Even if a proper NPD process does not exist, key personnel working in the interface between R&D and purchasing should be able to coordinate the projects. However, success factors from the literature included both, high quality NPD process and personnel between R&D and purchasing breaking departmental walls.

6 CONCLUSION

The case company's current state is not ideal when considering literature findings of success factors in supplier integration. In the literature, dozens or hundreds of papers examining supplier integration into new product development can be found. The subject has been of interest since 1985 which is why there is a lot of information. However, theory of supplier integration is not finished, that is, a common understanding of what makes it successful does not exist yet. Still, key factors to success can be found from different papers. This chapter summarizes the findings from the discussion where results of the research were compared to key factors to success from the literature, figure 2.22.

6.1 Managerial implications

Literature finds early supplier involvement as "best practice" in new product development, but succeeding in it requires quite a lot from the customer company. Comparing the case company's internal issues to literature findings brought up managerial implication that can be categorized to hard and soft implications.

Hard implications concern the most critical success factors in literature for supplier integration. These implications are the requirements for high quality supplier integration but also they should be major upgrades for the case company:

- Establish a clear process for new product development that concerns one purchased item, and implement a strict process discipline
- Set key persons to work in the interface between R&D and purchasing
- Align procurement strategies to correspond R&D's technology road map and know-how

A process for NPD has to include one purchased item. There needs to be clear merging points for other departments and suppliers. The process should have clear gates between steps where decisions are made in cross-functional teams. Furthermore, personnel need to be trained to use it.

Interface between purchasing and R&D needs somebody to control the cooperation. The personnel of neither of the departments have sufficient resources to control everything. Interface needs persons that are allowed to exceed departmental boundaries making sure that the both functions are on the same page.

Procurement strategies should be completely aligned with engineering's technology road map and technology know-how. This way it is possible to know in which product categories supplier integration is needed and in which level. Furthermore, this information needs to be shared internally.

Soft implications touch only the surface of how supplier integration is done:

- Give should costs to the engineering and suppliers
- Inform purchasing and engineering of their roles in supplier integration
- Carry out more cross-functional meetings during design processes

Calculated should costs should be given to engineering and also inform supplier about it. To create trust in deep design cooperation, the supplier should be able to keep the profit if it could sell the product with even lower price. However, intellectual property should not be given to the supplier. By doing so, purchasing can divide some of its responsibilities to suppliers and engineering, and also develop engineering's perception on cost factors.

Personnel in engineering and purchasing had differing opinions on who should lead the project, who should be responsible of the costs, and who should communicate with the supplier, even inside the functions. Because of this, roles and responsibilities should be made completely clear for all the participants in the beginning of the project.

During the design process of a single purchased item, cross-functional meetings should be held more often. This works as a learning practice to personnel on how to involve other parties into the design process. Bringing e.g. quality, after sales, and production to the design process enhances the final design.

6.2 Academic contribution

Kraljic created the purchasing portfolio in 1983, to which many papers about supplier integration still refer. Also, Burt & Soukup (1984) are referred as the first ones to suggest using the purchasing function to leverage suppliers' potential in their own expertise areas. Benefits were proved by Clark (1989) when he stated that Japanese manufacturers got some of their competitive advantage from cooperation with their suppliers. Many of these are referred in the most of the popular papers about supplier integration that have given a significant contribution to the field. Even though there is a lot of literature around the subject, which of a couple tried to find the key factors to success, e.g. Ragatz et al. (1997), McGinnis & Vallopra (1999), Wynstra et al. (2001), and Yeniyurt et al. (2014), not all papers agree with each other on all the aspects. Consequently, the theory of supplier integration has not been summarized as Barczak & Kahn (2012) have done to cross-functional NPD teams.

This thesis made a figure of intangible key factors of supplier integration, covering most of them. It does not include those factors that some of the papers disagreed, like supply base rationalization. Also, structural issues like IT systems were not covered. Different levels are combined in the figure which is only one of the reasons why it is not water proof. The figure does not conclude the whole theory but it is a good starting package for the people who are trying to learn supplier integration. Same kind of clearly illustrative figure was not found in the literature of the subject.

Conducted research was a single case study which did not really contribute anything to the academic circles. Still, two findings could awake some discussion: supplier integration may require some organizational rearrangements, and doing deeper supplier integration may fail if the supplier owns the intellectual property. However, those are just hypothesizes that cannot be proved by this thesis. Organizational rearrangements are partly covered by current literature since interface between purchasing and engineering has been found as a key factor to success.

6.3 Limitations and critical review

This research summarized the theory of supplier integration into one figure and gave improvement suggestions for the case company through a survey/interview. However, summarizing theory and conducting research had many assumptions, generalizations and a number of limitations which are discussed below.

Summarizing theory required going through more than a hundred papers. Some of them did not agree with each other but only one opinion of certain issues was taken into the thesis. Basically, there is a lot of information that was not covered which can lead into loopholes in the theory part with non-linear approach. Putting the theory into one figure is not a simple task since the concept can be divided into levels that have their own specifications. Also, many factors from the theory are bound to certain industry areas. Only some of the researches were so wide that they can be thought as general researches. However, the whole concept is related to automotive industry which has its own characteristics. Transferring this into another industry might lead to wrong conclusions. Some of the researches were from certain parts of the world that can bring cultural aspects to the theory part. Combining these researches did not include any examination of in which part of the world the research was conducted. Furthermore, literature speaks of supplier integration and supplier involvement which does not always mean the same.

According to Wadembere (2012), qualitative research is best conducted with combination of data collection tools. This research included a survey and an interview which together gave a good possibility to find the interesting phenomenon in the setting. However, every research is exploring or observing a phenomenon which is why there can be problems with the quality of the research (Wadembere 2012). The research was re-

viewed through four qualitative validity criteria from Trochim (2006): credibility, transferability, dependability and confirmability.

Credibility of the research should be in order since multiple interviews were conducted and participants had a possibility to argument their opinions. Many citations were used to bring out the different opinions. Participants are the only ones who really understand the situation which is why their opinions were appreciated. However, researcher in this case was working in one of the relevant functions that might have formed subjective prejudices before conducting the research. Second opinion interpreting the data would have eliminated this problem but it was not used.

Research cannot be transferred to another setting without modifications. Questions were thought after an understanding of the case company. However, questions were quite general around the subject and the research can be used in another setting if the researcher knows the setting. After a wider interview with one or two persons from another company to understand the setting, this research could be transferred to it. However, if the industry area, organizational structure or the size of the company is differing too much transferring this might not bring out essential findings.

Dependability aspect of the research is the most critical one. The research was custom made for the case company's state of the time and all aspects were not considered or introduced in the research. Subject included many factors, such as organization structure, management, methods, key factors, industrial area and processes affecting to the research, all of which were not introduced. Consequently, all possible phenomena could not be recognized but the research concentrated on the setting to find improvement suggestions regarding to the theoretical framework.

Confirming the results is feasible. Most of the findings came straight from the theory and, due to the many sources cited, there should not be a totally differing view. Findings from the results can be seen in many graphs created and opinions gathered which give support to each other. They could be critically defied if another research would be made from engineering perspective concentrating only to design cooperation.

Drawing conclusions from the results included a lot of assumptions. Most of the questions touched the theory but were not exactly on it. Thus, some of the conclusions may be composed with too little support from the results. Also, cultural aspects, that may explain some of the low grades, was not taken into the discussion and neither was the translations. Interviews were done in Finnish but the thesis is in English.

6.4 Future research

Research literature of the subject mostly concentrates on customer's side. The whole concept has been under study for almost thirty years but nobody has been able to put it together like Barczak & Kahn (2012) did to cross-functional teams. Many papers are focusing on how to involve suppliers in NPD, how to get innovations from suppliers, and how to get knowledge from the suppliers. In order to do create a summarized theory out of supplier integration, a more research is needed approaching the subject from the supplier's perspective. After that, creating summarized theory about the concept could be possible.

Other issue would be to study which kind of organizational structure supports supplier integration the best. There are many researches about the subject but the most of them does not consider that companies have different kind of organizational structures. How a company can know who should lead design cooperation and supplier integration if their organizational structure does not favor it? Because of this, next Master Thesis in the case company should find out what kind of organizational structure would be the most beneficial for the company. Establishing strict process discipline is a big step where new organizational structure could clear the way from change resistance.

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APPENDICES

APPENDIX 1: Survey & interview frame

Closed questions
Answer to the following questions on scale 1-7: 1 = not at all… …7 = very much

1. How much do different departments collaborate in the company?
2. According to your knowledge, how much design cooperation with the suppliers there is in the company?
3. How much case company's suppliers have done initiative design improvements?
4. How much do you know about company's important suppliers that are related to your work in overall (turnover, location, personnel, product portfolio etc.)?
5. How much should the suppliers of strategic and critical items be involved in company's design process?
6. How much there is cross-functional design in the company?
7. How much do company's purchasers know about the parts they are buying (technology, requirements, materials, etc.)?
8. How much do you think that designers know about the cost factors of their designs?

Answer to the following questions on scale 1-7: 1 = very bad… …4 = OK… …7 = excellent

9. How would you evaluate purchasing department's ability to bring a supplier into company's new product development process?
10. How would you evaluate purchasing department's resources (time, personnel) to bring a supplier into company's new product development process?

11. How would you evaluate engineering department's capabilities to do design collaboration with a supplier?
12. How would you evaluate engineering department's resources (time, personnel) to do design collaboration with a supplier?

13. How would you evaluate purchasing department's motivation to do collaboration with engineering?
14. How would you evaluate engineering department's motivation to do collaboration with purchasing?

15. How good is the new product development process of the company?

Other closed questions:

16. In design cooperation with a supplier, who should have the responsibility for the success of the design? 1 = Buyer… …4 = 50/50… …7 = Supplier

17. In design cooperation with a supplier, which department internally should have the responsibility for the success of the design? 1 = Purchaser… …4 = 50/50… …7 = Designer

18. According to your knowledge, what are the design core competencies of the company? Evaluate design abilities in different functional groups as following:

    1 = very little know-how, suppliers help necessary
    2 = a little know-how
    3 = good know-how
    4 = very good know-how
    5 = excellent know-how

    a. Cylinder block
    b. Crank train
    c. Gear train
    d. Cylinder heads
    e. Valve train
    f. Cooling and lubrication
    g. Fuel system
    h. Engine Electronics
    i. Turbocharger
    j. Accessories (pulleys, belts, starter, charger)
    k. Customer specific parts (oil sump, flywheel housing, flywheel, intake manifold)
    l. EGR components

19. According to business theories, there is always a power relation between the buyer and the supplier. Do you feel that power is usually on our case company's side or on supplier's side? 1 = Case company… …4 = 50/50… …7 = Supplier

20. In which design phase you think each department should step into the design process for the first time? Alternatives (design phases):

    1. Definition of design requirements
    2. Concept creation
    3. Initial design
    4. Actual design
    5. Complementary design
    6. Finishing design
    7. Prototype phase

    a. Departments
    b. Design
    c. Purchasing

d. Quality
e. Production
f. Sales
g. Logistics
h. Financial
i. Member(s) of executive committee

21. Choose the most suitable answer: Company's supplier selection criteria mainly consist of:
    a. Completely operative issues such as current price
    b. Mainly operative issues and requirements in near future
    c. Balanced mix of operative issues and long term requirements
    d. Mainly strategic issues, such as supplier's technological know-how, technology road-map, future perspective and investments
    e. Completely on strategic issues

22. If the supplier is taken into the new product development process, what do you think will happen to the price of the purchased product?
    a. Decreases a lot
    b. Decreases a little
    c. Stays the same
    d. Increases a little
    e. Increases a lot

23. If the supplier is taken into the new product development process, what do you think will happen to the quality of the purchased product?
    a. Improves a lot
    b. Improves a little
    c. Stays the same
    d. Decreases a little
    e. Decreases a lot

24. If the supplier is taken into the new product development process, what do you think will happen to the design project lead time?
    a. Shortens a lot
    b. Shortens a little
    c. Stays the same
    d. Lengthens a little
    e. Lengthens a lot

25. How much do you know about purchasing department's strategies?
    a. I did not even know that they have strategies
    b. I know only that strategies exist
    c. I know some, but not even closely everything

d. I know a lot but not all details
e. Practically, I know everything about them

26. In which design phase you think that supplier should be involved in the new product development process for the first time?
    a. Definition of design requirements
    b. Concept creation
    c. Initial design
    d. Actual design
    e. Complementary design
    f. Finishing design
    g. Prototype phase

Open questions

27. What does the case company want from the supplier when doing design cooperation with it? How accurately it should be told to the supplier?
28. Who/what department should take the role of leadership of the whole concept when cooperating with the supplier? Why? Which department is responsible of deadlines?
29. What do you consider as responsibilities/role/tasks for the purchasing department when establishing design cooperation with a supplier?
30. How should the communication happen between the case company and the supplier? Who is doing and what?
31. Do you feel that the case company is tied to its old suppliers and they are exploiting the situation? Where can it be seen?
32. Do you think that requirements for designs of new products are clearly defined?
33. Should purchasing and engineering hold meetings on certain time intervals?

To the designers:

34. How well do you know the engineers of our suppliers?