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**SUPPLIER SEGMENTATION AND DEVELOPMENT IN PROJECT  
BUSINESS**

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## **ABSTRACT**

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The purpose of this study was to expand the applicability of supplier segmentation and development approaches to the project-driven construction industry. These practices are less exploited and not well documented in this operational environment compared to the process-centric manufacturing industry. At first, portfolio models to supply base segmentation and various supplier development efforts were investigated in literature review. A step-wise framework was structured for the empirical research. The empirical study employed multiple research methods in three case studies in a large Finnish construction company. The first study categorized the construction item classes into the purchasing portfolio and positioned suppliers to the power matrix by investigating buyer-supplier relations. Using statistical tests, the study also identified factors that affect suppliers' performance. The final case study identified improvement areas of the interface between a main contractor and one of its largest suppliers. The final results indicate that only by assessing the supply base in a holistic manner and the power circumstances in it, buyers comprehend how to best establish appropriate supplier development strategies in the project environment.

## TIIVISTELMÄ

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Tutkimuksen tavoitteena oli laajentaa toimittajien segmentoimisen ja kehittämisen lähestymistapoja rakennusalan projektiluonteiseen liiketoimintaan. Tässä toimintaympäristössä kyseiset tekniikat ovat vähemmän hyödynnettyjä ja dokumentoituja verrattuna prosessikeskeiseen tehdasteollisuuteen. Aluksi kirjallisuuskatsauksessa tutkittiin erilaisia portfoliomalleja toimittajakannan segmentoimiseen sekä pyrkimyksiä toimittajien kehittämiseen. Löydösten perusteella luotiin vaiheittainen viitekehys empiiristä tutkimusta varten. Empiirinen tutkimus yhdisti useita metodeja kolmessa case-tutkimuksessa, jotka sijoituivat suureen suomalaiseen rakennusyhtiöön. Ensimmäiseksi rakennusnimikeluokat kategorisoitiin hankintojen portfoliomalliin sekä toimittajat sijoitettiin valtasuhdematriisiin ostaja-toimittaja suhteita tutkimalla. Tilastollisten testien avulla myös tunnistettiin millä tekijöillä on vaikutusta toimittajien suoriutumiskykyyn. Viimeinen tutkimus tunnisti kehityskohteita pääurakoitsijan ja sen merkittävän toimittajan rajapinnassa. Tutkimus osoittaa, että ainoastaan arvioimalla toimittajakantaa kokonaisvaltaisesti sekä sen valta-asetelmia, voivat ostajat ymmärtää miten parhaiten laatia tarkoituksenmukaisia toimittajien kehittämisstrategioita projektiluonteisessa liiketoiminnassa.

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## 1 INTRODUCTION

To prosper in a fast-paced environment, many large organizations are placing more reliance on their suppliers as they themselves try to focus on criteria like innovations, sustainability and efficiency in the heightened market volatility. As a consequence, firms require capabilities outside their own and need to be outsourced from suppliers. In the construction industry, studies have shown that up to 75-90 % of the new project's turnover is spent on buying goods or services from suppliers (e.g. Dubois & Gadde, 2000; Karim et al., 2006). Therefore, it is vital to ensure that suppliers are capable to meet the buying needs for demand. By investing in supplier relations a buying company can improve its competitiveness (Li et al., 2012; Sánchez-Rodríguez et al., 2005). As a result, many firms have started to engage supplier in development programs as a mean of improving their suppliers' capabilities and overall performance (e.g. Arroyo-Lopez et al., 2012; Modi & Mabert, 2007). However, by tradition these studies have concerned and benefited the manufacturing industry, ignoring other types of industries such as construction, which operates in a geographically dispersed project-centric environment.

Thus, projects are of great significance in many modern companies. Construction is a very good example of a project-centric environment against process-centric environment (Fearne & Fowler, 2006). These modern organizations represent a special category of organizations, and therefore require alternative courses of action in order to succeed (Cox & Ireland, 2002). Furthermore, construction is surely the least integrated of all the industrial sectors characterized by adversarial and disjointed relationships between the parties involved (Fearne & Fowler, 2006). No wonder that numerous researchers are claiming that the industry suffers from poor supply chain performance (e.g. Karim et al., 2006; Löngrenn et al., 2010). As a cure, concepts such as integrated supply chain management (e.g. Love et al., 2004) and Lean approaches (e.g. Arbulu et al., 2003) are suggested as best practices within the construction industry. Nonetheless, one must acknowledge that demand and supply circumstances vary significantly in the construction industry making most of these

approaches difficult to implement and sustain (Cox, 2004; Bankvall et al., 2010; Ireland, 2004). Notwithstanding, this study claims that large customers in this industry should at least investigate with which suppliers it would make sense to establish more collaborative relationships and possibly exploit supplier development activities. Accordingly, some stress that buyers need to regularly monitor and measure strategic suppliers' performance and provide this information to the suppliers (Talluri & Sarkis, 2002). Regrettably, studies from the construction industry have failed to discuss the process of supplier evaluation that enables supplier growth (Eom et al., 2008). Therefore, more research is required of the conditions under which collaborative relationships between suppliers and contractors can be formed (Bemelmans et al., 2012). Notably for organizations with big and complex supply bases a vital question is which suppliers to involve in a supplier development program. Given this, the buying organizations should categorize the supplier base as well as understand the suitable methods for achieving the benefits of development initiatives (Dyer et al., 1998). In particular, supplier base segmentation is needed for the buyer to determine the future state of supplier relationships (Day et al., 2010).

This thesis explores supplier segmentation and development practices as a part of strategic purchasing by examining the concepts from a theoretical and empirical perspective. Based on a case study, the thesis strives to initiate the supplier development work in the purchasing organization in which the researcher has worked within supplier management team for a while. Based on the findings, this study aims to suggest ways to improve suppliers' management and their development in project-based industries. As it becomes clear, largely the focus is in the construction industry, having the contractor-supplier relationship at the center of an attention. After the topic is set up, the objectives and limitations are presented. Afterwards, the methodology and primary sources of information are introduced. Finally, the study construction is announced.

## **1.1 Supply chain issues in the construction industry**

The importance of the construction industry within developing economies cannot be underestimated. In Finland, for example, the industry currently contributes approximately 7 % to GDP (Statistics Finland, 2007). Considering the importance of the sector, it is surprising that research on innovation and management has overlooked this and preferred the manufacturing industry (Gann & Salter, 2000). It is clear that construction industry is totally different from other industries due to exclusive products, momentary organization and site production (Segerstedt & Olofsson, 2010). In addition to the peculiarities, it is often emphasized that construction industry suffers from poor performance (e.g. Love et al. 2004). Attempts copied from other industries such as partnering with suppliers (Bresnen & Marshall, 2000; Gadde & Dubois, 2010) and lean construction (e.g. Eriksson, 2010) have tried to fix the fundamental problems. Despite this, many industry initiatives targeting to improve supplier performance have often failed (Cox & Ireland, 2002; Cox et al. 2006). This implies that the proper ways for managing the construction supply chains have not been understood.

The ruthless project-based nature of construction serves to highlight the problems faced by larger contractors in this sector. The main contractors that manage the construction project mostly perform only a small percentage of the project by their own staff and production. For instance, in Finland approximately only one-third of the construction workers in a specific site are employed by the main contractors, when the rest belong to subcontractors' payroll (RT, 2014). This large number of suppliers within the fragmented supplier market increases the difficulties for the principal contractors (Cox & Ireland, 2002; Briscoe & Dainty, 2005). The main contractor has to acquire, coordinate and manage a myriad of supply chains: professional services, materials, equipment and labour (Cox & Ireland, 2002). Furthermore, tasks are performed in a project environment, characterized with high levels of uncertainty and complexity (Fearner & Fowler, 2006). Therefore, the demand for work stays

temporary in which the parties may have low incentives to commit in long-term supply relations. In conclusion, the variety and reliance on external chains sets strains on buyers in terms of procurement and supplier management and reduces the potential for process integration (Briscoe & Dainty, 2005).

## **1.2 Procurement in construction companies**

Notably in large organizations centralizing the purchasing function has been on top of the agenda for the last decades. In the construction industry, however, the purchasing management remains an under-researched field (Cox & Ireland, 2002). Still, it is emphasized that more fully developed supply chain management is possible in this sector (e.g. Lönngren et al., 2010). One must acknowledge, however, that construction supply chains have a tendency to possess waste and inefficiencies which cannot be fully removed. Regrettably, even with the greatest input to a single project, the main contractors don't have the opportunity manage all the chains within a single project effectively (Holti et al., 2000).

The tendency and desire to maximize profits in every project has reflected to supplier procurement in price-based transactional interactions. Studies show that these short-term transactional practices are the most utilized supplier procurement methods in head contractor firms (Pala et al., 2014). By employing this, the buyers have reckoned themselves that it is the surest way to reach the lowest price (Cox & Thompson, 1997). However, the main contractors may choose between multitudes of procurement routes and exploit different levels of involvement to different chains (Bildsten, 2014). Therefore, some large organizations nowadays have a framework agreement with their pre-qualified suppliers for specified periods of time. These agreements introduce themselves as project collaboration relationships (where the buyer may decide to work collaboratively based on past transactions) or they have been established for strategic purposes (Gadde & Dubois, 2010). As a result, the

identified supply chains within a building project come with three types; temporary, framework-specific and strategic (Bankval et al., 2010).

Evidence from companies' annual reports show that large contractors in Nordic countries are trying to reach cost efficiency by centralizing their procurement routines. Lower cost-base is endeavored by coordinating the procurement activities across business units (NCC, 2013; Skanska, 2013) and by concentrating on larger purchasing volumes (YIT, 2013; NCC, 2013). Other methods include renegotiating agreements with suppliers and subcontractors and increasing the volumes in international purchasing (Peab, 2013; NCC, 2013). Additionally, major contractors are aiming to work more closely with important suppliers to re-design their mutual business processes (Peab, 2013; NCC, 2013). Annual reports reveal also that currently the focus has been in establishing long-term agreements, which in turn, provides the opportunity to develop activities and processes in the long run (Lemminkäinen, 2013; YIT, 2013). Furthermore, it seems that procurement plays one of the key methods in promoting sustainable and responsible business (YIT, 2013, 29, 18; Peab, 2013; Skanska, 2013; NCC, 2013). All in all, it seems that purchasing is placed in the heart of the contractors' business models through which the players seek competitive advantage against their competitors.

It appears that procurement is understood as a method for continuous cost reductions within the construction companies. Secondly, the companies are using purchasing as a leverage function to influence the relationship with suppliers. However, it is not observed from the strategy documents that Category Management approach would be introduced as a tool for managing company purchases. Only a little empirical evidence from the use of purchasing categories or portfolios linked to construction industry was found from the literature (see Ferreira et al., 2014; Bildsten, 2014). After all, category management technique has professionalized the procurement role for two decades and formed the fundamental basis for procurement activities in many industries (Smith, 2013). Although category management has recently been the Holy

Grail in procurement thinking, there are authors that emphasize the importance of supplier management for the next years to come (e.g. Smith, 2013; Bartolini, 2014).

### **1.3 Supplier relationships in the construction industry**

Seeing that managing the business on a project basis has led the construction industry and companies involved emphasizing short-term profit sharing, and thus, making long-term success hard to realize (Ingirige & Sexton, 2006). Thereby, it is no wonder that relationships in construction are often featured as adversarial and arm's length. By adopting this strategy, buyers have been able to convince themselves that they can take advantage of the "market forces" (Dubois & Gadde, 2000, p. 213). On the other hand, dissatisfaction towards impermanent relationships has led others to gain value through collaborative relationships. In particular, the focus has been in the client-contractor relationship, putting aside the relationships that the contractor has with its downstream suppliers and subcontractors (Bemelmans et al., 2011). Furthermore, it is generally considered that long-term relationships lead to better results (e.g. Humpreys et al., 2003). This is somewhat strange since the chain below executes the majority of the work. Luckily, Eom et al. (2008) provided a frame of reference for more effective subcontractor management and relationship development. Additionally, Kamann et al. (2006) surveyed through a large sample size how expected future interplay and shared past collaboration effect in contractor-subcontractor relationships. Contrary to expectations, the results found no confirmation supporting shared past on supplier performance. Moreover, that expected shared future showed to have only marginal effects on the probability of interferences in the future.

However, close collaboration is not required from all supplier relationships. Bildsten (2014) stresses that limited resources shouldn't be targeted on relationships that can be loose. From the study it was found that buyer-supplier relationships in the construction industry exist between two dimensions: level of interaction and length of

the relationship. For example, standardized products such as insulations can be acquired in large collective batches without much interaction even on long-term basis. In other words, some relationships can be long-term and involve large volumes of business, but are low-involvement in nature (Dyer et al., 1998.) In turn, the execution of special purchases can be an onerous job of infrequently carrying out one-time purchases. It seems that each firm needs to analyze the products and services that they purchase and be aware of the appropriate relationship management techniques available for their organization. The generic portfolio model of Kraljic (1983) can be used as analysis tool for visualizing suitable sourcing strategies.

Previous insights indicate that the construction industry has not found the cure for its poor performance and illnesses within the supply chain. Many believe that suggested concepts and theoretical models are not appropriate for the industry, or the industry players are not capable to implement the practices (Bankvall et al., 2010). Perhaps, we are trying to employ techniques that are not striking against more powerful suppliers. Smaller suppliers, on the other hand, might not yield the head contractors requirements. They might assume that they don't necessarily win the bid race for the next project. Furthermore, those that are taking responsibility of the purchasing might be located too far from the actual building site. There might constitute a gap between expressed intentions at the corporate level and actual behavior at the construction site (Bresnen & Marshall, 2000).

### **1.1 Moving towards proactive approaches**

Dubois & Gadde (2000) argue that the lack of continuity in between parties in the construction industry is the main reason for the industry's failure to increase efficiency and innovation. It is because long-term relationships enable secure supply and decentralized decision making, and therefore, generate value creation (Bildsten 2014). When procurement is proactive, close cooperation is pursued with the most important suppliers (Baily et al., 2005). These observations demonstrate towards the

importance of supplier development, that is, another important aspect of buyer-supplier relationship management (Bemelmans et al., 2012). Proactive purchasing aims to influence changes in advance and guide them in the desired direction by segmenting purchases on a strategic level and increase cooperation inside the buying organization (Iloranta & Pajunen-Muhonen, 2012). Taking advantage of supplier development will require more proactive approach to procurement (Cox, 2004). Hence, exploiting proactive buying requires cutting loose from reactive buying and seeing proactive buying as a strategic function that can bring advantage and value to the business (Baily et al., 2005). On the other hand, as we see later, supplier development practices might just as well consider reactive measures to correct existing deficiencies in suppliers' performance and without considerable investments from the buyer (Wagner, 2006a).

Yet other conditions for supplier development, beyond the specific research on the exact topic, can be assumed to exist for its implementation. Considering the construction industry, the most obvious may be power (Ireland, 2004). The typical setting of larger buyer-smaller supplier may not exist in the construction industry since the industry is highly fragmented (Cox & Thompson, 1997). Therefore, initiatives to develop a larger, more powerful supplier may be just be a waste of resources. Therefore, firms must first segment the external spend for determining who has the power in the supplier relationships so that an initial supplier development strategy can be applied (Cox & Ireland, 2002). For this purpose, the purchasing portfolio matrix (originally developed by Kraljic 1983) has been a very helpful for positioning commodities in different segments (Gelderman & van Weele, 2003). On the other hand, it seems that supplier segmentation, from a purchasing perspective, still appears to be in the early stages of providing strategic suggestive for companies (Day et al., 2010).

## 1.2 Objectives and research questions

Due to the identified research gap, the main objective of this study is to expand the applicability of supplier segmentation and development approaches to the project-driven construction industry. This study seeks to shed light on the development practices, processes and critical elements in order to witness supplier performance improvements. Moreover, the objective is to investigate empirically the circumstances where supplier development is both desirable and feasible considering the industry characteristics. The feasibility of supplier development in the project-environment is investigated through a comprehensive literature review from which the key points are condensed and described in a process-orientated approach designed to assist large buyers in their supplier segmentation and development endeavors. Accordingly, this work, through an extensive literature review, combined with empirical case studies, aims to: (1) identify the appropriate suppliers for supplier development purposes, and (2) to suggest ways to better manage and develop suppliers. The primary objective of this research is extracted in the main research question. The sub-questions defined here provide the understanding of the research phenomenon required to answer the primary question. The main research question is formulated as follows:

*How to establish supplier development so that the performance and capabilities of suppliers in the construction project business could be improved?*

The main research question stems from research gap which was earlier discovered. Approaches to improve supplier performance have not taken root in the project-based environment, while the manufacturing industry has taken the advantage of supplier development for decades. This research gap was identified by Frödell & Josephson (2008) who themselves utilized value stream analysis when developing the contractors' largest supplier. To the researcher's knowledge, no other study has ever tried first to segment and assess the supply base before structuring development initiatives. This is somewhat surprising as the first mentioned is often considered as

the precondition for determining which suppliers to include in supplier development (e.g. Rezaei & Ort, 2012; Cox, 2004; Cox & Ireland, 2002). Since it is not feasible to develop all under-performing suppliers, or strategic partners, one must first segment the external resources in order to find out which suppliers should be awarded additional relationship management resources. Therefore, this study will specify supplier segmentation issues from a theoretical perspective and exploit an applicable method using a case study. Due to the comprehensive nature of the first research question, three sub-research questions were formulated for support:

*RQ 1) How to segment the many types of suppliers involved into distinctive groups taking into account various industry and supplier characteristics?*

Moreover, when striving to improve suppliers' performance, we must investigate the factors that have effect on various performance metrics. Traditionally, studies have failed to discuss the process of evaluation that enables supplier growth in the construction industry (Eom. et al. 2008). This thesis aims to invalidate this argument by analyzing the relationship between various relationship and supplier related characteristics factors to suppliers' performance in terms of quality, safety and time discipline. Therefore the second sub-question was formulated as follows:

*RQ 2) What factors affect suppliers' performance?*

Additionally, an essential part of this thesis is to consider the effort and resources required from major contractor companies to enhance supplier performance. Many argue that supplier development involves considerable investments in time and effort (Cox, 2004). On the other hand, there exists a large variety of initiatives that can be exploited when improving suppliers' performance. They start from low involvement activities such as supplier evaluation to more resource demanding activities such as training suppliers and joint product development (Sanchez-Rodriguez et al., 2005; Wagner & Krause, 2009). Although reactive supplier development may bring quick

fixes in deficient supplier performance, this thesis argues that competitive advantage through supplier development can be grasped only through persistent and continuous supplier collaboration which cannot be achieved by means of a single study. Therefore, the final sub-question is:

*RQ 3) How the suggested and exploited supplier segmentation and development approaches can be further utilized in the case company, and can it be used to enhance the overall supplier management process?*

To fulfill the objective of this thesis and answer the research questions, an extensive literature review and three empirical sub-studies are conducted. The next chapter focuses more specifically on the research scope by introducing the theoretical key concepts and main limitations.

### **1.3 Research framework and key concepts**

Notably, this study concerns the construction industry as an example of a project-based industry and how large buyers in this sector should make the most out of their supply bases. Following a larger research gap, this thesis is limited to consider the dyadic relationships between the contractor and its suppliers and not to dwell on contractor-client relationships. The terms supplier covers subcontractors, material suppliers and service suppliers. The research framework therefore illustrates the fundamental supplier management issues for organizations within this scope (see Figure 1).

Three constructs in this thesis, are seen as the important building blocks of supplier management; supplier segmentation, evaluation and their development. Thus, using multiple criteria, buyers first select the most suitable suppliers, either to fulfill the needs of a single project, or a series of projects. Afterwards, large organizations need supplier segmentation and evaluation to adopt strategies to cope with each segment,

from which supplier development presents a viable alternative. The theoretical findings are drawn from the academic literature but evaluated in a case environment. Next, the main themes covered in this research are defined to give the reader an insight to the key concepts of the study.

**Supplier management** aims at managing the relationship with suppliers over time and is defined as the communication, evaluation and other relationship building efforts involving suppliers (Anderson et al., 1998). After suppliers have been selected, organizations with large supply bases need supplier segmentation to determine how the various suppliers should then be managed. In this thesis, **supplier segmentation** is seen as a process in which suppliers are divided into distinct crowds with different strategic importance for the buyer, including various power attributes and levels of performance, so that appropriate relationship management strategies can be developed.

As implied, supplier performance may represent one segmentation criteria for buyers. Additionally, supplier evaluation activities act as the prerequisite and catalyst for more systematic supplier development. **Supplier evaluation** is defined as a process of evaluating and monitoring supplier performance and suppliers' business practices for the purposes of reducing costs, mitigating risks and driving continuous improvement (Gordon, 2008). Supplier segmentation and eventually evaluation results to the selection of candidates for **supplier development**, which is defined as any effort of a buying firm with its suppliers to improve their performance and/or capabilities in order to meet the buyer's needs (Krause & Ellram, 1997).

This study will undertake the concept of supplier development to consider the buyer's current supply base. Therefore, this thesis is limited to discuss the 'broader perspective' towards supplier development where activities are targeted towards the existing suppliers (Hahn et al. 1990). Alternatively, supplier development initiatives may consider the 'narrow perspective' where the buyer strives to create new purchasing sources (Hahn et al., 1990). The foregoing implies that the process of

selecting suppliers has been omitted from the study. Selecting the best possible suppliers for the organization is undoubtedly the most fundamental role for the procurement organization, and well addressed in the literature (Rezaei & Ortt, 2012, 4598). Additionally, one possible outcome of managing the suppliers, the supplier phase-out process in a supply chain discomfort situation, is omitted from the study. This process involves activities to prevent the return of an unwanted supplier after supplier development process has failed or was not possible to implement in the first place.

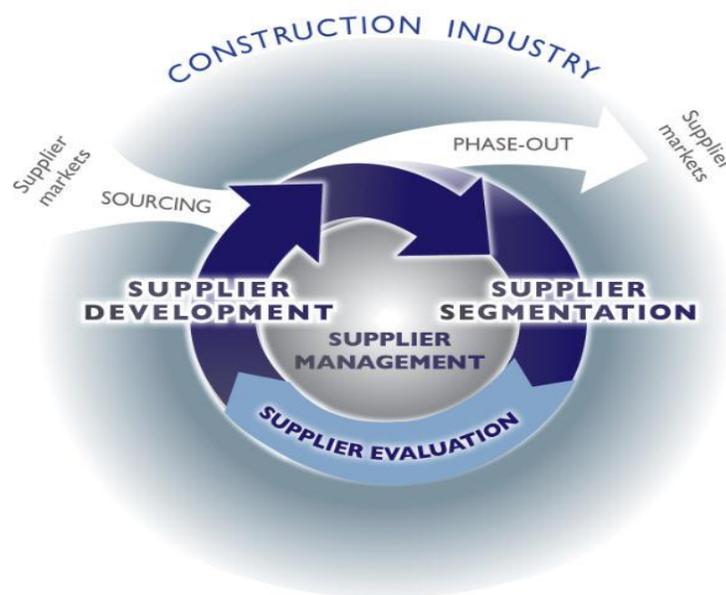


Figure 1. Theoretical framework of the research

#### 1.4 Research methodology

“Methodology is basically how you are going to go about your research” (Lee & Lings, 2008, p. 12). This research is explanatory in nature and consequently employs both qualitative and quantitative research approaches. Qualitative research aims to produce new knowledge about how things work in real-life business context and is particularly relevant when earlier insights about a phenomenon under examination are modest (Eriksson & Kovalainen, 2008). In addition to an extensive literature

review, the research design for this study involves empirical studies in a major construction company that are specified in the next chapter. As individual sources of evidence are not recommended for conducting case studies (Yin, 2009), the researcher has included secondary quantitative data and analyzes to support the main qualitative approach of this study.

In the next two chapters, the literature reviewed. The purpose of the theoretical part is to break down various supplier segmentation approaches and development initiatives with the focus on the buyer to improve supplier performance. The concentration is directed towards academic literature about strategic purchasing in various industries thinking about their applicability to the project-based construction industry. Since supplier segmentation results in very few relevant citations (Day et al., 2010), studies regarding supplier classification and categorization are being reviewed. Despite this, the study will not settle merely on Kraljic's (1983) concept on categorizing suppliers, and instead it will investigate subsequent research and case studies for segmenting suppliers. What comes to supplier development, the strategy is to examine various initiatives ranging from low-involvement activities to high-involvement activities combined to the critical elements for successful supplier development. The review of the literature is summarized in Chapter 4, for a conceptual model which is developed based on the main findings.

Next, the empirical section includes separate sub-studies in a large Finnish construction company. Summarized in Table 1, multiple sources of evidence are all triangulating on the same set of research questions (Yin, 2009). Triangulation improves thoroughness and validity, and most importantly, leads to better understanding of the phenomena under examination (Wagner, 2006a). Purchasing statistics and semi-structured interviews constituted the primary data collection method. The researcher is employed within the purchasing department of the contractor which enabled to include participative observations as well. Employment also enabled to gain access to groups that are otherwise inaccessible to a study (Yin,

2009). In addition, formal and informal discussions with personnel mainly from the case organization's purchasing department have been a useful source of information.

Purchasing statistics constituted the primary data for the item and supplier segmentation phase described in Table 2. Since quite of few attributes in supplier segmentation are qualitative (Ferreira et al., 2014), questionnaires were utilized to obtain qualitative data into a numeric form. The respondent - the district purchasing manager, was asked to give values on the effort required from the purchasing department when acquiring purchased items. The respondent was also asked about the number of alternative suppliers when analyzing the power and leverage circumstances between the contractor and its suppliers. Keeping in mind that "supplier segmentation...is not rocket science" (Gordon 2008, p. 43) and the scope of this thesis incorporating many different themes, this phase was kept unambiguous and without quantitative or quantifiable data on a set of factors. Moreover, supplier-specific data from the organization's internal analytics procurement tool and project-specific purchasing system were taken advantage of. Furthermore, suppliers' turnovers and credit information were received from an external service provider. Excel was utilized to a great extent for data extraction and for combining the external and internal supplier information.

Researcher's longer employment further enabled to gain data from a longer period of time (see Table 1). For instance, 67 structured interviews to evaluate the performance of suppliers, lasting from 30 minutes to 90 minutes, were obtained. Together with electronically received evaluations, the sample size reached over 1300 individual supplier evaluations. Therefore, statistical tests were exploited for quantifying data and for making generalized deductions. Relationships among variables were investigated using regression analysis, whereas ANOVA was used to detect the differences between different segments of suppliers.

In the supplier development initiative case, studied in chapter 6., four in-depth interviews were conducted, in addition to the participatory observations and purchasing statistics. These semi-structured interviews were mainly driven by the interviewee, which enabled to gain rich and in-depth answers that reflect deeply the respondents own experiences (Lee & Lings, 2008). This was considered important as the aim was to truly understand the interface between the supplier and the contractor. The results of these interviews were visualized using Value Stream Analysis approach and Service Blueprinting technique. The objective in utilizing different methods and multiple sources of evidence is to give depth into this exploratory study and enhance validity.

Table 1. Summary of data collection and methods in the empirical research

<b>Main type of method</b>	<b>Sub-study</b>	<b>Details</b>
<b>Purchasing statistics and questionnaires</b> <i>(Excel to structure data, Pareto analysis)</i>	<b>Supplier segmentation</b>	(1) Purchasing statistics from the company's internal analytics procurement tool, (2) two questionnaires to obtain district purchasing manager's knowledge about purchased item categories and suppliers, (3) supplier information (turnovers, credit ratings) from external service provider
<b>Structured interviews and electrical supplier feedbacks</b> <i>(Statistical software MINITAB to analyze data)</i>	<b>Supplier evaluation</b>	(1) 67 interviews; 40-90 minutes per interview, conducted between 2013-2014; interviewees: site managers and foremen, (2) electrical supplier feedbacks from the project-specific procurement system
<b>Semi-structured interviews</b> <i>(data structured using Service Blueprinting technique)</i>	<b>Supplier development</b>	(1) 4 interviews; 60-75 minutes per interview; interviewees: 2 project managers, customer guide, interior design manager, procurement person, (2) purchasing statistics, (3) participatory observations

## 1.5 Construction of the study

This chapter specifies the study construction, and more specifically, the three major empirical sub-studies (see Figure 2). Chapter 1 introduces the underlying motives for study, research questions, theoretical key concepts, data collection and research methods. Chapter 2 and 3 demonstrates comprehensive theoretical perspectives to the study concepts: supplier segmentation and development. By reviewing the evidence of various approaches to supplier categorization as well as the activities and critical factors in supplier performance improvements, the purpose is to give push to the outlined empirical studies. Chapter 4 summarizes key concepts from the literature review by providing a process orientated model for supplier development. Chapters 5-

7 examine the key concepts through empirical case studies by utilizing the outline of the constructed process orientated model. In the first study (Chapter 5), the case company's supply base in one business region is assessed in order to gain understanding where supplier development initiatives would yield the greatest benefit. Further, the second sub-study (Chapter 6) examines the factors explaining suppliers' performance as well as differences between distinct groups of suppliers. The final sub-study (Chapter 7) strives to initiate the supplier development work at the case company by identifying suggesting improvement areas to the interface between the buyer and its major supplier providing kitchen cabinets. Finally, chapter 8 summarizes this thesis by presenting the main findings and suggesting further research avenues. Next, the research design of the three empirical case studies is presented in more detail.

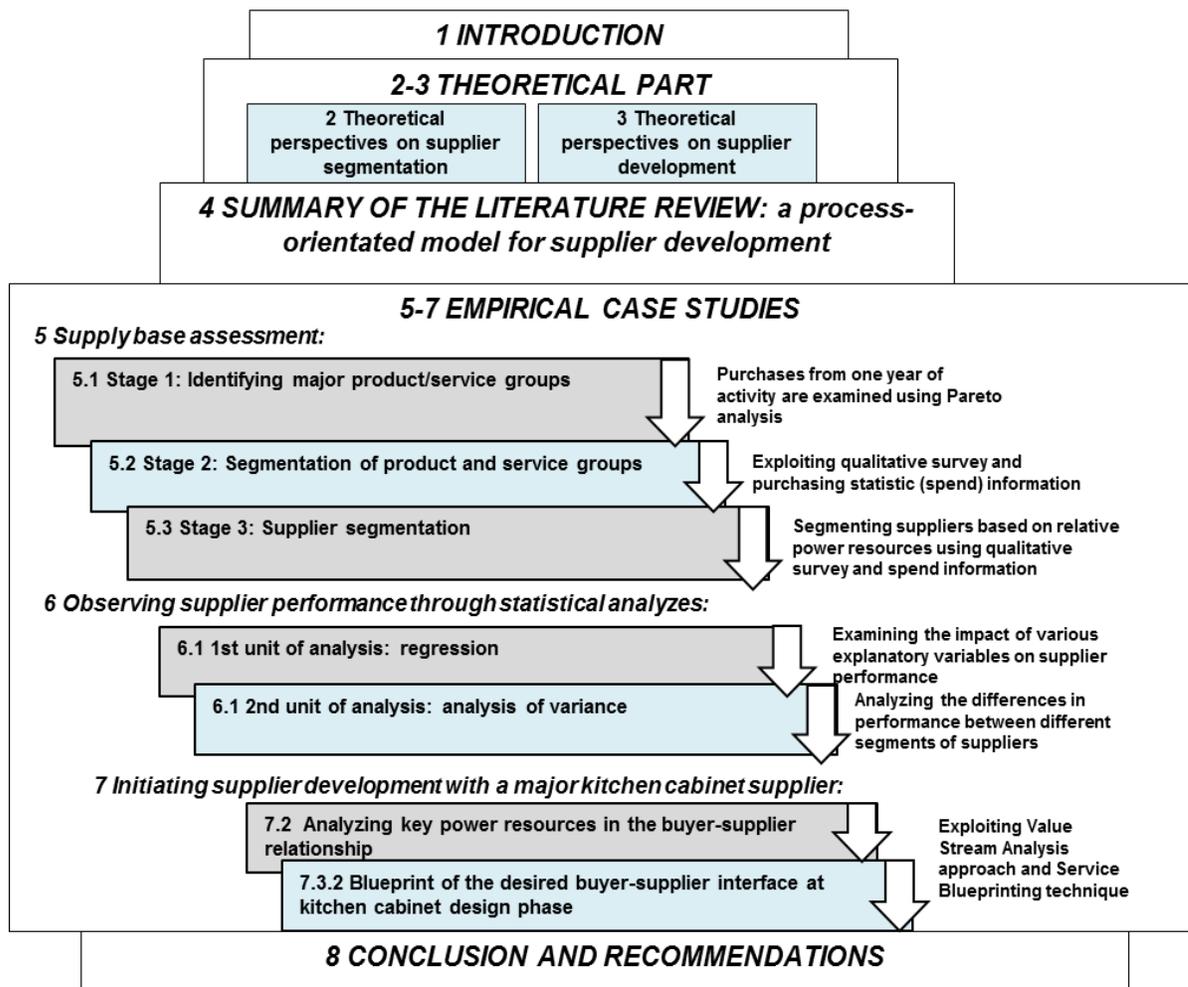


Figure 2. Construction of the study

The empirical study involved three major sub-studies in a large construction company operating in Finland. These study initiatives have a main objective to support the change towards a more structured approach of the definition of supplier development strategies in the company. The first sub-study concentrated around one business unit, residential housing in Southern Finland. This follows the notion by Ferreira et al. (2014) who emphasized that construction item classification should be done locally, not on a company level. Therefore, in step 1, the relative importance of the construction commodities and services purchased by the business unit are assessed by reviewing all purchasing data from one year (2013) period. The company's

analytics procurement and spend follow-up tool bundled the purchases into sub and main categories, although the categorization required data validation to a larger extent. Thereupon, using Pareto analysis, 42 sub-categories were identified as important based on the profit impact.

In the next phase, the identified sub-categories were segmented based on the impact on business and the effort required from the purchasing department when acquiring these items. In this thesis segmentation is conducted using “One-by-One” method (Gelderman & van Weele, 2003, p. 210), meaning that one key variable is selected per dimension. This will give insight of the most important purchased categories that require the most resources and time in order to fulfil the needs of demand. The profit impacts are comprised from the spend analysis and the second dimension is comprised by interviewing the particular district’s procurement manager. The respondent was asked to evaluate the sub-categories using values 1-4. 1 was marked as small effort, such as hardware store purchase acquired using a procurement system, whereas 4 was marked as very large effort required. An example of this would be a project-specific specialized concrete element solution.

Afterwards, major suppliers were placed in the buyer-supplier power matrix, after Cox et al. (2003). Here, it was focused on segmenting the construction related suppliers forming 80 % of the aggregated spend. Moreover, the previously categorized major sub-categories were linked to the specific suppliers. This supplier-level segmentation gave a comprehensive understanding of the power and leverage situations within the business unit’s supply chains, and therefore, gave insight on feasible supplier development strategies to the company. Number of alternative suppliers and buyer’s relative share of a total market for supplier during one year of activity were the key attributes in the power matrix estimates. Using spend analysis and district manager’s expertise, it was able to do an estimation of the surrogate suppliers for each of the suppliers forming 80 % of the aggregated spend. Hence, together with relative volume of the business to the supplier, the suppliers were placed in the quadrants of

*buyer dominance, supplier dominance, interdependence or independence* (Cox et al., 2003). In order to investigate the appropriate development strategies, it was also analyzed the segmented suppliers' performance in terms of safety, quality and compliance with agreed timetables.

In the second sub-study, supplier performance was analyzed using statistical tests; regression and analysis of variance. Using simple and multiple regression analyzes, the sub-study strived to rationalize supplier performance by investigating the impact of various explanatory factors to output performance factors; quality, safety and compliance with agreed timetables. Various  $x$  predictors (such as spend and suppliers' attitude towards safety) were used in the regression model.

In the second unit of analysis, it was analyzed the performance differences between distinct segments of suppliers by exploiting ANOVA models, and similarly, t-tests. The null hypothesis here was that our different groups of suppliers' means do not differ statistically from each other. The null hypotheses were strived to invalidate by arguing that various *power circumstances, distinct procurement methods and frequency of the exchange* do have significant influence in all of the performance indicators. Other constructs under analysis are suppliers' classification and their type (material/subcontractor).

All statistical tests of this research are performed using MINITAB statistical software. The data to the analysis were results of the 67 structured interviews where the respondents - mainly site managers - were asked to evaluate supplier's performance. The objective of these supplier feedbacks was to evaluate the suppliers' performance based on other criteria than price. Together with electronically received evaluations, our sample size accumulated to over 1300 individual evaluations from over 400 suppliers, which increased the reliability of the analysis.

In the final empirical sub-study, it was strived to find improvement areas in the interface between the case company and its major supplier providing kitchen cabinets. First it is presented managerially relevant issues in the current kitchen cabinet procurement as well as continued the power and leverage discussion by analyzing the performance management choices available for the buyer. Based on four in-depth interviews and participatory observations, this study presents an improved way of working for the kitchen cabinet design process. The data will be structured and visualized using Value Stream Management approach.

## 2 THEORETICAL PERSPECTIVES ON SUPPLIER SEGMENTATION

Suppliers contribute to a large part of buying firm's value creation in most industries, thus making supplier management an essential strategic purchasing issue (Dubois & Pedersen, 2002). Even the best supplier management processes won't be successful if organizations fail to identify suppliers with the highest value (Bartolini, 2014). With respect to strategic supplier management, Dyer et al. (1998, p. 59) recommend that firms should avoid a "one-size-fits-all" strategy and praise segmentation. Thus, it is vital to analyze the supply base before taking any actions towards strategic supplier management decisions. According to Day et al. (2010) segmenting the supply base should be the prerequisite for strategic decision-making and determining the future direction where the relationships with suppliers should evolve. They defined supplier segmentation in a comprehensive manner (Day et al. 2010, p. 626):

*"A process that involves dividing suppliers into distinct groups with different needs, characteristics or behavior, requiring different types of inter-firm relationship structures in order to realize value from exchange."*

This chapter emphasizes supplier segmentations as an essential part of strategic purchasing. Supplier segmentation provides an instrument for evaluating the supplier base and to structure information. In this thesis, it is regarded as an eye-opener for a number of supplier development initiatives that are reviewed in the next chapter. Next, various purchasing portfolio approaches are introduced. The method plays the most popular approach for the categorization of suppliers. Further, general critique and weaknesses of the approach are considered. The objective of this chapter is to identify the most appropriate ways to segment suppliers keeping in mind the empirical study.

## 2.1 Categorizing suppliers: purchasing portfolio models

Portfolio matrices are the most popular approach to categorize suppliers since Kraljic (1983) first presented a four box matrix based on profit impact and supply risk. In his seminal paper, Kraljic (1983) emphasized the role of purchasing as a success factor for the company and adopted the concepts of purchasing portfolios. This segmentation approach, with its emphasis on managing suppliers differently given particular circumstances, is very much utilized by consulting firms (Cox, 2004). Many scholars have further developed the concept of purchasing portfolios and suggested their own matrices (e.g. Olsen & Ellram, 1997; Bensaou, 1999). The suggested matrices employ to a larger extent the same dimensions and suggestions as the predominant work of Kraljic (Caniëls & Gelderman, 2007).

Although the portfolio approach has taken the buzzword role in recent decades, it has primarily been used in manufacturing industries (e.g. Nellore & Söderquist, 2000; Pagell et al., 2010). Its usage in project-driven industries, such as the construction industry, remains scarce. When categorizing different purchased items in construction, it is necessary to consider the project-based nature of the industry (Cox & Thompson, 1997). Only two recent studies were identified that expand the scope of application of purchasing portfolio model (PPM) to the construction industry. Ferreira et al. (2014) adapted and implemented PPM to a large Portuguese multinational construction company employing the analytical hierarchy process (AHP) for criteria prioritization. Bildsten (2014) performed an adaptation of the Kraljic model to the context of industrialized house building in Sweden. The study was conducted by studying purchasing strategies through data collection at four industrialized house builders.

In order to identify a variety of buyer-supplier relationships and purchased items requiring different kinds of title-specific purchasing strategies, Kraljic (1983) presented a 2x2 matrix based in two dimensions: the profit impact (cost) and risk (supply

complexity). Purchased items are placed to the two dimensions and divided into four categories: leverage, strategic, bottleneck and finally non-critical items (see Table 1). Each of the four categories require a distinctive approach towards supplier management, providing recommendations either to exploit power (Olsen & Ellram 1997) or to avoid resulting from the supplier's existing power (Dubois & Pedersen, 2002). Therefore, Kraljic (1983) focuses on the prevailing power balances between the buyer-supplier relationships. One would think this approach to be well suited in the construction industry, since buyers might be submissive against more powerful suppliers. However, it will be revealed that Kraljic (1983) does not explicitly deal with concepts of power and dependence (Caniëls & Gelderman, 2007).

## **2.2 Alternative perspectives on purchasing portfolio models**

It is clear to see from table 2 that after Kraljic's model was constituted, newer models have emerged where the cost is not considered to be the most important decision affecting the procurement decision. For instance, the total cost of ownership (TCO) philosophy aims to believe that considering the total life-cycle of a purchased item, more expensive items may become more profitable after all (Ellram, 1995). Also, establishing closer relationships with suppliers may bring both parties lower costs (Humpreys et al., 2003). This is aligned with the perception that the process of evaluating bids from numerous suppliers increases transaction costs. Furthermore, whereas Kraljic's (1982) model considers close relationships as risky, some believe believe that resources that are based outside organizations boundaries contribute to value creation of the focal firm (Dubois & Pedersen, 2002). Hence, many of the subsequent models concentrate on analyzing supplier relationships instead of company's purchased products. A common feature in many models is that they introduce action plans to supplier management in order to match the various categories (Table 2).

Table 2. A summary of approaches to supplier segmentation

Author(s) and year	Constructed dimensions	Segments	Methodology used	Action plans
Kraljic (1983)	Importance of purchasing (y) axis Complexity of supply market (x) axis	<i>Materials:</i> Non-critical items Leverage items Bottleneck items Strategic items	Conceptual	Exploit Balance Diversify
Olsen & Ellram (1997)	Difficulty of managing the purchase situation (x) Strategic importance of purchase (y)	<i>Purchases:</i> Non-critical items Bottleneck items Leverage items Strategic items	Conceptual	Strengthen the relationship / Improve the supplier attractiveness OR the performance of the relationship / Reduce the resources allocated to the relationship
Dyer et al. (1998)	Arm's length versus partner suppliers (x) General characteristics; relation-specific assets, information-sharing, trust/contracts (y)	<i>Relationships:</i> Durable arm's length; Strategic partnerships	Empirical	
Bensaou (1999)	Supplier's specific investments (x) Buyer's specific investments (y)	<i>Relationships</i> Market exchange Captive buyer Captive supplier Strategic partnership	Empirical	Design management profiles for each of the contextual profiles
Gelderman & van Weele (2003)	Profit impact (y) Supply risk (x)	<i>Purchased items:</i> Non-critical items Leverage items Bottleneck items Strategic items	Empirical	Pursue efficient processing/Pooling of requirements/Exploit buying power/ Develop strategic partnership / Reduce dependence and risk/Accept the dependence Terminate partnership/Accept the locked-in "partnership"
Cox et al. (2004)	Buyer power relative to supplier (y) Supplier power relative to buyer (x)	<i>Power and leverage circumstance:</i> Buyer dominance Interdependence Independence Supplier dominance <i>Supplier type</i>	Conceptual	Select the appropriate relationship management style and appropriate sourcing procedure to match the current power circumstance
Rezaei & Ort (2012)	Suppliers' willingness (y) Suppliers' capabilities (x)	SM1 (low capabilities, low willingness) SM2 (low capabilities, high willingness) SM3 (high capabilities, low willingness) SM4 (high willingness, high capabilities)	Empirical	Determine and implement the suitable strategy to manage each segment and the suitable strategy to develop the supplier relationship
Bildsten et al. (2014)	Length of the buyer-supplier relationship (y) Closeness of the buyer-supplier relationship (x)	<i>Items:</i> Non-project specific Specialized solutions Supplementary Project-specific	Empirical	

Based on the above, Bildsten (2014) investigated buyer-supplier relationships in industrialized building and how they bring value in production. In the model, *closeness of the buyer-supplier relationship* (close/loose) is on one axis and *length of the buyer-supplier relationship* (short-term/long-term) is on the other. It appears that by the categorizing suppliers, the most cost-effective approaches can be captured, since the classification provides solutions on how to handle each supplier relationship in the most efficient way. This is encouraged by Wagner & Johnson (2004) who concluded that strategic supplier portfolio management contributes to competitive advantage by optimizing inevitably limited resources. Likewise, Bensaou (1999) argues that various product-, market- and supplier-conditions require portfolio management approaches and the supply chain failure is the “result of a mismatched relational design or a poorly managed appropriate design” (Bensaou, 1999, p. 37).

More recently, Rezaei & Ortt (2012) developed a new approach to supplier segmentation by defining *supplier potential* as the buyer’s perception of supplier’s capabilities and willingness. Their approach reveals the most potential suppliers for supplier development and management. The advantage of the model is that firms can select the criteria for capabilities and willingness consistent with their business objectives. From the perspective of a construction firm, the criteria for supplier’s willingness, such as communication openness (Smeltzer, 1997) may be hard to measure due to the prevailing practices of short-term contractual agreements. Alternatively, just by analyzing the relationship closeness may indicate the extent to which the partners are willing to work closely.

### **2.3 Implications on supplier management**

Eventually, segmenting the supply base should provide a solid basis for supplier relationship assessment and development. Zolkiewski & Turnbull (2002) reasoned that purchasing portfolio provide a key input to successful supplier relationship management because it enables manager to develop, manage and optimize supplier

relationships in the most effective way. In the construction industry fragmented supply structure has led to market-exchange supplier relationships (Fearne & Fowler, 2006), even though buyers consistently procure their suppliers in various construction projects over time (Bemelmans et. al, 2011). Appropriate approach for construction companies should be relying on different terms of involvement (Gadde & Dubois, 2010). As follows, Junnonen & Kankainen (2012) developed purchasing portfolio approach for construction companies to use. They themselves utilized similar dimensions as Olsen & Ellram (1997) by concentrating on the effort required from the purchasing department and the impact on business. The matrix in Figure 1 describes the specific corporate level purchases as well as the suitable supplier management strategies for these items.

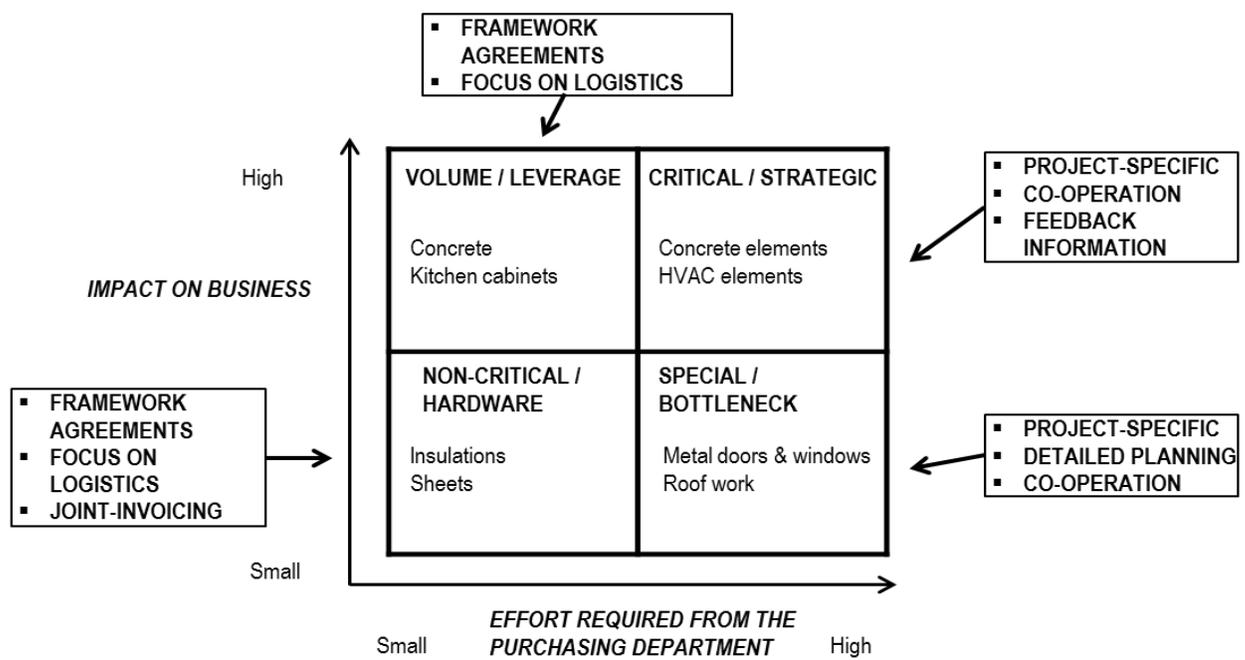


Figure 3. Portfolio analysis of corporate level purchases in the construction industry and suitable supplier management strategies (adapted from Junnonen & Kankainen, 2012, p. 16-17)

***Non-critical / Hardware products – non-project specific items***

The lower left quadrant consists of non-critical goods, which are usually minor in monetary terms, but often lead to other related expenses. These items are standardized; they require a little interaction in a loose relationship, and therefore, should be managed with functional efficiency (Bildsten 2014). When managing these purchases, the supplier and the buyer should come up with a solution for billing the purchases in large collective batches, thus making the routines faster and minimizing expenses (Junnonen & Kankainen 2012). Obviously, as the supply is often abundant, buyers' shouldn't invest plenty of resources in the relationship. In the case of incompetent supplier, supplier switching should be implemented quite easily.

***Volume purchases / Leverage items – non-project specific items***

Volume purchases are big in monetary terms but require limited interaction, and therefore, this can be considered a loose buyer-supplier relationship. Since the buyer has a lot of possibilities, getting the lowest cost is vital Olsen & Ellram (1997). Luckily, these non-project-specific items can be purchased across several projects and in large volume (Bildsten 2014). Buyers may take advantage of centralized tendering and favor framework agreements (Junnonen & Kankainen, 2012). Ollsen & Ellram (1997) state that with this category, it is important to identify particular value added and the goal should be communicating the requirements for the future; a good reciprocal relationship should be established. They further conclude that buyers should consider reinforcing the supplier relationship without allocating considerable resources to the relationship. Pagell et al. (2010) found out that in sustainable supply management, leading companies treated suppliers of this type as if they were strategic suppliers and helped them to improve their performance.

***Critical items / strategic solutions – project-specific items***

These purchases account for the vast majority of the project's total spend, whereas the efforts required from the purchasing department is high. Keeping in mind the result of a specific project, it is essential to concentrate on delivery precision and

reliability (Junnonen & Kankainen, 2012). Therefore, firms should manage these purchases by establishing close relationships with the suppliers, focusing on two-way communication and possibly joint development of products and services (Olsen & Ellram 1997). Since the suppliers in this category are often local (Junnonen & Kankainen 2012), establishing strategic partnerships might be difficult. Furthermore, the level of mutual dependence between parties might determine the type of buyer-supplier relationship in this category (Gelderman & van Weele, 2003).

***Special purchases / Bottleneck items – project-specific items***

Since fulfilling of special purchases is an onerous job of infrequently carrying out one-time purchases, Junnonen & Kankainen (2012) suggest the traditional project-specific partnering approach for these purchases. However, Gadde & Dubois (2010) claim that the benefits that depart from this traditional approach could gain even better conditions if the interaction would extent in time, moving towards a strategic approach. Olsen & Ellram (1997) stress that when purchase situation is difficult to manage, it is very important to strengthen the relationship in order to keep a loyal customer.

**2.4 Criticism of Portfolio Models**

Despite the growing acceptance and usage, purchasing portfolio models have gained a severe level of criticism. Some argue that business decisions that are complex in nature cannot be established on simple recommendations (Gelderman & van Weele 2005, 19). According to Dubois & Pedersen (2002) one cannot reason strategies from portfolio approach that is based on just two dimensions. In reality, some important relationships cannot be placed in the four quadrants at first glance. As a result Gelderman & van Weele (2003) found evidence that experienced portfolio users always include additional information to the analysis. The information includes 1) the overall business strategy, 2) the specific situations on supply markets and 3) the capacities and behavior of individual suppliers.

### 2.4.1 The problem of measuring

Since the current literature is rife with alternative portfolio models, firms may find it difficult to agree upon the suitable approach for their organization. Although they may pick out the most appropriate dimensions, the theory does not provide directives for measurement, which makes the selection of variables difficult to obtain (Gelderman & van Weele 2003). Therefore, Nellore & Söderquist (2000) stress that the variables used in portfolio analysis might not be accurate measures of the selected dimensions. Further, assigning weights to each of the factors is a difficult task, which makes this part of the implementation process very subjective (Olsen & Ellram, 1997).

How do purchasing professionals then apply the dimensions of the matrix to their own supplier base? Through a case study, Gelderman & van Weele (2003) identified three measurement approaches regarding purchasing portfolio analyses. The simplest detected is the “one-by-one” method where only one key variable is applied per dimension. For example, when the financial value of items is introduced as *profit impact* and the number of suppliers in the market as *supply risk* the matrix can be get together without much effort. Further, the *consensus method* is basically based on common understanding, which is achieved through reasoning and discussing. Last, weighted score methods enable to include a number of factors for each dimension. Holding this strategy, Ferreira et al. (2014) tackled the measurement problem by employing analytical hierarchy process technique (AHP) for criteria prioritization and direct measurement for criterion rating when developing a purchasing strategy for a construction company. To pinpoint the items in the KPM, they used multidimensional scaling. In their case study, only one item category was placed in the strategic category; concrete. Despite this, they considered the original KPM matrix as a valuable tool since it allows placing procurement at a strategic level and enhances the development of construction contractors’ supply base.

### **2.4.2 The absence of innovation and sustainable supply management**

The portfolio models that analyze products instead of relationships are limited to consider only “given” products. According to Dubois & Pedersen (2002) this might seem problematic since the resources associated with developing and producing the products are not included in the analysis. They stress that simple purchasing models may discourage innovativeness, and the overall productivity. In a similar vein, van Weele & Rozemeijer (1996) announce that companies which settle in product-based strategies instead of developing competence-based network strategies will fail in the competitive environment. Thus, considering the construction, the potential for engineering innovativeness is conspicuous by its absence. Nellore & Söderquist (2000) further discuss the importance of defining the specification required for a given item. They stress that portfolio models are too superficial, since they don't take into account the linkage between engineering, purchasing and the suppliers (Nellore & Söderquist). They concluded that the specification process should be included in the current models, and thus, which would help in improving buyer-supplier relationships.

The study of Pagell et al. (2010) revealed that the exploitation of purchasing portfolios won't either adequately explain or predict the behavior observed with respect to sustainable sourcing. Through a sample of 10 organizations, it was found out that some leading companies were treating their suppliers as if they were strategic suppliers by helping them to improve their sustainable supply management. Based on the Kraljic's portfolio approach, these suppliers would normally have been classified as leverage. Already Gelderman & van Weele (2003) stressed that the Kraljic framework does not provide guidelines for moving commodities and/or suppliers around the different categories. They themselves identified that purchasing professionals practice employ additional portfolio strategies. For instance, as Pagell et al. (2010) found out, buyers might develop leverage suppliers to the strategic category when the supplier has proper capabilities.

## **2.5 Power and dependence: determining the strategies feasible**

Depending on the type of buyer-supplier relationship, the proportions of power and dependency vary. It is argued that power and dependence underpin the development of the purchasing strategies for the buyer (Caniëls & Gelderman 2007). Furthermore, in order to find an appropriate strategy, Cox et al. (2006) emphasize that buyers in the construction industry must analyze the power and leverage situations in supply chains. Although improvement initiatives may benefit all companies involved, Cox (2004) argues that in the end all parties concentrate on their own advantages and goals. Although the empirical evidence on power and dependence in buyer-supplier relationships remains scarce, Maloni & Benton (2000) identified that power imbalances can be used as an instrument to foster supply chain integration and to give rise to premium levels of performance. Given this, it can be considered that the analysis of power circumstances in buyer-supplier relations should be an essential part of supplier segmentation. Furthermore, Cox et al. (2006) highlight that under some power and leverage circumstances supplier development simply is not feasible. That's why it is important to examine what are the relationships in which supplier performance and capabilities could be improved.

Unfortunately, the Kraljic's portfolio approach (1983) is too superficial to capture how the concepts of power and dependence influence the choice for a specific purchasing strategy. The study of Caniëls & Gelderman (2007) proved that there is a significant difference in the power positions between the purchasing strategies within each quadrant. By looking at Dutch purchasing professionals using a survey method, the results indicated that buyers were dominant in the leverage quadrant and balanced power prevailed in the bottleneck quadrant. In contrast, suppliers were observed to be dominant in the strategic quadrant – the field where one would presume the existence of balanced power. The results indicated the suppliers actually dominating the strategic partnerships.

In order to comprehend the distribution of dominance in the buyer-supplier relationship, one must conduct a *power regime analysis* (Cox et al., 2003). This combination of power and leverage dimensions allows four possible power combinations (see Figure 4). Since supplier's profit impact is one of the main attributes of supplier power, correspondingly the buyer's dominance increases side by side with the total market for the supplier (Cox et al., 2004). Further, the effort required in the purchasing situation tends to correlate with the uniqueness of the supplier's offering, weakening the buyer's position. Given this, it is concluded that the two approaches can be put together into one matrix (Figure 4).

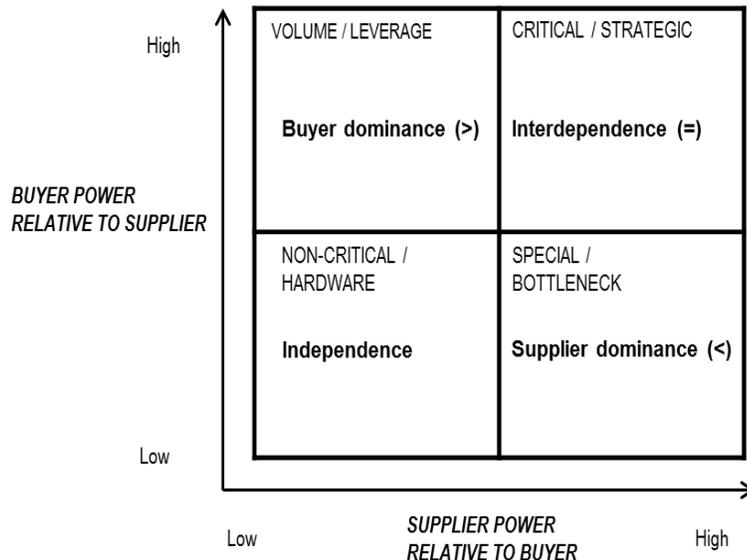


Figure 4. Merging the buyer-supplier power after Cox et al. (2003, p. 54) to portfolio analysis of corporate level purchases

**Interdependence** exists when both the buyer and the supplier have relatively high and reciprocal power resources towards each other. Often there are only few available players on both sides, and the supplier is strongly dependent on the buyer. It is also assumed that for both parties the switching costs are high, items provided by the supplier are one-of-a-kind and there is a little information symmetry. This

circumstance is likely to encourage collaborative ways of working and enabling proactive sourcing procedures. (Cox, 2004; Cox et al., 2006)

**Buyer dominance** is prevalent if the market holds fewer buyers than suppliers. The buyers spend constitutes a large part of the supplier's revenue. Suppliers in this category mainly offer standardized items, which makes supplier switching easy for the buyer. The buyer stays attractive to the supplier, while on the other hand, the dominant buyer may expect its suppliers to accept either market-testing or collaborative ways of working, in which most of the value from the exchange is passed to the buyer. (Cox, 2004; Cox et al., 2006)

Conversely, **supplier dominance** is conquered when a variety of buyers are procuring from a small number of suppliers. The dependency in the previous situation is reversed; the buyer needs the unique item or service, whereas the supplier has many alternatives to cash in. The supplier will expect the buyer to accept either an arm's length or highly collaborative relationship, in which most of the value from the co-operation is captured by the supplier. (Cox, 2004; Cox et al., 2006)

Finally, the situation of **independence** exists, when both supply and demand is abundant. Therefore, neither of the parties are dependent on each other, nor are the switching costs considerable. In this situation, an arm's length reactive approach is likely to be sensible for both parties to adopt. However, since neither party can exploit power against the other, a reasonable reciprocal adversarial approach may be adopted. Here, buyer may benefit more from this circumstance, since supplier performance improvements are prone to competition. (Cox, 2004; Cox et al., 2006)

It is not sufficient to state that buyers are always dominant in the leverage category or suppliers are in the bottleneck category (Caniëls & Gelderman, 2007). Firms must analyze the power regimes on a relationship level. According to Ireland (2004) key power resources in the relationship can be analyzed with three different variables.

The first one is the relative volume of the business to the supplier. Generally, construction projects are in high value and each one of them contributes for the long-term success of the parties involved. The second power resource involves the frequency of the exchange. One-off approach prevents effective sourcing for the buyer, whereas regular volumes make partnering and lean management approaches more feasible. The last factor that impacts the buyers and suppliers is the variety of corresponding relationships outside the specific relationship. In other words, this refers to the number of alternative suppliers providing similar products or services. Ireland (2004) adds that the complexity of the product and service offering is another element that regulates the level of relative power.

The aforementioned demonstrates that there appears to be a correlation between power circumstances and appropriate sourcing and relationship management styles (Cox, 2004). Cox et al. (2006) stress that managers have to be aware of the four relationship management styles (Table 3) and how they are linked with particular sourcing approach under specific power circumstances in order to optimize the performance first for them. Cox (2004) stresses that supplier development is only effective in situations of buyer dominance (>) and interdependence (=) where exchange partners operate in a collaborative manner. To contend, supplier development might just well be reactive (Krause et al., 1998). In these indirect supplier development activities, the buyer does not become actively involved and may exploit non-coercive leverage instead of joint actions (Wagner, 2010). For example, the study of Frazier & Summers (1984) stress that influence strategies (i.e. indirect supplier development) might be exploited to correct the operations of the supplier company, so that negative consequences are avoidable, and yet result in an improved performance.

Table 3. Appropriateness in supplier development as a sourcing strategy (adapted from Cox, 2004, p. 355)

<b>SOURCING APPROACH</b>	<b>POWER AND LEVERAGE CIRCUMSTANCE</b>	<b>APPROPRIATE RELATIONSHIP MANAGEMENT STYLES</b>
<b>SUPPLIER DEVELOPMENT</b>	<b>BUYER DOMINANCE (&gt;)</b>	Buyer Adversarial Collaboration/Supplier Adversarial Collaboration
	<b>INDEPENDENCE (0)</b>	Not applicable
	<b>INTERDEPENDENCE (=)</b>	Buyer and Supplier Non-Adversarial Collaboration
	<b>SUPPLIER DOMINANCE (&lt;)</b>	Buyer Non-Adversarial Collaboration/Supplier Adversarial Collaboration

### 3 THEORETICAL PERSPECTIVES ON SUPPLIER DEVELOPMENT

The increased reliance on suppliers fosters the need for buyers to manage effectively their supplier base and to ensure their performance in terms of cost, quality, delivery and technology. Buyers that confront deficiencies in supplier's performance or capabilities may: (1) switch the to a more capable supplier (2) bring back the item in-question in-house or (3) support the supplier in enhancing its performance and capabilities (Handfield, 2000; Macduffie & Helper, 1997). Supplier development is becoming ever more important since alternative suppliers might not be available or the switching costs could be high (Wagner, 2006a). Secondly, all the benefits associated with the current supplier relationship is lost if the supplier is switched (Macduffie & Helper, 1997).

A vertical integration is also costly and might be against the company's strategy to focus on their core-competencies (Wagner, 2006b). Hence, buyers use various supplier development practices to improve supplier performance requiring different levels of buyer involvement and implementation complexity (Sanchez-Rodriguez et al., 2005). Supplier development is expected to have positive and intensifying impact on buyer-supplier relationship (Prahinski & Benton, 2004; Krause & Ellram, 1997). This is greatly needed in the construction industry, where construction companies are recommended to increase communication with downstream suppliers to develop better working relationships (Proverbs & Holt, 2000; Bemelmans et al., 2012). Simply put, supplier development focuses on identifying areas for improvement and targeting performance improvements at suppliers. Krause & Ellram (1997, p. 21) provide more robust definition of supplier development:

*Supplier development is seen as "any effort of a buying firm with its supplier(s) to increase the performance and/or capabilities of the supplier and meet the buying firm's short- and/or long-term supply needs."*

They also identified critical elements in supplier development, which are among others: two-way multifunctional communication, greater percentage of the suppliers' annual sales and cross-functional teams. In addition, (Modi & Mabert, 2007) place the attention towards the importance of supplier evaluation efforts. They emphasize that these efforts are the most important development initiatives before any direct involvement initiatives can be undertaken. In a similar vein, Eom et al. (2008) stress that the development of continuous subcontractor evaluations and feedback processes allows the development of collaborative relationships in the construction industry.

Supplier development will often require a more proactive approach to procurement (Cox, 2004). Hence, firms may initiate supplier development activities in response to a specific problem with the supplier. Supplier's safety or quality problems causing disruptions might lead the buyers to take a reactive approach and ad-hoc measures to eliminate deficient supplier performance (Wagner, 2006b). The desire to seek competitive advantage influences buying firms to manage their suppliers from a strategic perspective, and may be implemented through supplier development program (Krause et al., 1998). Here, supplier development takes a more systematic approach after the firms have analyzed their supply bases. Before buyers engage in this kind of supplier development, they should establish goals it wants to desire in general as well as the measures on how to achieve these objectives (Wagner & Krause, 2009).

In this thesis supplier development is seen as any set of initiatives undertaken by a main contractor with the aim of improving suppliers' performance and/or capabilities. The purpose of this chapter is to explore various supplier development initiatives and analyze their appropriateness for project-business. The critical elements and the strategic process for supplier development are reviewed. Finally, the criteria for achieving better contractor-supplier relationships in the construction industry are considered. The aim of this chapter is to identify appropriate approaches for supplier

development, as well as capture the essential points of it, so that process-orientated model for supplier relationship management can be created.

### **3.1 The importance of supplier development**

The evidence from the positive impact of supplier development initiatives luxuriates when it comes to the manufacturing industry, whilst the empirical evidence from the service or project-based industries is difficult to pursue. For instance, Li et al. (2012) concluded that direct involvement activities significantly contribute to buyer-supplier performance improvement in the electronics manufacturing industry. As well, by examining 306 manufacturing companies, Sanchez-Rodriguez et al. (2005) identified that all levels of supplier development; basic, moderate and advanced are valid instruments for forecasting the buyer's purchasing performance. A more comprehensive sample was considered by the study of Krause (1997) who carried out a survey amongst 527 purchasing executives across a variety of industries. Although the results came out as remarkable, it was stated that observations considering the strategic outcomes could have been more favorable. Nonetheless, the empirical evidence across industries remains inspiring. A summary of empirical evidence from the impact of supplier development is described in table 4.

Table 4. A summary of empirical findings on the impact of supplier development

Author(s) and year	Research method:	Target industry	Development initiatives investigated / utilized	Observed impact / estimated effects
Krause (1997)	Questionnaire survey method amongst 527 purchasing executives	Both manufacture and service	Variety of supplier development activities according to the level of the buying firm's commitment	Among respondent firms: Incoming defects decreased by 50 %, late deliveries decreased by 50 %, incomplete orders decreased by more than 50 %
Sanchez-Rodriguez et al. (2005)	Questionnaire survey amongst 306 purchasing managers	Spanish manufacturing companies	Three levels of supplier development; basic, moderate and advanced	Positive effects on buyer's purchasing performance
Cox et al. (2006)	Case study involving main contractor and a service supplier	Construction	Proactive supplier development strategy	Buyer partially win and supplier partially win outcome
Cox et al. (2006)	Case study involving a housebuilding firm and a specialist materials supplier	Construction	Proactive supplier development strategy	Buyer lose and supplier win outcome
Modi & Mabert (2006)	Questionnaire survey amongst 114 US manufacturing firms	Manufacturing	Indirect development activities and operational knowledge transfer activities	Collaborative communication, training and education programs are positively related to supplier performance
Frödell & Josephson (2008)	Case study involving a major contractor and its largest supplier	Construction	Value Stream Analysis (Service Blue Printing)	Considerable potential for decreasing total cost for the delivery process were identified
Li et al. (2012)	Questionnaire survey method amongst 142 purchasing managers	Electronics manufacturing	Transaction specific supplier development and its determinants	Direct supplier development contributes significantly to supplier performance and the buyer-supplier relationship.

Luckily, some case studies provided by Cox et al. (2006) shed light on proactive supplier development strategies in the construction industry. The first case included a main contractor and its service supplier of specialized cladding solutions where both parties gained a partially win outcome due to the interdependent power situation. In this case the buyer was in a position to persuade the supplier to work within a collaborative relationship management framework. Dedicated project management was created for capability, IT-infrastructure and production processes. As a result, the

buyer achieved lower product costs, although the functional expectations were not exceeded. For the supplier, the level of profit was achieved and it maintained its reputation within the industry. Cox et al. (2006) concluded that the buyer could have found a more ideal outcome if it could have leveraged the supplier to reduce its costs.

The second case introduced by (Cox, 2006) included a specialist house building firm who pursued supplier development strategy where it provided its preferred suppliers a guaranteed revenue stream and relatively high profit levels. Unfortunately in this case, the strategy resulted in a loss the buyer, but a win for the manufacturer-supplier of timber frames. The buyer was let down by its consultants and was forced to allow its supplier to make above normal returns. The case showed that proactive buyers should effectively monitor their preferred suppliers in order to be spared from post contractual behavior.

### **3.2 Supplier development activities**

Practitioners must understand the different avenues to supplier firm improvement as a consequence of supplier development activities (Wagner, 2010). As the term supplier development is defined to include “any set of activities” (Krause et al. 1998, p. 40) “or any effort” (Krause & Ellram, 1997, p. 21) undertaken by the buying firm to improve supplier performance, one must examine more detailed what really are these initiatives. For instance, development activities can be categorized based on the buying firm’s level of participation and implementation complexity (Sanchez-Rodriguez et al., 2005).

*Indirect supplier development* refers to measures where the buying firms are not actively involved in the improvement process (Wagner, 2006b). These activities may range from the evaluation of supplier’s performance (Krause & Wagner, 2009) and further enforcing suppliers to improve and providing incentives such as a promise of increased future business (Krause, 1997). As a result, indirect measures allow the

buyer to recognize what supplier performance variables and/or capabilities need to be improved. Additionally, firms may exploit the use of external market by instigating competitive pressure by employing more than one supplier for a purchased item (Krause, 2000). This is possible only if there are alternative suppliers available in the supply market. Furthermore, the indirect activities become entangled with the influence strategies used in marketing channels. The two main altering perceptions strategies include: 1) *information exchange*, in which the buyer does not request any specific target actions, and 2) *recommendations strategy*, whereby the buyer predicts that supplier will be more profitable if it follows the buyer's suggestions regarding some specific action (Frazier & Summers, 1984).

On the other side of the continuum, *direct supplier development* represents those internalized supplier development strategies where the buyer represents an active role and invests resources to a specific supplier (Krause et al. 2000). Additionally, these activities may include the provision of capital, equipment, technology, or the buyer's personnel to a supplier's facility (Monczka et al., 1993). Krause (1997) identified site visits, supplier certification and award programs as activities where the buying firm actively commits to actively in supplier development. In the case of a deficient supplier, the assistance and knowledge of a capable buyer might play the key measures in improving its strategic processes (Wagner, 2006a). Others stress the critical role of direct development activities for achieving buyer-supplier relationship improvement, supplier performance improvement and even buyer competitive advantage (Li et al. 2012). However, Krause (2000) remind that direct investments may represent a risk for the buying firm since these measures are not transferable if the relationship with the supplier is dissipated. This notion relies upon the transaction cost economics (TCE) (Williamson, 1981). On the other hand, improvement in supplier's capabilities may reduce buying firm's uncertainty in operations, and thereby decrease its transaction costs in the long run (Li et al., 2012). Dyer (1996) found out that transaction costs decreased between a Japanese car manufacturer and its suppliers when parties made large asset specific investments to

develop their operations. He continues by stating that competitive advantage is most likely reached through direct investments when: 1) parties have safeguards which can deter opportunistic behavior; and 2) operations are characterized by a high degree of interdependence.

Hence, it is up to the buyer whether it desires immediate improvement in the supplier's performance or more indirect longer-term benefits. Taken together, there exists a large variety of initiatives that can be deployed to improve suppliers' performance making limited resources represent the only constrain for buyers. Further, as seen from the literature, there exists conflicting studies of various supplier development activities and their impact on performance. For example, many studies argue that direct measures are the most effective means (Li et al., 2012; Krause et al., 2000) or contrarily, suggest that indirect activities have more positive effect on product and delivery performance (Wagner, 2006b), the suppliers' capabilities (Wagner, 2010) as well as the relationship with the supplier (Prahinski & Benton, 2004).

Only little is known about the impact on performance when direct and indirect effects are applied together. On the other hand, the study of Wagner (2010) underlined that firms should engage either in indirect or direct development, but not to take advantage of both at the same time. This is because the combined activities are difficult to measure, making the overall goals expected from the supplier to become ambiguous (Wagner, 2010). The study also concluded that buyers should only try to develop a deficient supplier through direct practices if it strives to aid supplier's long-term capabilities (Wagner, 2010). It can be argued, that since there are a large variety of activities inside the direct and indirect constructs, the impact on performance should be investigated separately. Therefore, to further study practices that require diverse level of firm involvement and resources, Sanchez-Rodriguez et al. (2005) categorized supplier development activities into three sets of practices: basic, moderate and advanced.

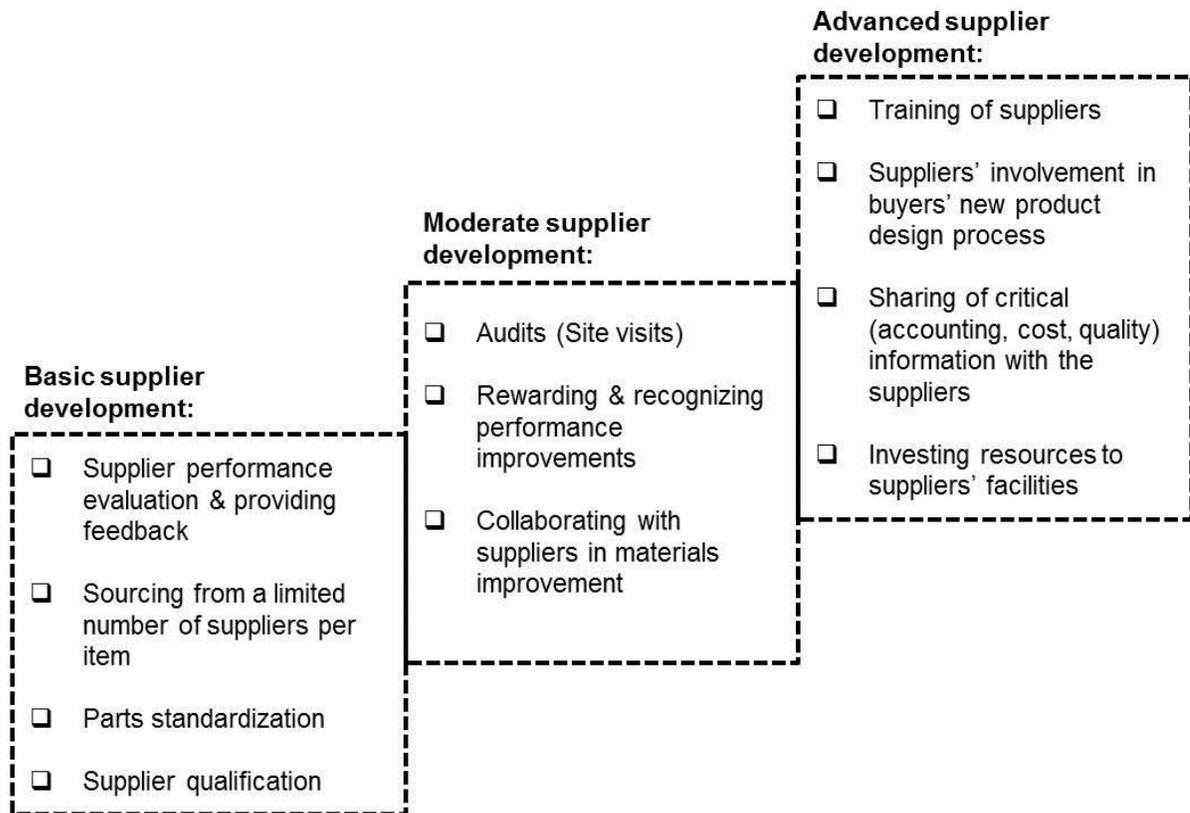


Figure 5. Basic, moderate and advanced supplier development practices (adapted after Sanchez-Rodriguez et al., 2005, p. 290-291)

According to the study, the basic supplier development construct represents the predictive measure for advanced supplier development activities (Sanchez-Rodriguez et al., 2005). The study reveals also that the basic level activities could reduce the overall development time as well as assist in the introduction of more complex development activities. Yet, as standardization of parts and processes is classified rather as strategic supplier development than reactive (Krause et al, 1998), it can be argued whether it really is included in the basic development category. Unlike in the construction industry, in traditional manufacturing parts standardization of semi-manufactured items is often utilized to increase efficiency and lower costs (Segerstedt & Olofsson, 2010). Contrary to expectations, the results of the study indicated that the

basic supplier development practices were identified as having the most supreme impact on purchasing performance (Sanchez-Rodriguez et al., 2005).

The moderate supplier development construct includes activities requiring more company resources in terms of time, personnel and capital such as the provision of incentives and rewards for better performance (Krause, 1997) as well as site visits to assess supplier's facilities. Bemelmans et al. (2011) found out that auditing the supplier before the contract is signed has become quite common practice among the sample of Dutch contractor firms, mostly on ISO certification and other quality demands. These techniques can be helpful for subcontracting firms in adopting quality principles, in case the company didn't have the resources to embrace the modern principles of quality management (Karim et al., 2006). The united actions with suppliers in materials improvement supplement the moderate development construct, as it doesn't require as much involvement as participating supplier in the new product design (Sanchez-Rodriguez et al., 2005). The utilization of these measures could reduce the continuous need for adjustments in a construction project and at the same time increase the efficiency of site operations (Dubois & Gadde, 2000).

The last category pertains to those characterized by the highest level of implementation complexity and buyer involvement with suppliers requiring the greatest use of company resources. Sanchez-Rodriguez et al. (2005) found that firms adopting high levels of moderate supplier development practices tend as well practice advanced initiatives. This category included the already discussed direct measures; involving suppliers to the joint-development of product design process, supplier training and other investments. According to Bemelmans et al. (2012) trainings in construction companies can be mutual and organized in two directions so common improvement programs can be established. Further, the list included intensive sharing of weighty information with the supplier, which in turn, enables a cooperative climate between the parties involved (Sanchez-Rodriguez et al., 2005). According to Bemelmans et al. (2011), the aforesaid is required from contractor companies when

striving to maintain successful relationships with strategic suppliers to fully exploit joint opportunities. Nevertheless, Sanchez-Rodriguez et al. (2005) found out that the effects of advanced development practices on purchasing performance were non-significant, whereas moderate activities seemed to have a positive effect on buyer's purchasing performance only. Although this study was based on a descriptive sample of the manufacturing industry, the results of basic development activities having both positive and significant impact on purchasing performance lead to further examine the importance of supplier evaluation as a basic supplier development practice.

### **3.3 The importance of supplier evaluation**

Developing suppliers doesn't always require considerable investments. Embodying basic supplier development, supplier evaluations can be used as a means to improve suppliers' short-term performance as well as long-term capabilities (Wagner & Krause, 2009). Hence, organizations who evaluate their supply base, not only have better transparency into supplier performance, but in addition expose hidden cost drivers and risks. They also realize how to best leverage their supply base and organize practices in relation with the suppliers (Gordon, 2006). Moreover, supplier evaluations and feedback discloses that the suppliers are aware of their performance as well as the level of expected performance level from the buyer (Modi & Mabert, 2007). Therefore, supplier evaluation may act as a means to strengthen the buyer-supplier relationship as well as supplier's commitment to the buying firm (Prahinski & Benton, 2004).

Supplier evaluation approaches may include extracting information from buyer's current systems, supplier self-assessments questionnaires, internal company surveys, third-party information supplier scorecards and even supplier audits (Gordon, 2008). Supplier audits represent basically a more in-depth assessment of the supplier's performance in which case it is also suitable for the supplier evaluation and feedback construct (Wagner & Krause, 2009). According to Park et al. (2010)

supplier evaluation may include the evaluation of supplier's performance, capability and ability to collaborate. They developed a framework in which supplier evaluation is integrated into the entity of supplier relationship assessment that also includes the initial material evaluation in the form of a matrix. Thereby, the main conclusion is that supplier evaluation starts out after the item categorization but is preceded by the establishment of supplier development action plans (Park et. al., 2010).

Modi & Mabert (2007) and Prahinski & Benton (2004) emphasize the importance of inter-organizational communication in their studies from the manufacturing industry. The study of Modi & Mabert (2007) made evident that supplier evaluation efforts are one of the important prerequisites before taking more elaborate development activities, such as supplier training. Prahinski & Benton (2004) addressed the power of feedback on organizational performance for the first time. The results showed that when a buying firm utilizes collaborative communication, it is perceived by the supplier as an effective mean to improve the buyer-supplier relationship. The main conclusion of the study was that the evaluation process does not enhance the suppliers' performance unless the supplier is committed to the buyer's organization. This is supported by the study of Wagner & Krause (2009) who concluded that evaluations alone are considered as insufficient investments when striving to develop supplier's capabilities. Still, since giving feedback to the supplier enhance supplier's perceptions of the buyer's commitment to the supplier (Prahinski & Benton, 2004). This may this result in increased commitment of the supplier to the buying. For the buyer it is vital to include a feedback process to the overall management process to make good use of the evaluation results (Eom et al., 2008).

In order to continuously evaluate subcontractor performance in the construction industry, Eom et. al. (2008) developed a framework based on the balanced scorecard system. The framework included attributes from subcontractor's financial stability and a project-orientated on-site evaluation, resulting into one comprehensive index score. Their case study demonstrated that the scorecard model was the most appropriate

model to enhance collaborative relationship in the particular context, although not tested in real situation (Eom et al. 2008). Whereas scorecards can be a powerful tool to evaluate supplier performance and organize data, they require resources to update and might have problems with respect to data integrity and might not play as a sufficient tool to identify the root causes (Gordon, 2006). Another approach developed by Karim et al. (2006) focused on identifying defects in subcontractor supply chains and developed a tool to analyze these. The results of the study were found to be promising in managing subcontractors, although this method is limited in areas of quality. Comprehensive evaluation practices should include the quantitative measures in quality, delivery and cost as well as the ultimate qualitative performance factors (Gordon, 2006).

### **3.4 Lean supplier development and value stream management**

One approach for developing suppliers is the “Lean” way (Macduffie & Helper, 1997; Marksberry, 2012; Dyer & Hatch, 2004). By tradition, lean thinking concentrates on identifying and removing waste and other non-value adding activities from supply chains. It also encourages a culture of continuous improvement (Womack & Jones, 2003). As a result, lean organizations strive to replicate their lean capabilities into suppliers and jointly resolve performance issues. Lean supplier development is often linked to Toyota’s management system that remains one of the most benchmarked business improvement strategies in modern industry (Marksberry, 2012). The company has long prospered at transferring its know-how to the network of suppliers to improve their performance (Dyer & Hatch, 2004). Marksberry (2012) found out that most of the Toyota’s initiatives on lean encourage changing the production environment through analyzing and testing. These practices seem to suit well in the manufacturing industry, which calls for stable, repetitive processes in contrast to the construction industry. On the other hand, an interesting remark is that Toyota doesn’t expect suppliers to improve existing processes before they are in control and standardized (Marksberry, 2012).

It is well known that organizations implementing Lean management principles employ value stream mapping methods to identify and remove the non-value adding activities in processes (Hines & Rich, 1997). Approach developed originally in 1995, requires organizations to analyze the output among the series of contingent tools developed for waste removal (Hines et al., 1998). Mapping the current state will also serve as the basis for developing the envisioned future state (Womack & Jones, 2003). In the construction industry, Frödell & Josephson (2008) employed Value Stream Analysis as a supplier development initiative for assessing the interface between a major contractor and its largest supplier of rented construction machinery. By interviewing key persons from both sides, it became obvious that the supplier was being too flexible to the contractors' orders, in which case the overall efficiency suffered. They concluded that the total costs would likely decrease if the processes would be more stringently followed (Frödell & Josephson 2008). However, one must remember that projects are subject to variability, which may constrain the effectiveness of processes (Fearne & Fowler, 2006). Also, outside the context of supplier development, Arbulu et al. (2003) found inefficiencies at the interface between processes, disciplines and organizations in a construction supply chain. They concluded that the supply chain performance could improve, if the suppliers would be regarded as partners, in which case communication and coordination would be fostered. The study underlined that that the introduction of Lean tools to the construction industry could assist practitioners to recognize opportunities for improvement (Arbulu et al., 2003).

However, many have taken the more critical perspective towards Lean thinking. Eriksson (2010) concluded that increased cooperation among supply chain actors is the prerequisite starting point for a further development of the Lean concept (Eriksson, 2010). Also, Lean principles are said to function only in high volume, low variety and predictable environments (Cox & Ireland, 2002). For example, Fearne & Fowler (2006) found empirical evidence whereby construction firms are trying to deploy Lean thinking too blindly and narrowly, which may result to unsuccessful

project delivery. They state that lean methods are more suitable for process-centric environment, and again in project business may lead to partial optimization. They argue that “leaning” the supply chains results to lower flexibility and responsiveness since suppliers are encouraged to remove inefficiencies. They conclude that current Lean principles should be replaced with more integrated and customized approaches, which in turn, require more fundamental changes in relationship management between parties involved.

However, collaborative learning may prevent organizations from thinking Lean in isolation. For example, knowledge sharing is extremely important in Toyota’s supplier development process because it directly routes the suppliers to lean faster (Marksberry, 2012). An extensive study of Dyer & Hatch (2004) proved that Toyota has received a significant and sustainable competitive advantage by promoting knowledge sharing among the network of suppliers. They found that the company has achieved this by employing supplier associations, consulting groups and learning teams. Likewise, successful examples of buyer-supplier relationships from the construction industry are based on inter-organizational project teams (Briscoe & Dainty, 2005). Characteristic for the construction project environment is that parties from different construction companies and subcontractors have most often worked together for a while (Bröchner et al., 2002). This notion could be taken advantage in order to, as recommended by Ingirige & Sexton (2006), the development of construction industry alliances so that individual firms could reach sustainable competitive advantage. Their research addressed the value of these alliances and long-term collaboration in order to fully break the project-based mindset so that effectiveness and efficiency of interactions could be improved (Ingirige & Sexton, 2006).

### **3.5 The process of supplier development**

After buying firms have encountered shortcomings in supplier performance/or capabilities they may engage in the process of supplier development. According to Hartley & Jones (1997) process-oriented supplier development requires a major commitment of time and other resources, and therefore, it should consider only strategically important suppliers. However, they further emphasize that process-orientated approach is the conclusive factor for sustaining the change process as well the only way in improving the supplier's capabilities in comparison with results-orientated supplier development.

For buyers in the construction industry, Cox & Townsend (1998) suggest that the first steps in the development of suppliers should concern the supplier assessment techniques that are followed by the actual development. They argue that the former techniques: spreadsheets, personal assessment and vendor ratings, play a pre-requisite for the latter because it is clearly not possible to know what to develop. As the final steps in the process include supplier audit and a should-cost approach (Cox & Townsend, 1998), it can be concluded that their conclusions handle the strategic development.

However, the process might as well just be a remedial way to correct obvious supplier deficiencies. For example, Krause et al. (1998) discuss a reactive approach to supplier development. The latter goes beyond supplier evaluation and includes proactive efforts to improve suppliers' capabilities. Based on data of 84 companies across industries, the study revealed that some companies used both reactive and strategic approaches, but clearly tended to emphasize one approach over the other. The reactive firms identified supplier development candidates only after a problem had occurred and were less systematic in the evaluation process, whereas companies practicing strategic development focused on continuous improvement of the supply base. Based on the qualitative survey responses, Krause et al. (1998)

constructed the process for strategic supplier development. Next, this process is reviewed and completed with views by other researchers.

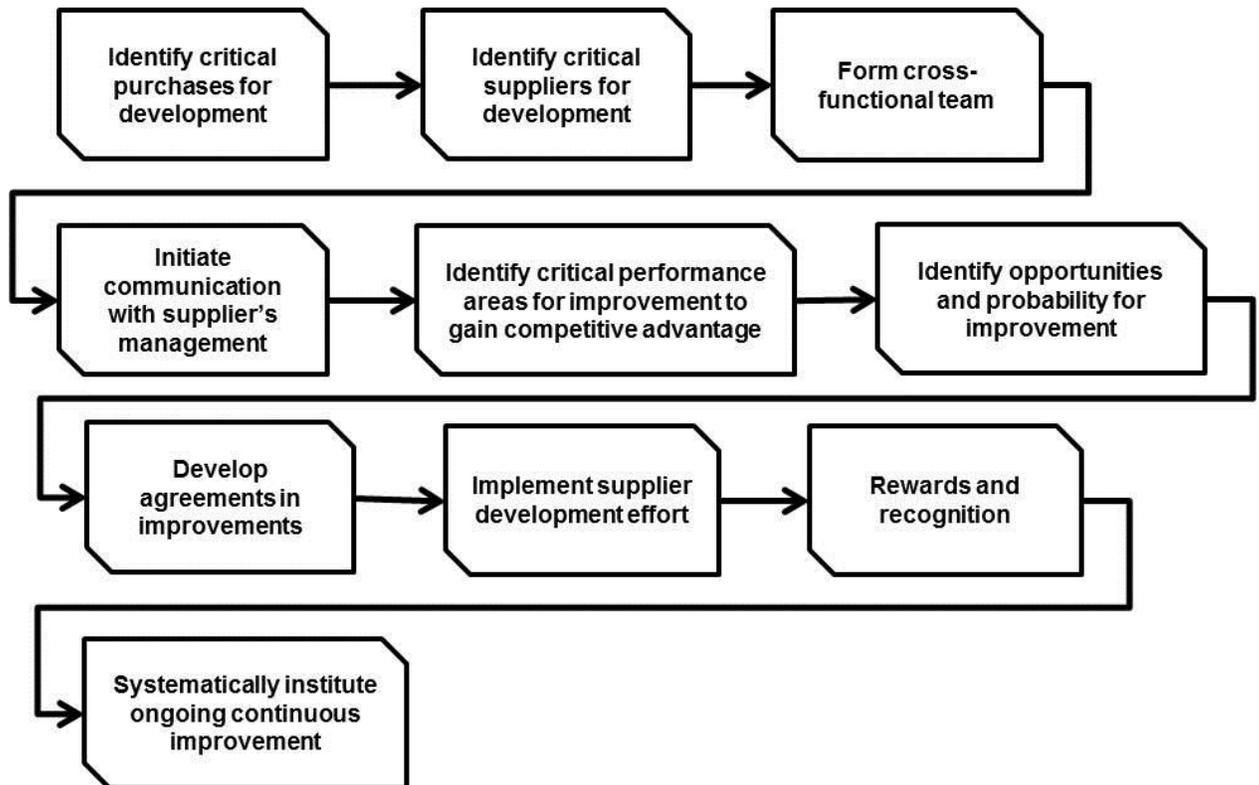


Figure 6. Strategic supplier development process (Krause et al. 1998, p. 44)

Obviously, the process begins by identifying critical commodities and suppliers for development. Alongside purchasing portfolio analysis, firms use other classification methods, such as Pareto analysis to identify high-value-added strategic commodities and services (Krause et al., 1998). Afterwards, firms should identify suppliers requiring development. Suppliers should also be segmented based on their capabilities and willingness (Razaei & Ort, 2012). Strategic-approach companies usually possess a formal supplier performance measurement system to assess supplier's cost, quality, service, delivery, technology and even environmental performance (Krause et al., 1998.). Buyers in the construction industry must observe also whether the candidates offer regular, continuous and sufficient volume to the

buyer. Some argue that only in such conditions supplier development strategy is feasible (Cox et al., 2006). After prospect candidates have been chosen, firms must determine whether a supplier is ready to participate in the supplier development program (Hartley & Jones, 1997).

At all events, cross-functional teams have been identified as important runners to the success of efforts, such as productivity and cost reductions (Ellram & Pearson, 1993). Given this, according to (Handfield et al., 2000) buyers should establish internal cross-functional consensus for supplier development initiative before approaching the supplier. This is because buyer must send the supplier consistent messages about appropriate development strategies and the roles of procurement. Furthermore, as implementing system-wide changes and analyzing problems is difficult, buyer's development team must have good interpersonal communication skills as well as technical ones (Hartley & Jones, 1997). Similarly, buying firms tend to represent an agreement to work jointly to improve the interface for mutual benefit instead of merely representing a demand for improved performance (Krause et al., 1998).

The problem solving phase includes identifying performance gaps and opportunities jointly. Often, objectives are driven by the buying firm's customer expectations, whereas other areas may include standardization or parts and processes as well as process-mapping to identify quality problems (Krause, 1998). Dunn & Young (2004) point out that measuring the problem areas is often problematic in which the parties often fail. Therefore, once a feasible development initiative has been identified, the parties must come to an agreement on the specific metrics that will be exploited when measuring the project's success (Krause, 1998). Many leading companies are also requiring suppliers to measure themselves and report the results to the procurement organization in the belief that this will drive suppliers towards continuous improvement (Dunn & Young, 2005). It is possible, however, that suppliers will act opportunistically, so the approach should be used with caution. Firms indicate that important portions of the development agreements are specific time-phased milestones for improvement

including role of each party and the manner and timing for deploying allocated resources (Krause et al. 1998). An agreement including a definite time set will result to fewer misunderstandings about what behaviors are expected from the supplier (Wagner, 2010).

After agreement on performance metrics has been made, the development efforts can be put into practice. What was identified from the qualitative responses was that strategic-approach companies emphasized that development requires joint improvements by both parties and not just involvement from the supplier's side (Krause et al., 1998). By modifying its own systems the buyer demonstrates commitment to the improvement process (Hartley & Jones, 1997). Furthermore, results indicate that a supplier is unlikely to fully embrace a set of changes required for improvement, unless there is evidence that the buyer will support their efforts (Krause et al. 1998). By serving as trainers, the buyer can teach the supplier how to identify opportunities and improve processes on their own (Hartley & Jones, 1997).

Finally, establishing performance awards and other forms of recognition may provide suppliers to improve. However, if the development efforts don't prove to be successful, corrective actions might be taken. In this case, respondents indicated that they might reduce the supplier's share of business or even disqualify the supplier for future business (Krause et al. 1998). This outcome may contrast markedly with successful suppliers. After a development project has been completed, it is important to create support systems and follow-up procedures; defining goals and program plans and jointly reviewing progress on a regular basis can be utilized to keep the supplier motivated (Hartley & Jones, 1997). The monitoring phase may also include a continuous improvement strategy and plan-do-check-act (PDCA) cycles in order to improve processes under development (Park et al., 2010).

### **3.6 Critical elements and pitfalls in supplier development**

In order supplier development to be successful, certain elements and conditions must be in place. Literature especially from the manufacturing industry addresses well these critical elements. An extensive study by Krause & Ellram (1997) indicated that two-way communication, top management involvement and cross-functional teams are one of the most important elements when developing suppliers. Others have also emphasized the importance of inter-firm communication and top-management's commitment. According to Krause & Wagner (2009) efficient communication is an important facilitator in buying firms efforts to transform supplier development to suppliers' performance improvement. And as for the top management's commitment, Li et al. (2012) came into the conclusion that this element is the most important factor that initiates and encourages in direct supplier development initiatives.

Also, Handfield et al. (2000) studied specifically the pitfalls to supplier development. They listed the lack of supplier commitment, insufficient supplier resources, lack of trust, poor alignment of organizational cultures, and insufficient inducements to the supplier as typical pitfalls that buyers find themselves when striving to improve supplier performance. Many of these determinants point out to supplier's willingness, that refer to supplier's confidence, commitment and motivation to engage in a (long-term) relationship with a buyer (Razaei & Ort, 2012). Analyzing the confidence or trust aspect is especially important since trust may deter the supplier's tendency to act opportunistically (Dyer, 1996). Therefore, it can be concluded that suppliers' willingness needs to be considered especially in high-involvement (direct) supplier development.

Furthermore, it became evident from the study of Krause & Ellram (1997) that firms involved in supplier development gave a great emphasis that the buyer should have a significant percentage of the supplier's annual sales. This notion is supported by the empirical research of Ireland (2004) who concluded that the relative volume of the

business to the supplier is one of the key power resources in the buyer-supplier relationship. This source of power is often considered as the biggest obstacle in the implementation of proactive sourcing strategies in the construction industry (Cox & Ireland, 2002).

In order to distinguish the impact of power and to untangle other critical elements in construction proactive sourcing strategies, the critical success factors and explanations to failure outcomes of various case studies described by Cox et al. (2006) are summarized in Table 5. The round-up demonstrates quite clearly that win outcomes for the buyer are the results of favorable power positions. Under power and leverage circumstances of independence and supplier dominance, the buyers cannot provide any incentives for the supplier to enter into a long-term relationship (Cox et al., 2006). Also, it appears that buyers must be able to make dedicated investments in internal procurement capabilities to support improvement strategies but also be able to identify the opportunities for additional leverage in order to enjoy full win outcomes. A major finding on the other hand appears also to be the fact that even dominant buyers may fail to impose aggressive commercial leverage resulting into win outcome for the supplier. What also seems to be critical is the regularity and predictability of demand that enables to implement proactive and collaborative ways of working with upstream suppliers (Ireland, 2004). Finally, it seems that construction buyers who possess extensive knowledge of the industry are more capable to prevent suppliers from opportunistic behavior and the overall value for money being attained (Cox et al. 2006).

Table 5. Causes for win and lose outcomes in case studies of supplier development in the construction industry (based on Cox et al., 2006)

Cases and performance outcomes:	Performance outcome in detailed:	Why win outcome?	Why lose outcome?
1. Buyer partial, Supplier win	<b>Buyer:</b> lower construction costs, project delivery on time <b>Supplier:</b> high profits (return close to 5 %), enhanced reputation within the industry	<ol style="list-style-type: none"> <li>1. Number of safeguards to protect from opportunistic behavior</li> <li>2. Detailed scope of works</li> <li>3. Additional site investigations, feasibility and value engineering studies</li> <li>4. Buyer had extensive information and understanding of supply markets</li> <li>5. Supplier was guaranteed a high annual work load</li> <li>6. Buyer was able to incentivise the supplier to take dedicated investments and relationship-specific adaptations in the long-term</li> <li>7. Established IT-technology to ensure the delivery of cost-effective solutions</li> <li>8. Power situation: one of buyer dominance</li> <li>9. Demand from supplier: high volume and frequency</li> </ol>	
2. Buyer partial win, Supplier lose	<b>Buyer:</b> lower construction costs, delivery of project on time, <b>Supplier:</b> damaged its reputation and suffered financial loss as much as 4 % of contract value	<ol style="list-style-type: none"> <li>1. Buyer employed cost consultant to audit the supplier performance</li> <li>2. Buyer had robust understanding of the supply market</li> <li>3. Supplier was guaranteed average annual workload</li> <li>4. Buyer was able to incentivise the supplier to take dedicated investments and relationship-specific adaptations in the long-term</li> </ol>	<ol style="list-style-type: none"> <li>1. Supplier failed to manage its own responsibilities effectively</li> <li>2. Buyer failed to understand the scope for additional leverage</li> </ol>
3. Buyer lose, Supplier lose	Lengthy legal battle between the buyer and the supplier <b>Buyer:</b> project delay of three months, painting costs three times higher than original budget <b>Supplier:</b> significant financial problems, damaged reputation within the industry		<ol style="list-style-type: none"> <li>1. The buyer failed to eliminate all risks by ignoring the technical advices of the supplier</li> <li>2. No party willing to take the responsibility of the failure</li> </ol>

### 3.7 Towards more efficient contractor-supplier relationships

It appears that the literature might address rather barriers to supplier development than the factors advocating it. Nonetheless, as far as suppliers are deficient and switching the supplier is not viable, development might be the only option for the buyer (Wagner, 2006b). In order to overcome the barriers, buyers need to find ways to facilitate the development of relationships or to break the supplier dependency. In the construction industry, Cox & Townsend (1998) imply that the development of preferred supplier relationships in which a team building approach is utilized, might break-down the barriers and the high dependence on suppliers. Through a case example, the author witnessed improved performance in terms of project delivery by nurturing the relationships from a strategic perspective. It can therefore be concluded that buyers in the industry must find the critical factors for more efficient buyer-supplier relationships in order to improve the interface between parties involved.

Based on the perceptions of strategic purchasers within a large contractor, Frödell (2011) identified the criteria for achieving more efficient contractor-supplier relations. In the study, respondents were asked to freely explain the five most important criteria both from the contractor and supplier side. Altogether, 120 criteria were collected and categorized to the input-throughput-output model (Figure 7.) The enabler category addresses the prerequisites for the development of an efficient relationship whereas the activities category addresses the criteria directly affecting the relationship between the parties. Finally, the results category infer to the operative and strategic outcomes of the relationship between parties. The model compiles well the discussed critical elements in supplier development, e.g. feedback, commitment, as well as the characteristics of the industry that often deter proactive ways of working, e.g. lack of long-term orientation. However, when contractors decide to nurture the relationship with suppliers, it is possible to achieve significant outcomes, say competitive advantage. Traditionally main contractors seem to prefer transactional exchanges with suppliers (Dubois & Gadde, 2000) and therefore might be reluctant to develop their supplier base. However, the utilization of the criteria identified by Frödell (2011) might facilitate this situation.

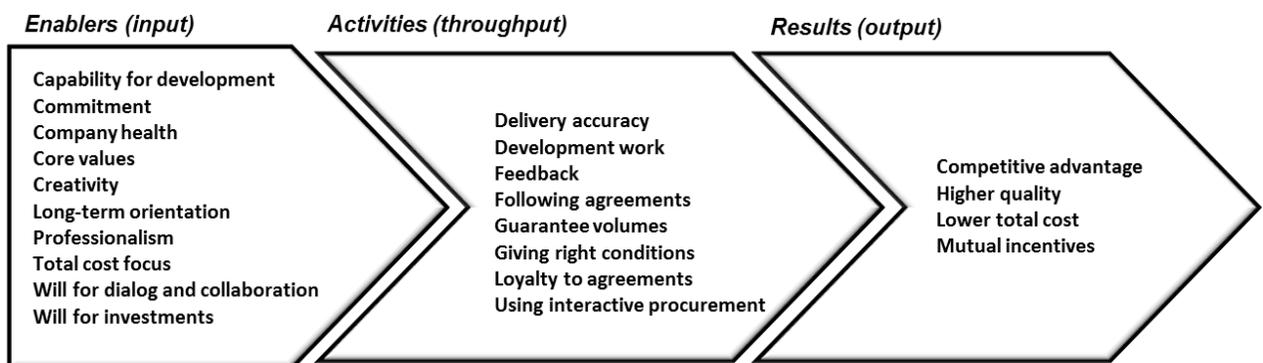


Figure 7. Criteria for achieving efficient contractor-supplier relations, adapted from (Frödell, 2011, p. 390)

#### **4 SUMMARY OF THE LITERATURE REVIEW: a step-wise model for supplier segmentation and development**

Building on lessons of supplier segmentation and development, this section presents and describes a conceptual model for construction buyers firms to use when striving to increase supplier's performance and capabilities. Suggestions are based on the comprehensive literature review on which the process-orientated supplier development model is based (see Figure 8). The developed model will serve the basis for the empirical part, wherein the pattern is exploited to some extent.

As it was described, motivation for the buyer might be either reactive or strategic supplier development. Therefore, two different starting points was visualized to the conceptual model. If developing suppliers represents a strategic weapon for the buyer, firms should first focus on identifying critical commodities and suppliers requiring development, with the intent to create a superior supply base that brings sustainable competitive advantage for the buyer (Phases 1 and 2). First and foremost, firms need to segment the supply base based on external spend in order to understand under which circumstances it is appropriate to use which supplier development tools and techniques. As we saw, firms may use a Pareto analysis, purchasing portfolio matrix and power regime analysis to achieve the supplier segmentation. Although portfolio strategy to supplier segmentation was identified to possess many drawbacks, it was however, found to be a good way to quickly structure data and a good preparatory step for supplier development. Firms should, however, avoid making supplier development decisions on simple recommendations, meaning that the portfolio approaches should be supplemented with company specific information. Furthermore, possible adjustments should be done afterwards to the analyses.

In contrast, supplier performance evaluation may reveal supplier non-performance which may motivate some firms to undertake a reactive approach to supplier

development. However, as Eom et al. (2008) emphasized that in order to maintain long-term relationships, supplier evaluation and feedback should be a continuous process for principal contractor firms. Therefore, categorizing suppliers into deficient, adequate or world-class may represent a conclusive segmentation factor and technique for identifying suppliers requiring development. At this point, the segmentation activities should have provided the buyer enough information about various supplier profiles in order to develop action plans to either improve supplier performance, maintain the current state, or even, prevent future orders from the deficient supplier. If some of the current relationships are perceived as adequate, firms should nurture the relationship in order to maintain the status quo. The criteria for achieving better contractor-supplier relationships in the construction industry, constructed by Frödell (2011), may assist in achieving this. As we saw, before defining and establishing the final development activities, firms need to assess the supplier's willingness to change. Already the evaluation of power attributes in phase 2 has indicated the extent to which supplier is dependent on the buyer, which in turn, may act as the source of willingness. Also, the type of contracting strategy with the supplier, framework or project-specific, reveals already much about the relationship closeness that can be translated into willingness. If it seems that the supplier is not willing to change, firms may strive to reduce or break dependency on the deficient supplier. Whether this can be possible, is determined by the market structure. If the buyer is dependent on the supplier, and not vice versa, the buyer needs to discover and demonstrate to the supplier that it will gain tangible advantages as well. If contractors find themselves in this situation, they may strive to exploit indirect influence strategy to implicate that the supplier would benefit from changing its operating procedures.

Next, the buyer must plan development activities and goals it wishes to achieve through supplier development. In the strategic approach, suppliers and buyers may jointly find areas for improvement, which on the one hand, requires first to initiate communication with the supplier's management. In strategic development, however,

internal consensus should be first achieved within the cross-functional team. Any direct investments should be safeguarded through agreements against supplier's opportunism and to ensure the development program's success. Furthermore, if the buyer strives to correct a deficient supplier performance, not capabilities, nothing but an indirect development strategy is needed to apply (Wagner, 2010). After implementing the first set of improvement activities, the buyer should strive to support suppliers to preserve and progress the change process.

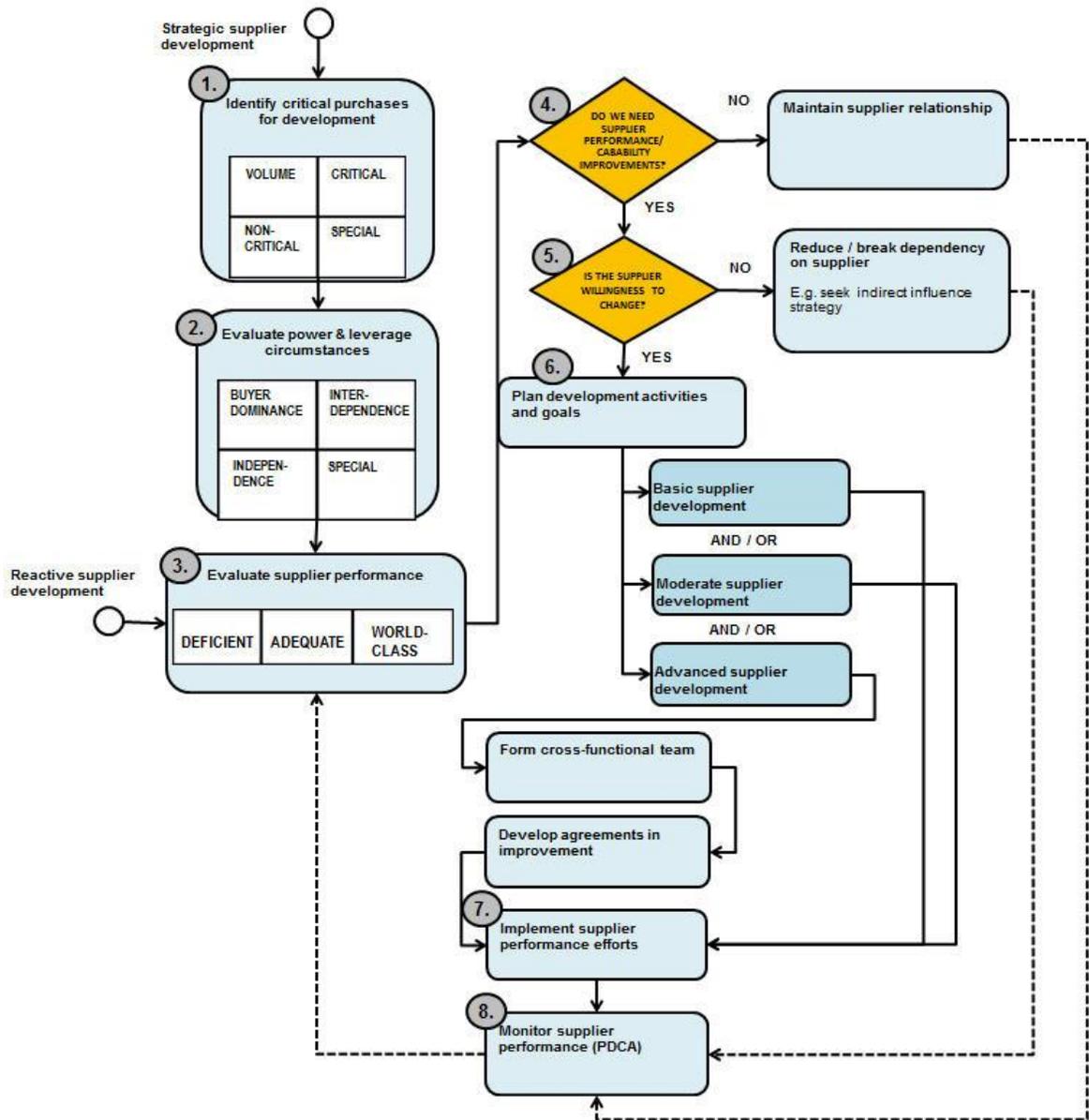


Figure 8. Summary of the literature review: a step-wise framework for supplier segmentation and development

## **5 1<sup>st</sup> EMPIRICAL STUDY: supply base assessment**

This chapter presents the point of departure for the empirical studies. The empirical studies combine three cases including the supply base segmentation (Chapter 5), the investigation of supplier evaluations using statistical tests (Chapter 6), and finally, a supplier development case effort between the case company and one of its major suppliers providing kitchen cabinets (Chapter 7). In the following chapter we differentiate the supply base identifying the critical and strategic construction item classes and segment major suppliers' into distinct power quadrants. It is also looked at other supplier related characteristics, e.g. performance, the relationship length and early transaction amount. Thereafter, the purpose is to propose suitable supplier management strategies for managing the four power quadrants of suppliers. To start with, background to the empirical studies is announced by providing the company description and by specifying the underlying motives for conducting the case studies.

### **5.1 Company description**

The case company in this thesis is one of Finland's major contractors and part of an international corporation which makes it one of the leading construction and project development companies in the world. In the empirical studies, the case company is referred to as *Blue*. Currently Blue provides employment to over 57,000 persons in selected markets located in three continents. Operations in Finland cover residential and commercial development along with construction services which comprises building-, civil-, and environmental construction. In the year 2013, the combined sales of operations in Finland comprised a total of 800 million euros and the number of employees was around 2200. The company's special strength is the unique network of local and international expertise which is capitalized in hundreds of projects located all over Finland each year.

Blue's business strategy is firmly focused on emphasizing the importance of safety, ethics, risk management and environmental efficiency. Based on its global green experience, the company aims to be the clients' first choice for green solutions. In particular, Blue has a clear desire to pioneer in safety in all domestic markets. Furthermore, the company is proud of its reputation of ethical practices such as equal opportunity and workplace diversity. Notably in Finland the present five-year business strategy is concentrated around profitability and safety.

## **5.2 The contractor's procurement organization**

Historically, purchasing at Blue has been a decentralized activity where each project has had the overall responsibility. Even so, a few years ago Blue took a route for centralized purchasing by combining Nordic purchases as a joint procurement unit. As a result, the business unit in Finland currently holds over a hundred national and Nordic framework agreements with qualified suppliers. After the purchasing transformation, the heart of the purchasing department is formed by the category managers and other purchasing managers who are responsible of the supplier relationship development. Notwithstanding, majority of the purchases are still conducted by title-specific and project-specific purchasers. As a part of the procurement transformation, logistic practices and e-procurement systems were implemented and developed. This thesis is concentrated around the procurement organization where the researcher is also working as a project coordinator for supplier management. This enables to conduct more grounded research, since the author has gained a few years' experience about the procurement strategies and practices.

Regardless of the efforts towards a centralized function, only about 50 % of the purchasing volume is controlled by the centralized procurement organization. However, as Finland is a country with long distances, project organizations are established to perform operative purchasing in geographically dispersed projects. Usually, these projects make the final decision of what suppliers to use, and as a

result, the project-specific suppliers form the majority of the 10 000 annually invoiced suppliers. However, the framework agreements still play an important role enabling high price reductions and better service from strategically important suppliers resulting into competitive advantage for the company. Overall, the purchased materials and services represent around 75 % percent of the company's turnover making the orchestrating activities with suppliers a strategically important issue.

The variety of procurement methods has led to the existence of over 50 000 suppliers in the company's database. Therefore, this diverse population of suppliers is a challenge to meet the company's safety, ethical and green premises. Currently, suppliers have a high priority in the company's business strategy as laid out by the company's procurement organization. Ultimately, the company should achieve a base of suppliers committed to the requirements and values set out by the main contractor.

Even so, a much needed systematic way of working description for supplier management that would encompass all levels inside the company is yet to come. The researcher is part of this task force and hopes that the research findings will contribute to the work. This work has been piloted within the company's Preferred Supplier Program which aims to improve and manage the company's supplier base through supplier pre-qualification, evaluating supplier performance and targeting supplier development initiatives towards the suppliers.

The researcher has been one of the persons responsible of the program's operative work, which has increased the awareness of the supplier's markets as well as the behavior and capabilities of the current supplier base. With the help of this study, the researcher hopes to gain more understanding of the feasible methods for supplier management that includes segmenting, relationships management and developing suppliers' performance over time. In this study the term supplier will be used interchangeably covering both material suppliers and subcontractors.

### 5.3 Stage 1: Identifying major product and service groups

To enter upon supplier development, the purchased product and service categories need to be prioritized. In the first phase, this requires the identification of major product and service categories (Krause et al., 1998). The supply base of residential building was reviewed by looking at the major categories according to spend using Pareto analysis based on the suggestion of Gordon (2008). Almost all indirect purchases were removed from the analysis since these purchases may not be a high priority for performance improvements (Gordon, 2008). In a participatory discussion with the district purchasing manager, it seems that:

*“Generally speaking, categories which are onerous to procure and where the schedule is critical, such as ground works, HVAC and electrical installations as well as interior contracts, should be included in supplier development procedures” (District Purchasing Manager, 2014)*

Accordingly, company level purchases were segmented based on the effort required in purchasing situations and the impact to business (according to Junnonen & Kankainen, 2012). The first-mentioned describes factors external to the company, by revealing purchases that require extra attention and effort to manage and monitor (Olsen & Ellram, 1997). In other words, the “high” effort required item categories act more potential for development procedures. Assuming that suppliers’ performance and capabilities would improve as result of development process, it would in an ideal world, ultimately lower the purchasing function’s effort required in purchasing situations. Also the profit impact dimension is easy to assert. This is because items purchased in high volumes have generally higher strategic importance for the company. On the other hand, high-spend and low-effort categories require efficient processing, which may also be achieved through development procedures. Alternatively these item classes, such as personal protective equipment and office supplies, are easily recognizable.

The process began by reviewing all items purchased during one year of activity in the target business unit. The internal follow-up tool for spend bundled the purchases into product and service categories, which reduced the segmentation complexity. However, this prefabricated categorization required manual alterations, a result of which items were placed in more appropriate categories. This required supply market research as well as an interactive process between the researcher and the district purchasing manager. After removing not-construction related classes, the bottom line consisted of 132 sub-categories. Of these, 42 major spend categories were included in the analysis, of which Figure 9. displays the 80 % aggregated spend. These 24 categories account almost 20 % of all the sub-categories, making the Pareto principle 80/20 valid. This means that 80 percent of the district spend is the result of 20 percent purchased categories. It seems evident that concrete elements embody the most purchased category in the region.

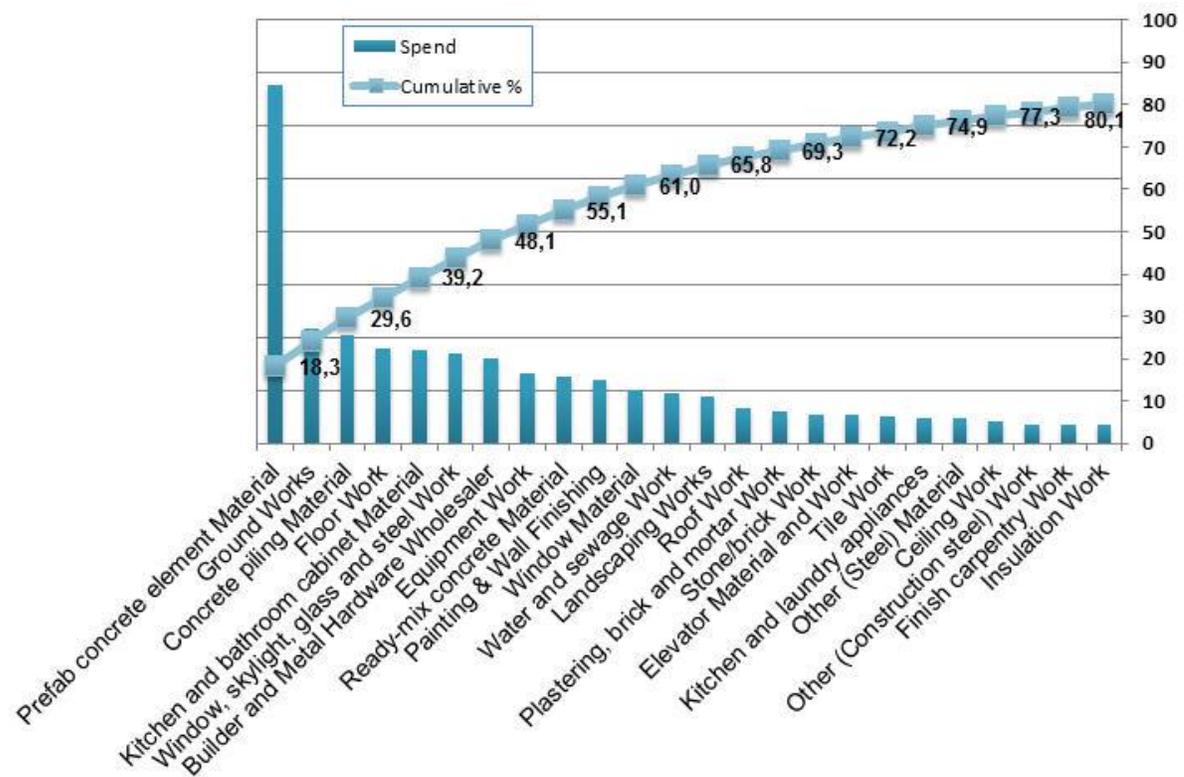


Figure 9. Pareto analysis of various product and service categories procured

#### 5.4 Stage 2: Segmentation of product and service groups

Next, it was designed a questionnaire to obtain data pertaining to effort required attribute for various products and services procured by the purchasing department. Here, the district purchasing manager was elected as respondent for having the best knowledge of the matter. The respondent was asked to indicate the effort required from the purchasing department when procuring each of the 42 categories on a 1-4 scale. Combined to the annual purchased value, the degree indicated the appropriate quadrant for the construction item group; critical, volume, non-critical or special (Figure 10). Questionnaire results 3-4 embodied the *high effort required* quadrants, while in turn, categories squeezed into 80 % aggregated spend were positioned in the *high profit impact* dimension.

Due to the subjectivity in defining the boundaries between the categories, the results in Figure 4 may seem surprising at first glance since there exists only few item classes specified as special, whilst many as critical. One must remember, that the total amount of purchased demonstrate the heaviest criterion in choosing appropriate categories for the analysis. Given this, the critical category includes a total of 61 % of the entire matrix spend and a total of 16 product categories. These represent construction category classes with high purchased value and great effort required in purchasing situations. The corresponding figures for volume items constitute 19 %; 8, for non-critical items 6 %; 12, and finally, for special 4 %; 6. Due to the subjectivity of this application, the purpose is not to propound applicable relationship management strategies for the differentiated classes before deep-diving possibilities on a supplier level. It is argued that recommendations must, rest on understanding not what is ideal, but also what is possible (Cox et al., 2006). However, the importance of this phase cannot be underestimated since later various product categories need to be united with individual suppliers.

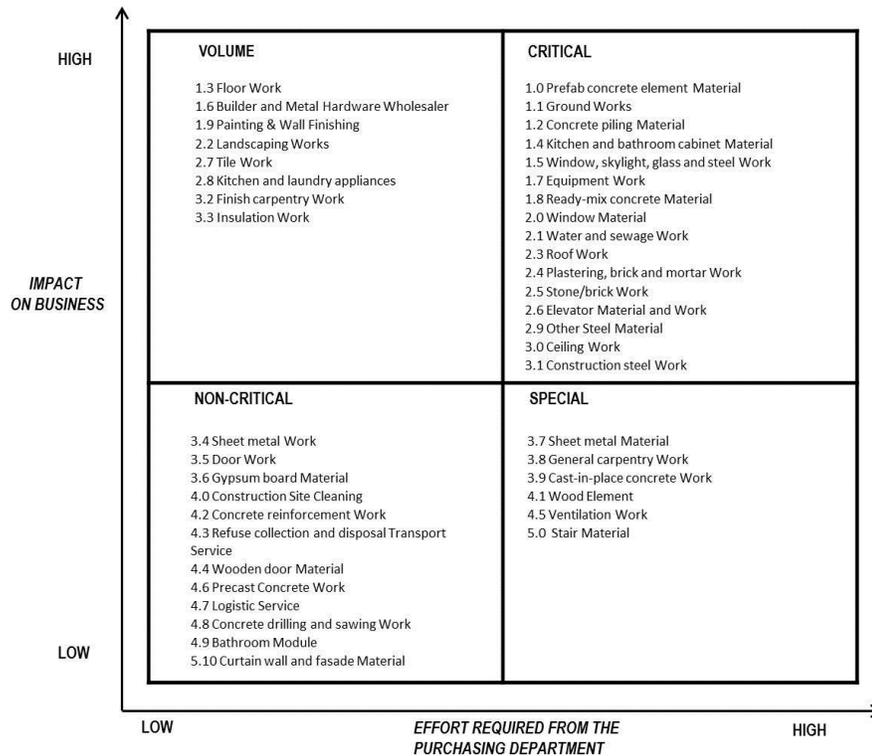


Figure 10. Mapping of the 42 works/services in the quadrants of the Purchasing Portfolio ( based on Junnonen & Kankainen, 2012)

### 5.5 Stage 3: Supplier segmentation

The segmentation of product groups merely gives insight of the critical and strategic items for the company. In other words, this category-level information is not sufficient to disclose which suppliers are critical for the buying firm. Besides, some previous studies tend to argue that supplier development tends to work best in circumstances when buyers have dominance over suppliers (e.g. Cox et al., 2004; Cox & Ireland, 2002). Since power imbalances determine the strategies for the buyer, four possible power combinations, introduced in the literature review, were linked to the suppliers compiling 80 % of the region's external purchases in 2013. This was achieved by analyzing the key power resources in an individual relationship level; relative volume of the business to the supplier and the number of alternative relationships outside the specific relationship. The latter criterion was obtained through a questionnaire, where

the company expert, district purchasing manager, were asked to indicate whether there exists a multitude of alternative suppliers offering potentially similar products or services, or alternatively, whether the supply is relatively unique yielding at the maximum existence of two alternative suppliers. In contrast, the supplier turnover was compared against the Blue's annual purchases of the supplier. The aforesaid figure was drawn from a leading service provider of credit and company information. Figure 12 outlines the current supplier base distribution; suppliers that fall in the top 80 percent of the district spend, in the power matrix.

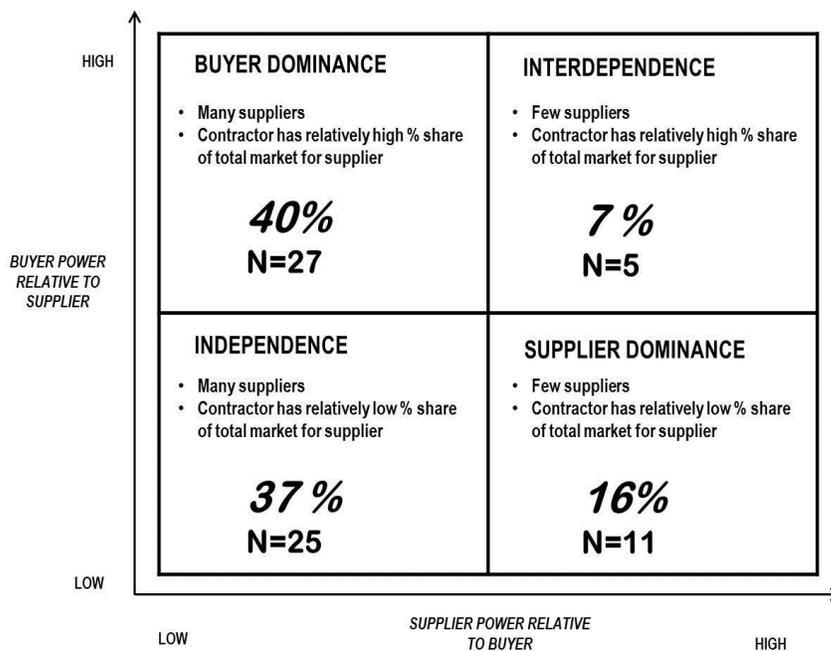


Figure 11. District's major suppliers positioned in the power matrix (after Cox et al., 2003, p. 54)

## 5.6 The supplier segmentation directory

The previous simplistic demonstration does not consider frequency of the exchange with individual suppliers or suppliers' performance. For this purpose, a supplier segmentation directory was created (Table 6). The idea behind this was to create a library where supplier specific data would be easily internalized so that tactical and

strategic level decisions would be more straightforward to reason. This allows us to identify sub-optimal suppliers potential for development by first looking at the supplier base as a whole; power circumstances, suppliers' performance and financial capabilities.

Based on different criteria on supplier feedbacks, the performance indicators were divided into deficient, adequate and world-class to indicate development needs. Indicator of supplier's financial capability was provided by an external service provider of company credit information. Other supplier specific information, such as relationship length, was calculated based on invoices from Blue's internal analytical procurement tool. In the directory, data is tabulated in terms of aggregated spend during supplier's one year of activity (Table 6). In Appendix 2, supplier information is tabulated based on the four power circumstances. Next, the findings of the analysis are specified including proposals for managing the suppliers inside the power circumstance quadrants.

Table 6. Supplier segmentation library – supplier specific information combined to construction item classification

SUPPLIER SEGMENTATION DIRECTORY										PERFORMANCE EVALUATION STATUS:						
Framework agreement*																
ID	Supplier type	Agg. Spend	Category Type	Yearly Transaction amount	Relationship length	Spend share of supplier's annual turnover	Amount of alternative suppliers	Power circumstance	Financial status	Quality	Trend: quality	Safety	Trend: Safety	Timetables	Trend: Timetables	
S1	Material Supplier*	6%	Critical	High	>3 years	12%	Oligopoly	Interdependence	✓	✓	↓	✓	↑	✓	↓	
S2	Subcontractor	12%	Critical	High	>3 years	14%	Low	Interdependence	✓	✓	↓	✓	↓	✓	↓	
S3	Subcontractor	16%	Critical	High	>3 years	27%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S4	Material Supplier*	21%	Critical	High	>3 years	20%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S5	Subcontractor*	25%	Critical	High	>3 years	6%	Low	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S6	Material Supplier	28%	Critical	High	>3 years	27%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S7	Subcontractor	31%	Critical	High	>3 years	5%	Oligopoly	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S8	Subcontractor*	33%	Volume	High	>3 years	11%	High	Interdependence	✓	✓	↓	✓	↓	✓	↓	
S9	Subcontractor	35%	Critical	High	>3 years	6%	Oligopoly	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S10	Subcontractor	37%	Critical	High	>3 years	28%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S11	Subcontractor*	39%	Critical	High	>3 years	15%	Low	Interdependence	✓	✓	↓	✓	↓	✓	↓	
S12	Subcontractor	41%	Critical	High	>3 years	18%	Oligopoly	Interdependence	✓	✓	↓	✓	↓	✓	↓	
S13	Material Supplier*	43%	Non-critical	High	>3 years	0%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S14	Subcontractor	45%	Volume	High	>3 years	8%	High	Interdependence	✓	✓	↓	✓	↓	✓	↓	
S15	Material Supplier	48%	Critical	High	>3 years	9%	Low	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S16	Material Supplier	49%	Critical	High	>3 years	10%	Low	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S17	Subcontractor*	50%	Critical	High	>3 years	6%	Low	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S18	Material Supplier	53%	Non-critical	Low	>3 years	54%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S19	Subcontractor	54%	Critical	High	>3 years	51%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S20	Material Supplier	55%	Volume	High	>3 years	13%	High	Interdependence	No data	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S21	Material Supplier*	56%	Non-critical	High	>3 years	1%	Low	Supplier dominance	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S22	Material Supplier	57%	Critical	Low	>3 years	12%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S23	Subcontractor	58%	Non-critical	High	>3 years	0%	High	Independence	No data	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S24	Subcontractor*	59%	Non-critical	High	>3 years	4%	High	Independence	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S25	Subcontractor	60%	Volume	High	>3 years	25%	High	Buyer dominance	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S26	Material Supplier	61%	Critical	High	>3 years	5%	High	Interdependence	✓	✓	↓	✓	↓	✓	↓	
S27	Subcontractor	62%	Volume	High	>3 years	20%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S28	Material Supplier	62%	Critical	Low	>3 years	6%	High	Independence	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S29	Subcontractor	64%	Non-critical	High	>3 years	21%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S30	Subcontractor*	65%	Volume	High	>3 years	9%	High	Independence	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S31	Subcontractor	65%	Critical	Low	>3 years	No data	High	Interdependence	No data	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S32	Subcontractor	66%	Volume	High	>3 years	22%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S33	Subcontractor	67%	Special	Low	>3 years	42%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S34	Material Supplier	67%	Critical	Low	>3 years	13%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S35	Subcontractor	68%	Special	High	>3 years	45%	High	Buyer dominance	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S36	Subcontractor	68%	Critical	Low	>3 years	4%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S37	Subcontractor	69%	Critical	Low	>3 years	44%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S38	Subcontractor	70%	Volume	High	>3 years	19%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S39	Subcontractor	70%	Critical	High	>3 years	18%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S40	Material Supplier	70%	Special	Low	>3 years	4%	High	Independence	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S41	Subcontractor	71%	Non-critical	Low	>3 years	18%	High	Buyer dominance	✓	✓	↓	✓	↓	✓	↓	
S42	Subcontractor*	71%	Non-critical	High	>3 years	24%	High	Buyer dominance	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S43	Material Supplier	72%	Volume	High	>3 years	13%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S44	Material Supplier	72%	Volume	High	>3 years	46%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S45	Subcontractor	73%	Volume	High	>3 years	1%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S46	Subcontractor*	73%	Non-critical	High	>3 years	3%	Low	Supplier dominance	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S47	Subcontractor	74%	Critical	Low	<1 year	46%	High	Buyer dominance	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S48	Subcontractor*	74%	Critical	High	>3 years	1%	Low	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S49	Subcontractor	74%	Special	Low	>3 years	10%	High	Independence	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S50	Subcontractor	75%	Critical	Low	>3 years	17%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S51	Subcontractor*	75%	Special	High	>3 years	8%	High	Independence	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S52	Subcontractor	75%	Volume	Low	>3 years	6%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S53	Subcontractor*	76%	Critical	High	>3 years	6%	Low	Supplier dominance	✓	✓	↓	✓	↓	✓	↓	
S54	Subcontractor	76%	Critical	Low	>3 years	9%	High	Independence	✓	✓	↓	✓	↓	✓	↓	
S55	Subcontractor	76%	Critical	High	>3 years	6%	High	Interdependence	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S56	Material Supplier	77%	Special	High	>3 years	14%	High	Independence	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S57	Subcontractor	77%	Non-critical	Low	>3 years	6%	Low	Supplier dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S58	Subcontractor	77%	Critical	Low	>3 years	No data	Low	Independence	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S59	Subcontractor	78%	Critical	Low	>3 years	12%	High	Independence	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S60	Subcontractor	78%	Non-critical	Low	>3 years	18%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S61	Subcontractor	78%	Special	Low	>3 years	12%	High	Independence	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S62	Subcontractor	79%	Critical	Low	>3 years	51%	High	Buyer dominance	✓	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S63	Subcontractor	79%	Non-critical	High	>3 years	4%	High	Independence	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S64	Subcontractor	79%	Special	Low	>2 years	87%	High	Buyer dominance	No data	✓	No data 2014	✓	No data 2014	✓	No data 2014	
S65	Subcontractor	80%	Non-critical	Low	>3 years	34%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S66	Subcontractor	80%	Critical	Low	>3 years	No data	High	Independence	No data	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S67	Subcontractor	80%	Volume	Low	>3 years	49%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	
S68	Material Supplier	80%	Critical	Low	>3 years	22%	High	Buyer dominance	✓	✓	No data 2013	✓	No data 2013	✓	No data 2013	

Firstly, 40 % of the supplier base audible within the 80 % of annual spend fall within the **buyer dominant group**. The buyer dominant group includes a total of 27 suppliers, representing 73 % of the spend share under analysis. This is the quadrant where supply is more or less abundant, and in addition, Blue has relatively high % share of total market for the supplier. As suggested by (Cox, 2004) these are the situations where supplier development and even supply chain management sourcing approaches should be really effective. This is because the buyer is able to incentivize suppliers to enter into collaborative relationships (Cox et al., 2006). Thereafter, one

might wonder why actions against supplier S3, a subcontractor of ground works, have not been carried out yet. The performance indicators reveal major shortcomings in the supplier performance, and in particular, related to compliance with safety instructions and agreed timetables. In a participatory discussion with the district purchasing manager, these areas were found to be particularly critical in terms of ground works. It is not part of this study to determine whether it would make more sense to switch the supplier or to strive developing the current supplier in question. Notwithstanding, the relatively high share, 27 % of total market for this supplier would on the other hand allow the exploitation of inter-firm influence strategies to control the relationship. By making use of this approach, the possible benefits generated during the many years of co-operation would not be terminated.

Furthermore, over 50 % percent of the buyer dominant quadrant suppliers represent critical or special construction items classes, which are often the target of improvement activities (Gordon, 2008). These 14 suppliers are considered both strategic and critical for the company, and in addition, any improvement activities are considered feasible due to the prevailing power circumstance. Alternatively, seven suppliers of the group construct are characterized as volume suppliers (low effort but high profit impact). Here, it is proposed that exploiting low-involvement development activities, such as incentives or other communication approaches, could gain appreciable results. Regardless of the desirable power circumstance, the volume and leverage construction category presents an interesting opportunity to decrease costs Ferreira et al. (2014).

*Secondly, the interdependence category* comprises not more than 7 % of suppliers in the region and only 2,2 % of the spend share under analysis. There are only few, if any, alternative supplier providing similar products, but then again, Blue's purchases form a relatively high share of the total market for the supplier. Like the previous category, the interdependence regime is really prospective for development activities (Cox, 2004). In addition, deeper review strengthened the belief that suppliers in this

group possess relatively unique offering (Cox, 2004). Critical and strategic supplies are important to the buying firm and of major importance of overall, and therefore, often warranted supplier development. One of the suppliers in this category (S12) seems to have weaker financial status, but otherwise the performance levels don't seem to require immediate direct measures to remedy deficiencies in supplier performance. Due to the criticality, important for the case company would be trying to get the suppliers fully integrated in the supply chain. Often the high level of total interdependence indicates mutual trust and loyalty, making the both parties most likely to be willing to invest in the relationship (Caniels & Gelderman, 2007). Given this, the firm needs to analyze whether high interdependence is really prevalent as well as analyze whether any development measures, e.g. product development projects, bring any added value.

*Thirdly*, 18% of the 80 % aggregated spend is procured using independent transactional relationships. **This independence group**, 37 % of suppliers under analysis, consists of abundant supply and demand situations; there are a lot of alternative suppliers and buyer has relatively low percentage share of total market for the suppliers. From the analysis it seems that suppliers stem quite evenly from all item categories; volume, strategic, non-critical and critical. This implies that transactional supplier relationships are quite common procurement strategy for the firm in all types of product and service categories. Although this type of strategy may bring some advantages, the disadvantages may include lack of trust between parties and relatively high level of uncertainty as well as higher transaction costs (Pala et al. 2014). Therefore, one might wonder why more collaborative relationships have not been established with the suppliers belonging to the special and critical categories, which constitute as much as 64% percent of the total independence group. Furthermore, the suppliers' performance seems to vary to a great extent when looking at performance indicators. Due to a high level of alternative suppliers, the company could phase-out the low performing suppliers from the supplier base. Alternatively,

one option is to view more deeply whether individual suppliers are committed to the buying firm and utilize low involvement strategies to improve the performance.

*Finally*, the last 11 suppliers positioned oneself to the **supplier dominance group**, which represents almost 6% of the spend share under analysis. Noticeably, suppliers of this group are more or less one of a kind; there are none or at most few alternative suppliers. When observing the individual suppliers of this group we can see that they provide mainly strategic or critical construction item classes. Performance signals expose supposedly decent performance levels from the suppliers in question, although admitting descending trend curves from suppliers S7, S16 and S48. Due to the suppliers' power resources, the buyer might feel powerless to demand performance advancements. Yet, Cox et al. (2003) found out that even dominant suppliers do value the buyers enough to invest resources in collaborative activities, although the increase in excess value is principally kept by those suppliers. As a result, Blue might employ a *recommendation strategy* whereby it indicates the supplier will be more profitable if it follows the buyer's suggestions (Frazier & Summers, 1984). If the buyer can assure the supplier of the improvement proposals' usefulness, both the buyer and supplier may proceed with investing specific assets to the relationship.

## **5.7 Case discussion and limitations**

In its entirety, the 3-step supplier segmentation process demonstrated how much information the buyer can generate from its supply base to support its decision making processes. Also, it can be concluded that the prevailing power circumstance not only reveal what is feasible for the buyer to perform, but also what level activities should be favored at the maximum. In other words, if the buyer has leverage and the item provided by the supplier does not represent strategic or critical construction items for the company, there is no need to employ direct involvement strategies. At

the strategic level, this type of categorization assists in the development of more proactive development strategies.

The main limitation with the present study is the fact that only one case was used. Furthermore, it is acknowledged in that Stage 2, the positioning of the construction commodities and took place on subjective views of one expert (in addition to purchasing statistics) which may lead to erroneous outcomes if the results are not validated with other company experts. In addition, it is acknowledged that the developed directory may not include all of the important information that is needed to disclose which suppliers should be developed (e.g. suppliers' switching cost or their willingness to change). However, it is emphasized that filling of such data, precise in nature, should be carried out in later stages when validating strategies to improve individual suppliers.

## **6 2<sup>nd</sup> EMPIRICAL STUDY: analyzing supplier performance through statistical tests**

To evaluate supplier performance, Blue utilizes internal company surveys of suppliers as an evaluation approach. During the present study, the evaluation method was integrated as a part of the Blue's internal e-procurement system. Given this, the semi-structured interviews inquiring supplier's performance were replaced with electronic questionnaires. The template was retained the same (see Appendix 1). In both of the procedures, the building site employee, site manager or foreman, was asked to evaluate the suppliers' performance in various dimensions using Likert scale of 1-5. As the IT functionality has just been launched, the leading part of the evaluations analyzed in this thesis are gathered as site interviews (n=1049/1376). Furthermore, the author of this research has represented the interviewer in majority of the occasions. In order complement the answer of the first research question, the purpose of this chapter is to shed light on factors that are influential to supplier's performance in terms of safety, quality and compliance with agreed timetables.

The first unit of analysis (regression) includes evaluations from material suppliers, consultants and subcontractors. From the total of 1376 evaluations, 81 % pertain to subcontractors and 17 % to material suppliers. Furthermore, from all evaluations, 85 % belong to project-specific suppliers while rests comprise from framework agreement suppliers' evaluations. Later, the focus is centralized around the previously formed supplier segments and other distinct groups of suppliers. Here, the purpose is to explore whether the performance levels vary significantly between group constructs.

### **6.1 1<sup>st</sup> Analysis: regression**

Simple and multiple regression analyses were utilized for describing supplier's performance in terms of compliance with safety instructions (1.3), timetables (2.2),

and finally, performance quality (3.2) (see Appendix 1). The above-mentioned were chosen as dependent variables because they retell Blue's prevailing business strategy the most. The rest were placed as independent variables. Furthermore, yearly spend of the supplier was added in the model as an independent variable. The amount of purchases from the supplier during one year of activity was extracted from the company's database and made to match the individual evaluations. This was hypothesized to influence the key variables based on the recommendations by Ireland (2004).

In order to test relationship among variables, we hypothesized as follows: H0: All independent variables are unimportant for predicting dependent variables. Before executing the regression analyses, all variables were tested with respect to normality and multicollinearity. Using a significance level of 0.05, all p-values less than 0,05 indicate that the data of continuous variables follow a normal distribution based on the Anderson-Darling Normality test. Furthermore, Pearson correlation analyses reported that all variables correlated positively or significantly with the dependent variables: quality, safety and timetables (Table 7). However, the correlation among the independent variables were moderate, but not enough to be concerned about ( $VIF \leq 5$ ) (Martz, 2013). Furthermore, in all of the models the data was diagnosed for high residuals and unusual x values. Exploiting simple regressions, Table 7 demonstrates that nearly almost all of the relationships between the dependent and independent variables are significant ( $p < 0,001$ ). Only the relationship between compliance with safety instructions (1.) and yearly spend (12.) is not statistically significant. Based on the 5 highest R-squared values, independent variables were chosen to multiple regressions for deeper analyses.

Table 7. Pearson's correlation matrix and the relationship between the independent and dependent variables

<i>Dependent variables</i>	<i>1. Safety</i>			<i>2. Timetables</i>			<i>3. Quality</i>		
	<b>P. Cor</b>	<b>P-value</b>	<b>R-sq</b>	<b>P. Cor</b>	<b>P-value</b>	<b>R-sq</b>	<b>P. Cor</b>	<b>P-value</b>	<b>R-sq</b>
1. Compliance with safety inst.	1			0,41	< 0,001	17,21 %	0,48	< 0,001	17,21 %
2. Compliance with agreed timetables	0,41	< 0,001	17,21 %	1			0,59	< 0,001	34,25 %
3. Performance quality	0,48	< 0,001	23,75 %	0,59	< 0,001	34,25 %	1		
<i>Independent variables</i>									
4. Attitude towards safety	0,82	< 0,001	67,04 %	0,43	< 0,001	18,24 %	0,48	< 0,001	23,41 %
5. Cleanliness, order & environmental performance	0,66	< 0,001	43,48 %	0,42	< 0,001	18,26 %	0,47	< 0,001	22,70 %
6. Development activity in safety improvement	0,45	< 0,001	45,82 %	0,39	< 0,001	14,83 %	0,45	< 0,001	19,91 %
7. Supervisor expertise and availability	0,48	< 0,001	20,17 %	0,59	< 0,001	34,31 %	0,58	< 0,001	33,47 %
8. Unfounded claims presented by the supplier	0,34	< 0,001	11,40 %	0,38	< 0,001	14,45 %	0,39	< 0,001	15,20 %
9. Billing and payment terms	0,33	< 0,001	10,38 %	0,39	< 0,001	15,69 %	0,38	< 0,001	14,69 %
10. Agreement compliance	0,43	< 0,001	18,85 %	0,58	< 0,001	33,50 %	0,61	< 0,001	37,16 %
11. Development activity (way of working)	0,46	< 0,001	20,89 %	0,54	< 0,001	30,66 %	0,45	< 0,001	20,89 %
12. Yearly spend	0,04	< 0,108	0,19 %	-0,031	< 0,001	1,07 %	-0,048	0,012	0,64 %

### 6.1.1 Results

Figure 13. provides the results of the multiple regressions analyzes by visualizing the the main effects of the independent variables. To begin with, it needs to be stated that in all three of the multivariate models the estimate R-squared values are very good considering that the data is collected by questionnaires. In other words, 52-70 % of the variation of the output factors can be explained by the independent variables. Furthermore, the large sample size utilized here is large enough to obtain precise estimate of the strengths of the relationships.

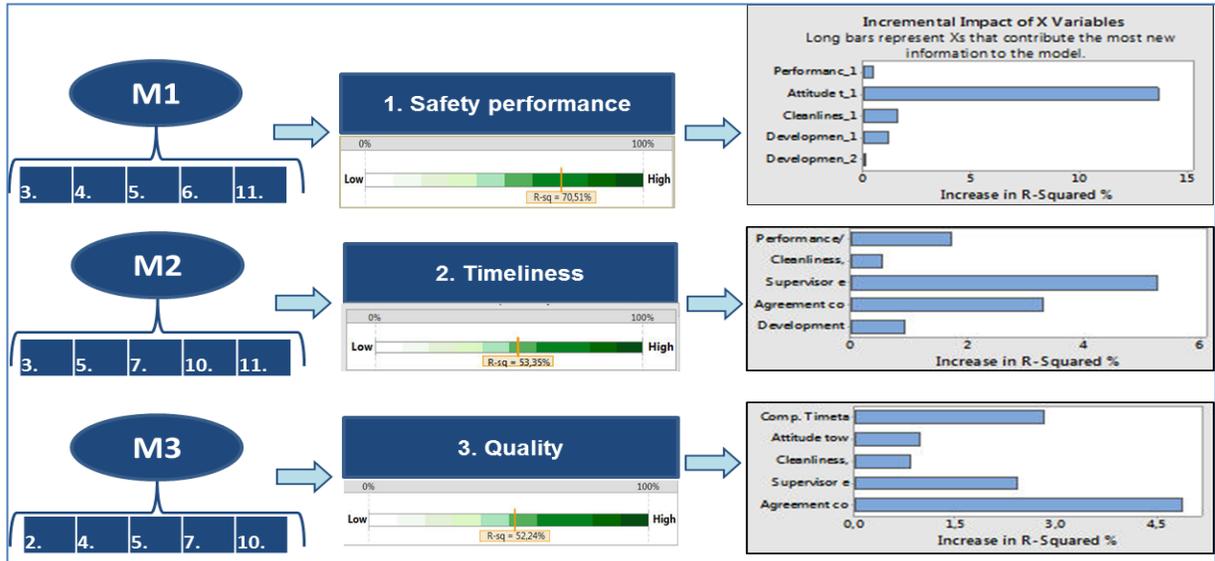


Figure 12. Multiple regression models and incremental impacts of independent variables

Furthermore, there are statistically significant predictors ( $p > 0,001$ ) in all of the models, allowing us to draw important conclusions about how changes in the independent variables are associated with changes in the dependent variables of safety, timeliness and quality. The individual main effects of independent variables are visualized in Figure 13.

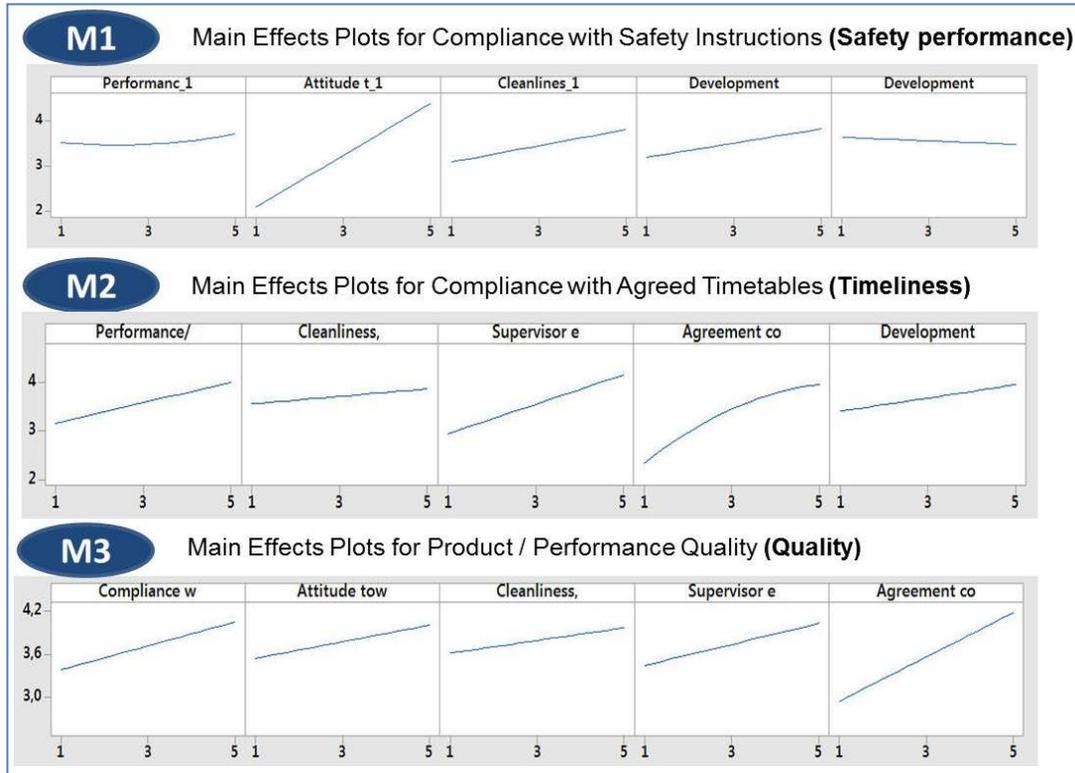


Figure 13. Main effects plots: the impact of independent variables of dependent variables

In the first model (M1) it was examined the interrelationships between safety performance and the independent variables. According to the results, supplier's attitude towards safety (4.) was the most important consideration in explaining the variation of safety performance followed by cleanliness, order and environmental consideration (5.). Together with development activity in safety improvement, performance quality (3.) and overall development activity (11.), the model explains the the variation of safety performance as much as 70,51 %. In all of the models, only 5-6 % of the observations were marked as having a large residual and were not seen as necessary to remove.

In the second model (M2), the R-sq did not equal as high as in the first model (53,3 %) indicating that there are more other factors that are playing important role in the background. But then again, it appears that suppliers' supervisors' expertise and

availability contributes the most information to this model followed by agreement compliance. Again in the final model (M3), agreement compliance seems to affect the most on the dependent variable of quality performance, followed by the variable compliance with agreed timetables. For the third model under consideration, all independent variables fit the data as much as 52,24 %.

The results of the multiple regression analyses are useful for the case company. For instance, as suggested in the model 2, if the firm tends to select and maintain subcontractors with capable and available supervisors (variable 7), it may increase the suppliers' overall compliance with agreed timetables. This in turn, may have positive effect on project's costs. On the other hand, from the effects report it was found that supplier's tendency to follow contract agreements (variable 10.) has a more radical positive effect on compliance with agreed timetables. This information can be exploited in the future, as suggested by Wagner (2010), clear objectives presented by the buyer lead to eligible supplier performance. This implies that when the buyer invests time and effort for making explicit agreements, it may improve the supply base performance especially in terms of timeliness and quality.

## **6.2 2<sup>nd</sup> Analysis: analysis of variance**

In order to distinguish supplier performance and to come up improvement strategies, it is necessitated to observe whether the performance levels vary between distinct groups of suppliers. The latter refers primarily to the four diverse power circumstances, particular supplier groups (material suppliers/subcontractors), categorical supplier classifications (A/B/C/D) and frequency of the exchange with the supplier (low/high). Accordingly, one-way analysis of variance (ANOVA) is used to determine whether the means of the dependent variables are the same in over two independent groups of an independent variable. Similarly, 2-sample t-tests were performed to identify possible differences in supplier performance when supplier groups exists only two, e.g. framework agreement suppliers and project-specific.

In order to make comparisons, particular evaluations of suppliers were associated with the category specific information, i.e. supplier specific information were drawn and combined to match the individual supplier feedbacks. Table 8. displays sample sizes, i.e. the amount of individual supplier evaluations, in every category construct. Minitab's Assistant was employed for performing the ANOVA and t-test analyses. Since Assistant uses Welch's method, the group variances and sample sizes did not need to be the same. Furthermore, normality was not an issue in the analysis due to large sample sizes in all constructs. Apart from supplier classification (SC) compound, other constructs refer to the evaluations of the suppliers segmented in chapter 5.4, comprising 671 individual evaluations. The classification construct reached as much as 1376 evaluations, representing the whole quantity of evaluations gathered from all business units. Table 8 includes also observation value averages and standard deviations for the dependent variable under each category construct.

Table 8. Means and standard deviations for the supplier constructs

Code	Construct	Sample Size	Safety		Timeliness		Quality	
			Mean	Std	Mean	Std	Mean	Std
PC	<b><i>Power circumstance</i></b>							
BD	Buyer dominance	172	3,395	0,958	3,720	0,987	3,767	0,789
INT	Interdependence	132	3,590	0,781	3,810	0,925	3,500	0,875
ID	Independence	110	3,427	0,840	3,681	1,039	3,878	0,688
SD	Supplier dominance	257	3,887	0,799	3,626	1,132	3,794	0,888
PM	<b><i>Procurement method</i></b>							
FA	Framework	334	3,700	0,794	3,697	1,093	3,694	0,878
PS	Project-specific	337	3,554	0,937	3,694	0,990	3,816	0,780
SC	<b><i>Supplier classification</i></b>							
A	Recommended	65	4,123	0,739	4,046	0,908	4,062	0,726
B	Applicable	1217	3,528	0,904	3,685	1,057	3,788	0,871
C	Candidate	68	3,323	1,043	3,455	1,138	3,764	0,994
D	Forbidden	26	3,460	0,947	3,269	1,079	3,461	0,989
SP	<b><i>Supplier type</i></b>							
MS	Material Supplier	520	3,692	0,709	3,788	1,080	3,781	0,790
SU	Subcontractor	151	3,628	0,913	3,669	1,031	3,748	0,844
FE	<b><i>Frequency of the exchange</i></b>							
LW	Low	215	3,660	0,839	3,837	1,507	3,883	0,755
HH	High	456	3,611	0,937	3,629	0,998	3,695	0,860

### 6.2.1 Results

Firstly, one-way ANOVA was used for resolving that if there are statistically significant differences between the four power quadrants (see Table 9 and Figure 14). For the case under consideration, we were able to reject the null hypothesis in many cases, at the significance level of 0,05. Accordingly, power circumstances seem to have significant influence in two of the three supplier performance measures.

Table 9. ANOVA analysis and 2-sample t-test results between item constructs and dependent variables

Code Construct	Safety		Timeliness		Quality	
	P-value	F-value	P-value	F-value	P-value	F-value
<b>PC</b> Power circumstance	< 0,001*	14,510	0,387	0,950	0,003*	4,690
<b>SC</b> Supplier classification	< 0,001*	10,410	0,002*	4,920	0,013*	3,330
	P-value	T-value	P-value	T-value	P-value	T-value
<b>PM</b> Procurement method	0,015*	2,170	0,968	0,040	0,029*	-1,890
<b>SP</b> Supplier type	0,928	-0,090	0,231	1,200	0,653	0,450
<b>FE</b> Frequency of the exchange	0,518	-0,650	0,014*	-2,470	0,004*	-2,880

\* Significant at a level  $p (>0,05)$

Firstly, mean comparison charts in Figure 14 reveal that suppliers which are overshadowed by *buyer dominance* show significantly lower level of performance for the continuous indicator: safety performance. Most importantly, it can be distinguished that *the interdependence group* mean is significantly different and lower than the three other means for product/performance quality ( $p= 0,003$ ). It is somewhat surprising to conclude that suppliers which have been awarded greater amount of turnover have a significantly lower performance concerning quality.

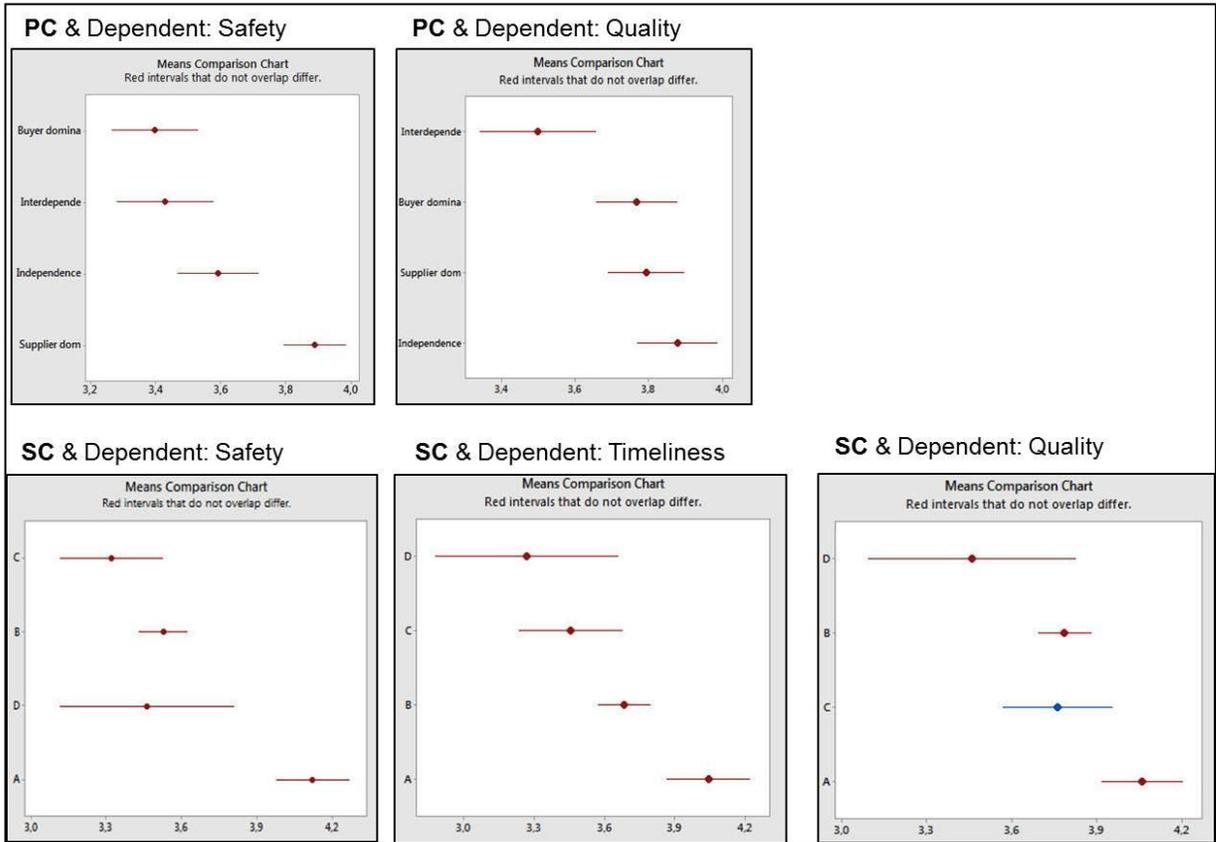


Figure 14. Means comparison charts between power circumstance (PC) and supplier classification (SC) group constructs by dependent variables

Secondly, supplier classifications seem to have significant influence on all of the three supplier performance measures. In almost all occasions, mean comparison charts reveal that the higher the supplier rating, the better is the supplier’s performance. For instance, the chart in Figure 14, reveals that supplier classification group C and D have significantly lower mean in all of the variables compared to the supplier classification group A. Lower classification is often a result of a weak financial performance or a sign of troubles in terms of societal obligations. What all of this means, therefore, is that by prohibiting purchases from D and C listed suppliers could result into better performance mean for the whole supplier base. Currently sufficient measures in restricting purchase behavior don’t exist in Blue’s operational system.

Two sample t-tests were adopted to compare the averages between two groups and determine if there is a significant difference between them. Accordingly, in all of the experiments the null hypothesis was that the supplier performance is equal between the two groups of suppliers. In the first set, the chosen procurement method (framework/project-specific) had a significant influence on dependent variables safety and quality. Presumably, the more experienced framework agreement suppliers announced significantly greater mean in safety performance ( $p=0,015$ ) which can be explained from the influence of strategic supplier status. On the other hand, we did not expect that the mean of framework agreement suppliers is significantly less than the mean of project-specific suppliers ( $p=0,029$ ) when quality embodied the dependent variable. Perhaps the larger amount of transactions is made possible at the expense of quality.

Subsequently, differences in the means of two supplier groups, material and subcontractors, were not identified in any of the three dependent variables. On the contrary, frequency of the exchange proved to have significant influence on two of the performance indicators. Here, the mean of high group was significantly less than the mean of low group ( $p=0,014$ ) in terms of compliance with agreed timetables. This is indicative of the fact that the projects perceive the frequently used suppliers carry out their fulfillments later. Likewise, this group demonstrated to maintain significantly lower mean than the low frequency group ( $p=0,004$ ) in quality. Preceding findings may indicate shortages in supply reserves due to high demand which also has proportional reflection to the quality of products and performance.

## **7 3<sup>rd</sup> EMPIRICAL STUDY: Initiating supplier development with a major kitchen cabinet supplier**

This chapter displays a real-life supplier development initiative which aims to identify improvement areas in the interface between the case company Blue and its major supplier providing kitchen cabinets, which in this thesis is referred as *Yellow*. Although the parties have shared co-operation for many years, the prevailing way of working is perceived as inadequate in terms of efficiency and functionality causing money leakages from the supply chain. As a result, Blue desires to develop closer and more efficient working relationship with Yellow through standardized processes.

The study initiates by investigating managerially relevant issues in the buyer-supplier relationship and evaluates different performance management choices through the prevailing power and leverage circumstance. During the study it became obvious that the current kitchen cabinet design process needed a clearer outline as well as more detailed determination of responsibilities. Therefore, four in-depth interviews were conducted in order to gain data and insights to re-engineer the desired state. The research direction was changed to include a service blueprinting technique to implement an effective change between Blue, the external architect and Yellow. At first, background to the case is introduced, followed by the preliminary research investigations. The final section visualizes and reviews the constructed blueprint of the kitchen cabinet design process. Finally it is concluded that the proposed framework would improve the overall performance of the kitchen cabinet supply chain.

### **7.1 Background to the case: kitchen cabinet procurement**

The parties involved have shared intense co-operation for many years in residential building making it profitable to establish a national framework agreement in 2010. From this year onward, Yellow has provided kitchen and bathroom cabinet materials

to over 170 Blue's projects across Finland. In majority of the projects, Yellow has provided installation service as well. As a result, cabinets have been installed by the Yellow's own cabinet installers or external 2<sup>nd</sup> tier subcontractors that Yellow has procured. To generate competition in the market, occasionally Blue has awarded contracts to smaller national and international suppliers. Owing to the long distances in Finland, the second largest player (see supplier 2 in Figure 15) in the supply market tends to dominate Northern Finland. Figure 15 displays the spend division by suppliers utilized in the kitchen cabinet materials and installation category on a national level in 2013.

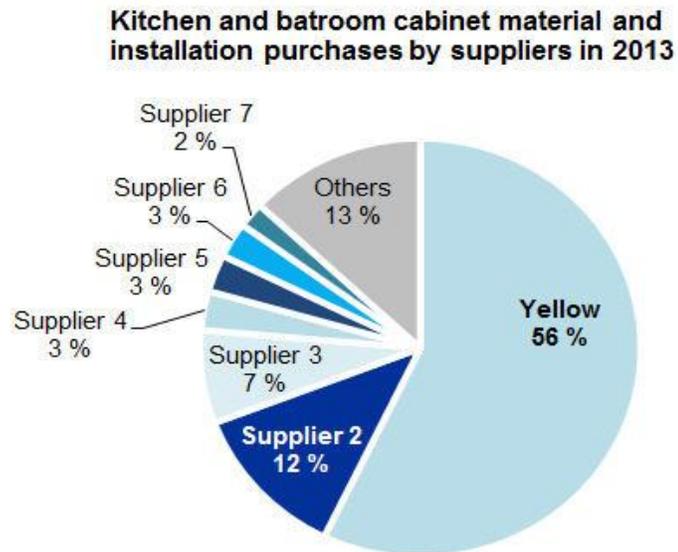


Figure 15. The division of spend between kitchen and bathroom cabinet material suppliers in 2013

Blue wishes to increase the level of international kitchen cabinet purchases in the future. At present, however, the potential international suppliers do not possess the required maturity level in order to deliver other than the individual projects. To begin with, the Blue seeks to improve the current way of working with Yellow in order to take advantage of the model with other suppliers as well. For instance, Blue has prefigured its future proactive strategy to include standardized design of key components in the pursuit of lower input costs. This work is planned to be initiated

together with Yellow so that the best practices could be transferred to concern other supply offerings as well. Thereby, the Blue's purchasing department has established a cross-functional working group whose task is to achieve the desired goals. This team consists of persons from different units; line organization, purchasing department and persons from the production design management. The established category team has defined its goal as follows:

*"To endeavor lower total cost by improving supply chain processes and by increasing competition in the market. Secure and improve RD profitability and desirability by having right suppliers."*

### **7.1 Methodology for the case**

The interface between Blue, Yellow and the external architect was investigated through value stream analysis approach. This approach included process activity mapping and service blueprinting techniques. The literature review already pointed out value stream management as a potential approach for supplier development since it aims to improve productivity. Using this approach, companies may choose from series of contingent tools, from which the process activity mapping is the most comprehensive, and utilized (Hines & Rich, 1997). On the other hand, if the joint-processes are in the development stage, the service blueprinting technique might be a useful mean for understanding the management of external relations (Fliess & Becker, 2006). This technique was originally developed by Shostack (1984). According to Frödell & Josephson (2008) the use of service blueprinting facilitates the arrangement of processes as well as comparative appraisal since it provides the participants a comprehensive view of the whole process rather than focusing on the burdens of specific persons.

For the case under consideration, in-depth interviews and participatory observations comprised the primary method for data collection. Informal conversations, supplier's

websites, purchasing statistics and other internal documentation were also exploited. For the four in-depth interviews, a semi-structured approach was chosen, allowing the interviewees to freely answer a number of questions as well as point out areas not inquired. The interviewees included persons from the Blue's organization who are in a continuous contact with the supplier as well as the external architect; two project managers, customer guide, design manager and one purchaser. The duration of these interviews varied from 60 to 90 minutes. For the present case, it was focused on remarks reporting on the difficulties and desirable possibilities for improvement. After the primary interviews, the researcher used time to visualize the desired kitchen cabinet design process. Afterwards, the process was revised with the help of the customer guide and the design manager in order to increase the validity of the created process.

## **7.2 Analyzing key power resources in the buyer-supplier relationship**

As the literature review demonstrated; only by analyzing supply chain circumstances and key power resources in it, it is clear for companies to understand the relationship management choices and strategies available to them. In order to clarify the feasibility in achieving the kitchen category team's goals, the key power resources in the principal supplier relationship are analyzed in this chapter. In the previous chapter, this buyer-supplier relationship was positioned in the *supplier dominance* quadrant (see ID S5 in Table 6). By tradition this leverage situation is least conducive to the implementation of supplier development and other proactive strategies (Cox, 2004). Despite this, a more detailed analysis could upgrade this transaction to the power situation of *buyer-supplier interdependence*, which is more preferred situation for the utilization of supplier improvement strategies. Next, the leverage situation is observed from both from the demand and supply sides and summarized in Tables 10 and 11.

Blue has a regular need to procure from the kitchen cabinet market for the purposes of residential and commercial building (see Table 10). Ongoing projects requiring

kitchen cabinet and bathroom materials constitute around 25 % of Blue's project portfolio. Although the Finnish construction market is highly fragmented, there are currently five other large construction companies in housing construction that need to procure from the kitchen cabinet markets. Blue's share of housing construction covers around 15% of all the main contractors in Finland making it relatively viable player in the market.

It is estimated that Blue procures around 2,500 kitchens annually from Yellow, which constitute around 70% of Blue's projects with kitchens on an annual basis. It is clear that Blue is relatively reliant on the supply of Yellow. However, the established category team possesses profound knowledge of the supplier markets which can be utilized in the creation and development of new purchasing sources. Despite this, considering that the demand from Yellow is continuous, the development of a deeper proactive procurement strategy would most likely bear benefits for both parties. Blue is also fully aware of the potential scope for standardization of key components and kitchen models across the projects. Blue expects that this would increase both parties efficiency and also reduce the amount of rework. The developed best practices could also be utilized with other suppliers later on. This could also reduce Blue's dependency on Yellow.

Table 10. Demand-side market and key power resources

Demand-Side Market and Key Power Resources

There are many main contractors acting as buyers, but fewer players demanding kitchen cabinets in larger batches for project sales

In recent years, Blue's **share of housing construction accounts 15 %** of all main contractors in Finland

**Blue has a regular need to source from the kitchen cabinet market**, but there is not fixed amount volumes defined

For Blue, the utilization of framework agreements is attractive to ensure the price level and capacity, in which the Yellow

Therefore, Blue is **highly dependent** on Yellow in the current market situation

**Blue's requirements vary between projects**, which requires a supplier who possesses know-how to design and manufacture

Blue has medium switching costs, as although there are some alternative suppliers, only few have the reputation to provide products on the same scale and price-quality ratio

Luckily, Blue possesses **has deep knowledge** about construction products and services, especially from kitchen cabinets, and strategies of the supplier market

Blue is fully aware of the **potential scope for standardization** of design and specification of key components and certain kitchen models across the projects

When analyzing the key power resources of Yellow, the most important thing is to acknowledge that there is a relatively low level of contestation: only few alternative suppliers possess a reckoned market share in project sales. Furthermore, there exists only a scatter amount of other manufacturers capable of delivering the required kitchen cabinets for project sales with a strict deadline and a fair price-quality ratio demanded by main contractors in Finland. It is close on clear that Yellow is the preferred supplier for majority of the main contractors in Finland. But then again, one would describe the current market situation to be oligopolistic: Yellow seems to dominate the Southern parts of Finland, whereas the second largest market player seems to be a strong competitor in the North (see supplier 2 in Figure 15). Last year Blue's purchases from Yellow accounted a relatively low share (<6%) of the annual turnover of Yellow. However, if compared only to Yellow's annual project sales, the share of Blue's purchases is estimated to account nearly 25%. In this case, Yellow might consider Blue as relatively attractive for the hope of higher revenues. This could make the supplier more committed and willing to establish more proactive strategies with Blue.

Table 11. Supply-side market and key power resources

A Supply-Side Market and Key Power Resources

The kitchen cabinet industry in Finland has thrived and these companies have made good profit in recent years  
 Although there are some alternative suppliers providing kitchen cabinets, the supplier in this case is currently **the leading firm in professionalized building construction possessing nearly 50 % of the total market share of the kitchen cabinet markets**

Yellow has a very strong brand image and reputation for delivering high-quality kitchen and bathroom cabinets  
 Yellow is **part of an international group, which is one of Europe's leading manufacturer of kitchen and bathroom**

While Blue's annual purchases from Yellow account a **relative low share (~ 6%) of the total annual turnover of Yellow**

However, in project-sales, it is estimated that Yellow produces kitchen cabinet materials for 10 000 kitchens every year, **of which Blue's share is estimated to account approximately 1/4**

Therefore, Yellow in this case is **relatively dependent** on Blue if it desires to maintain its dominant market share  
**Yellow is provided by ongoing revenue through a framework agreement.** For instance, the buyer has utilized it in 28 (out of 40) latest residential projects forming around 4,5 % percent of all the external purchases in these projects  
 However, Yellow has **low swithing costs**, and have other preferred customers as well

### 7.3 Possibilities for improvement

The purpose of this chapter is to identify the opportunities for improvement by specifying the findings from the semi-structured interviews, participatory observations, and one preliminary analysis. To begin with, long before establishing the category team in question, the supplier feedback received from the actual construction projects had denoted deficiencies in the supplier's performance:

*“The subcontractor foremen are hard to reach and their expertise is really weak. The flow of information inside their company is really slow. This causes continuous headache and extra work for us. The installers were late for couple of weeks and the quality of cabinets is weak once in a while. We received poor and even broken cabinets. We are forced to work with them because there are no alternative suppliers”*  
(Site Manager, 2014)

This and 46 other supplier evaluations exposed development needs from construction projects' perspective. Therefore, to start with, the researcher of this thesis conducted a preliminary analysis of a kitchen cabinet delivery and installation process occurring in an individual project site. In the present case, the supplier was responsible of the cabinet installation. By interviewing the site manager and two foremen, the time taken in each of the process steps was calculated (see Appendix 3). From the large amount of waste identified, a conclusion can be drawn that site operations are definitely not standardized. This finding is supported by the shared vision of the cross-functional category team that put emphasis on the following issues: 1) removal of non-adding work, 2) decrease the costs of installation and 3) establishing a clear way or working from design to product delivery between all parties involved.

However, this was a process description from an individual project site, and therefore, the results cannot be generalized to concern other projects as well. Moreover, an

informal discussion with a particular district manager revealed the larger potential for development:

*“You won’t get any significant saving just by measuring construction site processes that don’t exist. If we concentrate efforts to these individual construction sites we may just receive only marginal savings. The problems occur much earlier in the process. To reach 5-10 %, we need more fundamental changes.” (District Manager, 2014)*

In a similar vein, Love et al. (2004) emphasized that firms need to focus on involving contractors and subcontractors at an earlier stage in order to reach seamless construction processes from design to production. Successful collaboration and control between contractor and supplier may not be achieved within one single project, but may require long-term commitment. Accordingly, the interviews suggested that by focusing on streamlining the overall design activities and by bringing discipline through standardized solutions, all parties could the better avoid the drawbacks of re-design and other re-work:

*“In our (Blue) organization everyone do what they desire, without any proper framework. During design state, several persons approach to me with equipment levels and inquire whether this and this could be changed, i.e. we make too many adjustments to the kitchen drawings in the last minute. The supplier definitely has included these amendment cycles in their prices. We haven’t had common and standardized levels for kitchens, which we should have had ages ago. If we would, our salespersons could exploit it in advancing the apartment marketing and sales. Standardization would bring us competitive advantage.” (Category team member, 2014)*

This view by one interviewee from the design department crystallizes the main internal problems, and was supported by other respondents as well. First, it was emphasized that currently constant modifying hampers process efficiency and causes

interferences. One respondent claimed that even the supplier requires the buying organization to stop messing around. The internal lack of control leads in receiving the kitchen diagrams and price comparisons too late from the supplier. This escalates in delaying the advance marketing of apartments. In one project, for instance, new residents were forced to wait for as long as six months the selection of kitchen cabinets. In the end they were given only two weeks for decision making.

Secondly, all respondents emphasized the importance of standardization. This would reduce the variability in the supply chain and would be advantageous in terms of design as well as ease of purchasing (Arbulu et al., 2003). Standardization in this case stands for pre-determined kitchen collections and catalogues as well as other pre-determined alignments behind which Blue could stand for. One respondent pointed out that preliminary information supplemented now is not a standard template but rather than a long listing of notifications to the supplier.

The third dimension concerned changing the main design responsibility from the architect to the supplier. Respondents from the design and procurement organizations underlined that the supplier has the best knowledge of their own products and the required expertise for designing the kitchens diagrams. In other words, the architect should only have the replicate responsibility of the kitchen drawings created by the supplier. The supplier could also manage its own material suppliers better, e.g. procure materials well in advance (Arbulu et al., 2003). Some of the respondents pointed out that the architects' competence varies from side to side, e.g. when Blue has commented diagrams ought to be in good quality, it has escalated into bigger problems in later stages of the process.

To end up with, few of the respondents implied that one of the project managers has actually piloted the alternative way of working in separate housing projects. Transferring the main design responsibility from the architect to the supplier seems to result in more seamless procedures, as one of the respondents indicated:

*“When a new housing project is in the early design phase, various persons approach to me and asks the name of the responsible project manager. You see, one project manager is following the new approach meaning that the questioners have one less matter to worry. That includes me.” (Category team member, 2014)*

Respondents were also asked the about the strengths in the current way or working. Few of the respondents had experienced that cost estimation calculations and drawings are more easily available from the supplier due to the effectual framework agreement. Despite this, some of the respondents emphasized that the total contract amount nowadays can be sky high since products are not standardized. In other words, restricting design alternatives would most likely result in fixed amounts in building estimations.

#### **7.4 Blueprint of the desired buyer-supplier interface**

Service blueprinting method was used here to visualize the desired state of kitchen cabinet design process. A blueprint is basically a two-dimensional picture of a service process: the vertical axis separates different areas of actions and the horizontal axis depicts the line-up of actions conducted by members of either the customer or the supplier organization (Fliess & Becker, 2006). For the case under consideration, architect’s role was added. Based on the interviews and few replicate occasions, the constructed blueprint is visualized in Figure 16. The “line of interaction” isolates the buyer area from the supplier and architect area. Above this line there are measures to be performed by Blue’s organization. Next, the main elements of this process are demonstrated.

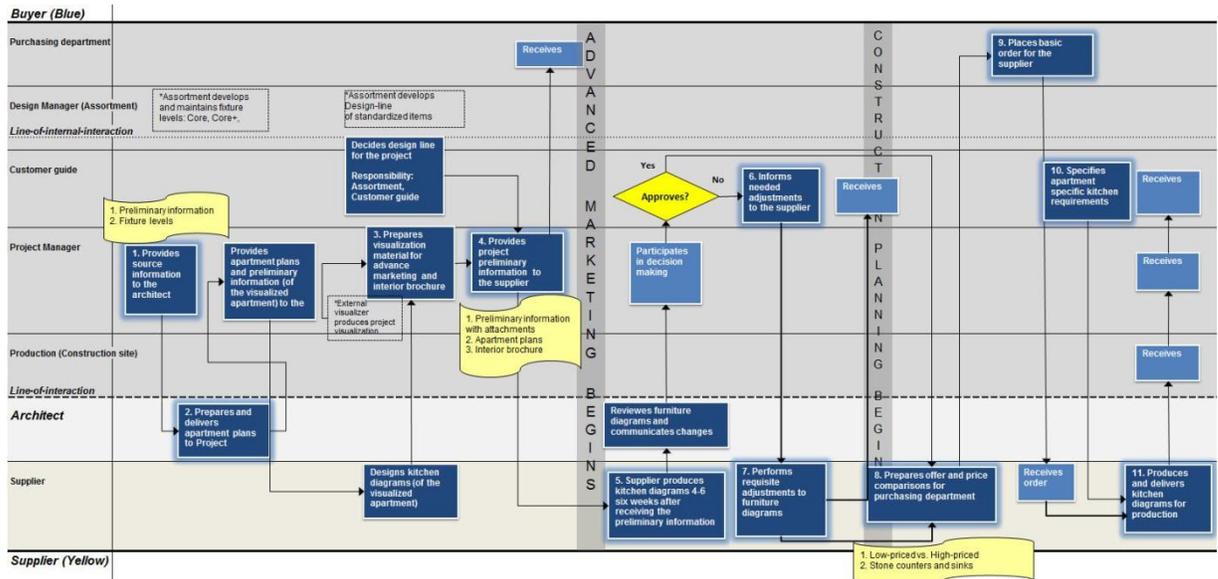


Figure 16. Blueprint of the desired buyer-supplier interface

Eleven main activities were identified to be included in the improved interface. The process kicks off when the responsible project manager transmits the pre-requisite information to the architect. All of the respondents underlined that preliminary information to be used in the future should be standardized. Here, the design manager (assortment) has the main responsibility of developing the fixture selection and design-line of standardized items. Since the maintenance of these activities should be continuous, they are placed above the line of internal action. In particular, the assortment has important roles in integrating the supplier and the end-customer in the preparation activities. In the next step, the architect creates and dispatches the apartment plans to the responsible project manager. This is where the desired state is different than the old way of working: the wall projection design is to be transferred to the responsibility of the supplier. The category team members emphasized almost in concert that this way of working would save all parties time throughout the process.

Before the project manager approves the visualization material for advanced marketing (Phase 3), the supplier has provided the kitchen diagrams of the visualized

kitchen. In the fourth stage, the project manager is responsible of providing the project preliminary information to the supplier. Before now, the design manager and the customer guide have agreed the suitable design line to the housing project under development. In the fifth stage, after receiving the prerequisites of the entire project, the supplier is given 4-6 weeks to design the kitchen diagrams. Next, the architect has the replicate responsibility of the images designed by the supplier. The final seal of approval, however, comes from the customer guide. If necessary, he or she informs the required changes to the supplier that is given approximately one week to perform changes to the fixture diagrams.

After final images are completed, the supplier is able to provide the offer and price comparisons to the purchasing department which can place the basic order through the procurement tool. In the current mode of operation, the purchasing department has not known the exact moment when to place this basic order. One respondent revealed that in one project actually the supplier contacted the purchasing department and inquired after the order. Reportedly the purchasing department was not even aware of the existence of the project! In this alternative way of working a respondent from the purchasing department emphasized that these unfortunate situations are avoidable. In the final stage, after the final apartment specific refinements have been sealed, the supplier is capable of providing the production diagrams to the construction site for production purposes. Obviously the process does not end here: the items need to be delivered and installed. In relation to this, one respondent emphasized that the supplier's current causes uncertainties, i.e. the buyer cannot promise to the end customer when it is able to provide a new cabin-door to replace the broken one. However, since it is claimed that early involvement of contractors in the design stage is a prerequisite for maximizing value and reducing costs (Bresnen & Marshall, 2000). This is why the interviews were targeted to improve only the initial design phase.

The discussions with the respondents revealed also some important aspects in general. Most importantly, the respondents emphasized the senior management's support in advancing the category team's work and making the implementation of improvement activities both legitimate and credible. The procurement expert, customer guide and the interior designer all underlined that the responsible project managers are the key to employ this alternative way of working to their construction sites.

The second issue related to the savings that are possibly generated in the future. All of the respondents felt that savings will be achieved in the working hours of many persons, and in particular, in supplier's time dedicated to planning and design if the blueprint is put into practice. However, no respondent was able to outline in more detail how the potential savings are passed from the supplier to the buyer. In the future, it is essential to validate the process by measuring the times spent on its turnaround and the prevent supplier from opportunistic behavior through specified agreements.

In its entirety, the interviewees supported: (1) the transfer of responsibility of the wall projection design to the supplier, (2) process and product standardization and (3) more precise definition of responsibilities. However, this case was limited to the perspective of the buyer which is why the supplier's willingness to employ the alternative way of working needs to be considered. The next target should be involving all parties together towards a shared set of objectives.

## **8 CONCLUSIONS AND RECOMMENDATIONS**

The main objective of this study was to expand the applicability of supplier segmentation and development approaches to the project business. The previous three chapters presented case studies in a large construction company operating in Finland. This thesis: (1) completed a supplier segmentation process starting from the classification of product and service categories resulting into the categorization of suppliers into the power distribution matrix, (2) examined the factors behind suppliers' performance, and finally (3) conducted a case study which identified improvement areas in the interface between the buyer and its major supplier to initiate supplier development work. This chapter offers the conclusions of the study in terms of answering the research questions defined in the introduction, assesses the theoretical contribution and managerial implications of the results, and suggests subsequent research avenues. Also the generalizability as well as reliability and validity of this research are reviewed.

### **8.1 Main results of the study**

The findings from the literature emphasized that supplier segmentation and development assists in maintaining a capable network of suppliers. Organizations may choose between the two extremes of supplier development (indirect vs. direct) that require different levels of buyer participation and implementation complexity. Interesting finding was that these different extremes proved to have contradictory individual effects on buyer-supplier performance. This underpins that there exist no one-size-fits-all development strategies that individual firms could employ (Dyer et al., 1998). This calls for supply base segmentation. Many demand also that in the construction project environment, what is applicable for construction buyer to perform, depends on the power and leverage situation from where it finds itself (Ireland, 2004; Cox et al. 2006; Cox & Ireland, 2002; Cox & Thompson, 1997). It was also emphasized that the differentiation of buyer-supplier relationships requires also the

evaluation of the supplier as well as the determination of strategic construction item classes. On the other hand, the extant literature does not include holistic guidelines of how to achieve this. Due to this incoherence, the present research provided a step-wise model for supplier categorization and the development of supply improvement strategies. Next, the value of the techniques used in the empirical case studies is reviewed. Summary of the entire empirical research is presented in Figure 17.

*In the first empirical case research*, the positioning of the major construction item classes inside the purchasing portfolio matrix took place. This break-up into the quadrants helps management to choose better supply strategies according to the effort required in the supply situation and profit impact. This can be leveraged to the benefit of supply base improvement. On the other hand, following the notions by Caniëls & Gelderman (2007) and Gelderman & van Weele (2005), it can be seen that the product-based portfolios are too superficial to capture the situations in supply markets and behaviors of individual suppliers. Furthermore, buyers in the competitive construction industry may not have the leverage necessary to elicit the supplier in a development program. Given this, the next phase included the segmentation of major suppliers in the four possible power combinations. Afterwards, this information was made to match the product specific information and the current performance of the suppliers. The information was entered in a supplier segmentation directory. This combined information showed quickly the needs for reactive supplier development to correct deficient supplier performance as well as the feasibility of establishing more proactive and strategic supplier development strategies. Therefore, this thesis supports the view by Wagner & Johnson (2004) who also found out that supplier segmentation increases the cost-effectiveness of purchasing processes by allocating resources in the most efficient way. In conclusion, segmentation of suppliers should be the precondition in aligning relationship management styles appropriately.

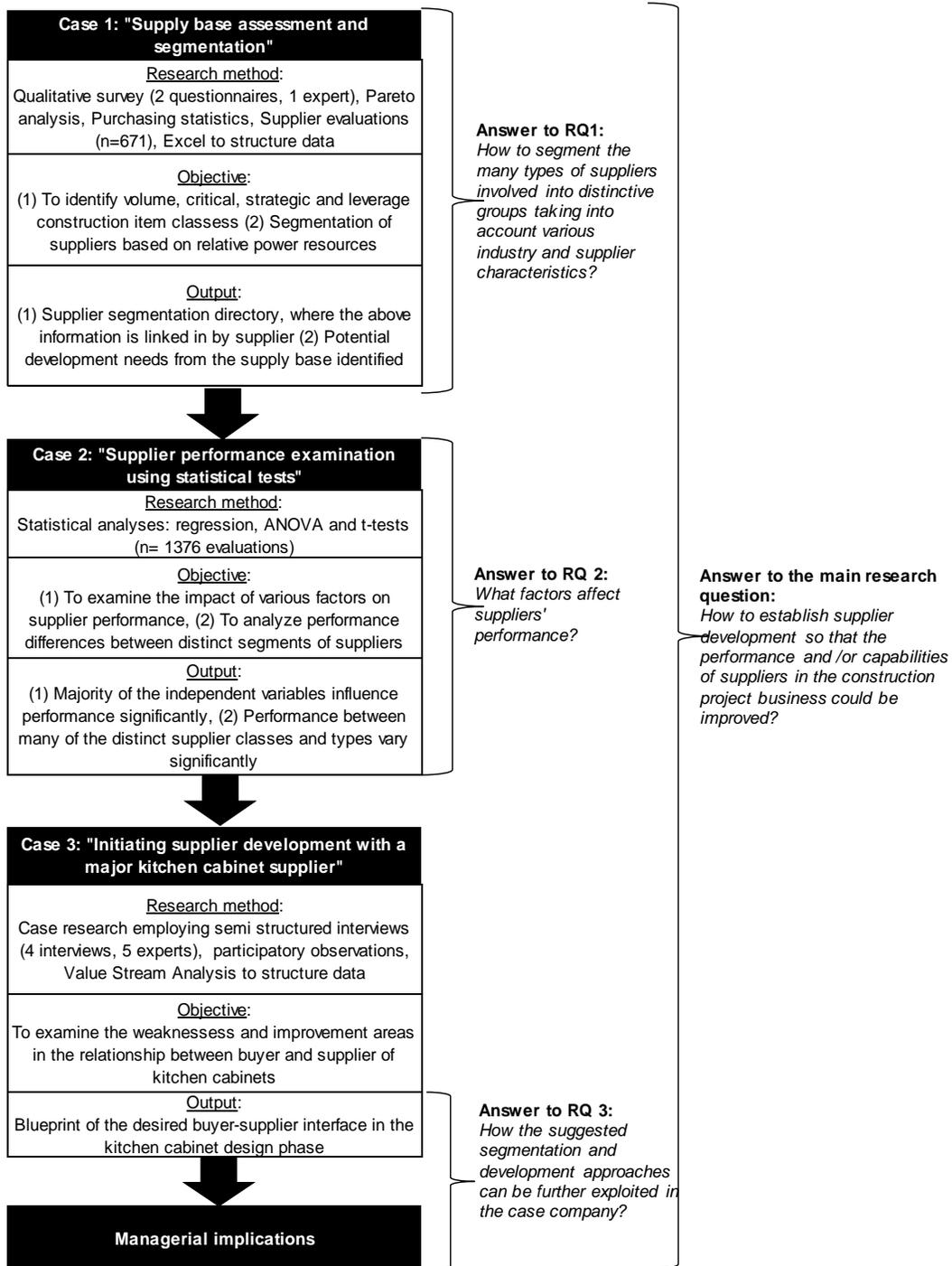


Figure 17. Summary of the empirical research

The second case research provided some initial understanding of how buyer-supplier relationship characteristics and other factors relate to suppliers' performance through

statistical tests. In the regression analysis, among all of the significant variables incorporated to the models, the supplier's attitude towards safety, supervisors' expertise and agreement compliance had the greatest incremental impact in the three output performance indicators. These findings can be translated to the benefit of the buyer, that can strive to improve the overall supply base performance by focusing on favoring suppliers that excel in the previous criteria. In the analysis of variance, it was witnessed that there are significant differences in performance between the distinct segments of suppliers. In particular, suppliers characterized by buyer-supplier *interdependence* and procured using *framework agreements* had significantly lower mean in terms of quality performance than other group constructs. In a similar vein, high *frequency of the exchange* seemed to impact negatively to timetables and quality. These case study findings are somewhat surprising since the general perception is that common shared past between the buyer and the suppliers lead to better performance. In conclusion, the findings show significant improvement areas within the suppliers that are offered a great deal of project sales.

*In the final empirical case study*, the purpose was to validate weaknesses and improvement areas in the interface between a main contractor and one of its largest and long-term suppliers. By interviewing key persons from the main contractor's side, it became obvious that the buyer represented a quite disorganized customer for the supplier in the kitchen cabinet design phase. By creating a blueprint of the desired process, the study identified considerable potential to increase efficiency and reduce costs in future buyer-supplier collaboration. More standardized ways to procurement lead to improved buyer-supplier relationships in the project environment, as suggested by Humpreys et al. (2003) and Love et al. (2004). Furthermore, the blueprinting technique was a valuable tool to document how processes between the interfaces should be re-engineered. The case also illustrated how integrated approaches are more valuable in establishing proactive supplier development strategies compared the sub-optimization of construction site-specific operations.

Also, consensus should be established through internal cross-functional team before approaching suppliers and require them to improve.

This explorative study provided indication that there exist no guidelines on how to establish supplier performance improvements in project-based industries even though the process-orientated manufacturing industry has proved its value through successful cases. The evidence from the construction industry is limited in few documented case studies, although it is suggested that concentrating on efforts in downstream suppliers may bring significant improvements. It is close on clear that close relationships is not required in all situations whereas all purchasing situations don't even require it. Furthermore, the study showed several constrains for construction buyers to engage in strategic level development as well all critical elements that should be paid attention. First of all, the study argues that if buyers become aware of their own power basis, they may leverage it the best possible way, i.e. direct involvement might not even be required.

In conclusion, buyers in the project-driven construction industry should assess and segment their supply bases in a holistic manner, i.e. a combination of models should be used in the examination of construction item classes and in the investigation of individual supplier relationships in order to be one step closer to competent supply bases. This study suggested that this establishment requires at least the following steps: (1) the identification of critical and strategic construction item classes; (2) evaluating and categorizing suppliers' performance; (3) the segmentation of external spend based on relative power resources. The study also suggests that buyers in construction project-business should acknowledge their own interest and performance first before demanding suppliers to improve.

## 8.2 Limitations and suggestions for further research

Due to case study methodology with a small number of cases the current study concerns several limitations that persuade future research. The principal limitation joined with the empirical research is the fact that only one case company was used and therefore the results cannot be generalized to concern other construction companies as well. Therefore, there is a need to exploit the proposals through other case studies and validate the results.

The second main limitation of the study concerns the fact that the studies were bounded to the perspective of the buyer. However, contractor-supplier relationships in construction projects are dyadic in nature. Suppliers might have different opinions about the need for improvement activities as well as the prevailing power and leverage structures. Thus, there is a need to fully investigate the supplier's perspective in order to validate the buyer's segmentation. Also, the suppliers' point of view may assist in revealing what are the other independent factors that influence their performance.

The ability to incentivize suppliers in the proper way was also characterized as a critical element in development initiatives. Interesting would be therefore to investigate how the regularity of construction demand influences the suppliers' willingness to engage in supplier development programs. The paper of Ireland (2004) already revealed that the regularity of demand is of major significance in the making of sourcing strategies for the construction buyers. Referring to this, the present study showed that the high *frequency of the exchange* seems to impact negatively to suppliers' performance in terms of quality and staying on timetables. In particular, future research should investigate how the promise of future business influences suppliers' performance and willingness.

In conclusion, the combined use of construction product and service purchasing portfolio (after Junnonen & Kankainen, 2012) and power matrix (after Cox et al., 2003) will assist the buyers both in tactical and strategic level supplier management decisions. A logical next step is to further investigate the impact of the development practices on the performance of the buying and supplier firms in the project-driven construction industry.

### **8.3 Managerial implications**

The findings have significant managerial relevance. For purchasers in the case company, the managerial implication of this study is that dependence on suppliers entails vulnerability. In addition, power imbalance should be used as an instrument to foster premium levels of improvement (Maloni & Benton, 2000). Given this, the buyer could exploit indirect influence strategies (Frazier & Summers, 1984) especially to the buyer-supplier relationships characterized by *buyer dominance* or suppliers providing volume products. Many suppliers were also positioned in both of the quadrants (see Appendix 2). It is generally considered that coercive power and its lighter forms are effective means to influence the leverage suppliers. Similarly, supplier switching may also represent also a viable option in the case of *buyer dominance* since there are a lot of alternative suppliers.

Moreover, this study identified major suppliers providing the critical and strategic construction item classes. From a strategic perspective, the case company should strive to establish closer working relationships with these suppliers in terms of joint actions, e.g. product design to improve efficiency. For instance, the constructed alternative way of working in the kitchen cabinet design process should be viewed jointly with the supplier and see whether it should be put into practice without any changes.

The results of the statistical tests should also have an impact on how the case company should manage its supply base in the future. For instance, there is a huge potential to prohibit purchases from poorly classified suppliers (C and D), because it could increase the performance of the whole supply base. The results also showed worthy development needs regarding the product/performance quality that is provided by the framework agreement suppliers. On the other hand, the company could use this and some of the other findings as a source of bargaining power in the future.

#### **8.4 Reliability and validity**

Reliability and validity describe the quality of this exploratory research method. Validity can be divided into two types: internal and external. Internal validity evaluates whether there is a match between researcher's observations and the theoretical ideas she or he developed (Bryman & Bell, 2011). Secondly, the external validity evaluates whether the study findings can be generalized beyond the immediate case company (Yin, 2009). Reliability entails the capability of a study to display the same results while using different data collection methods (Yin, 2009).

Internal validity was reinforced because the researcher is an employee at the case company. This enabled to make a more grounded research. Also, validity is reinforced since the researcher used pertinent research material and observed the issue from different directions. Triangulation entails using more than one method or source of data in the study (Bryman & Bell, 2011). And as for the external validity, the results of this study can be said to be valid in this research context, but cannot be generalized to concern other companies. The reliability of this thesis is guaranteed by reporting and by decisions that the researcher has done concerning research selection.

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## APPENDICES

### APPENDIX 1: Supplier performance evaluation template

## Supplier performance evaluation template

Supplier name

		Grading scale:
<b>1 Safety</b>		
1.1	Attitude towards safety	(1-5)
1.2	Cleanliness, order & environmental consideration	(1-5)
1.3	Compliance with safety instructions	(1-5)
1.4	Development activity in safety improvement	(1-5)
1.5	Additional comments:	
<b>2 Co-operation, reliability and administrative matters</b>		
2.1	Supervisor expertise and availability	(1-5)
2.2	Compliance with agreed timetables	(1-5)
2.3	Possible unfounded claims presented by the supplier (e.g. billing of unfounded extra work)	(1-5)
2.4	Billing and payment terms were in accordance with the contract	(1-5)
2.5	Additional comments:	
<b>3 Quality</b>		
3.1	Compliance with the agreement	(1-5)
3.2	Performance quality (products, operations)	(1-5)
3.3	Development activity (collaboration, way of working)	(1-5)
3.4	Corrective actions in possible complaints and claims presented by the buyer	(1-5)
3.5	Additional comments:	
<b>4 Summary of the supplier performance</b>		
4.1	Recommendation to the following projects	(Yes/No)
4.2	Additional comments:	

## APPENDIX 2: Supplier segmentation library – supplier information tabulated based on prevailing power circumstance

SUPPLIER SEGMENTATION DIRECTORY										PERFORMANCE EVALUATION STATUS:						
Framework agreement*																
ID	Supplier type	Category Type	Yearly Transaction amount	Relationship length	Spend share of supplier's annual turnover	Supplier spend of total purchases	Amount of alternative suppliers	Power circumstance	Financial status	Quality	Trend: quality	Safety	Trend: Safety	Timetables	Trend: Timetables	
S3	Subcontractor	Critical	High	> 3 years	27%	4%	High	Buyer dominance	🟢	🟡	↓	🟢	↑	🟢	↓	
S4	Material Supplier*	Critical	High	> 3 years	20%	4%	High	Buyer dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S6	Material Supplier	Critical	High	> 3 years	27%	3%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S10	Subcontractor	Critical	High	> 3 years	28%	2%	High	Buyer dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S18	Material Supplier	Non-critical	Low	> 3 years	54%	1%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S19	Subcontractor	Critical	High	> 3 years	51%	1%	High	Buyer dominance	🟢	🟡	↓	🟢	↑	🟢	↓	
S25	Subcontractor	Volume	High	> 3 years	25%	1%	High	Buyer dominance	🟢	🟢	No data 2014	🟡	↓	🟢	No data 2014	
S27	Subcontractor	Volume	High	> 3 years	20%	1%	High	Buyer dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S29	Subcontractor	Non-critical	High	> 3 years	21%	1%	High	Buyer dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S32	Subcontractor	Volume	High	> 3 years	22%	1%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S33	Subcontractor	Special	Low	> 3 years	42%	1%	High	Buyer dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S35	Subcontractor	Special	High	> 3 years	45%	1%	High	Buyer dominance	No data	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S37	Subcontractor	Critical	Low	> 3 years	44%	1%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S38	Subcontractor	Volume	Low	> 3 years	15%	1%	High	Buyer dominance	🟢	🟡	↓	🟢	↑	🟢	↓	
S39	Subcontractor	Critical	High	> 3 years	18%	1%	High	Buyer dominance	🟡	🟢	No data 2013	🟢	No data 2013	🟡	No data 2013	
S41	Subcontractor	Non-critical	Low	> 3 years	18%	0%	High	Buyer dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S42	Subcontractor	Non-critical	High	> 3 years	24%	0%	High	Buyer dominance	🟢	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S43	Material Supplier	Volume	High	> 3 years	18%	0%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S44	Material Supplier	Volume	High	> 3 years	46%	0%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S47	Subcontractor	Critical	Low	< 1 year	46%	0%	High	Buyer dominance	No data	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S50	Subcontractor	Critical	Low	> 3 years	17%	0%	High	Buyer dominance	🟢	🟡	↓	🟢	↑	🟢	↓	
S60	Subcontractor	Non-critical	Low	> 3 years	18%	0%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S62	Subcontractor	Critical	Low	> 3 years	51%	0%	High	Buyer dominance	🟢	🟡	No data 2014	🟢	↓	🟢	No data 2014	
S64	Subcontractor	Special	Low	> 2 years	87%	0%	High	Buyer dominance	No data	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S65	Subcontractor	Non-critical	Low	> 3 years	34%	0%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S67	Subcontractor	Volume	Low	> 3 years	49%	0%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S68	Material Supplier	Critical	Low	> 3 years	22%	0%	High	Buyer dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S13	Material Supplier*	Non-critical	High	> 3 years	0%	2%	High	Independence	🟢	🟢	↓	🟢	↑	🟢	↓	
S14	Subcontractor	Volume	High	> 3 years	8%	2%	High	Independence	🟢	🟢	↓	🟢	↑	🟢	↓	
S20	Material Supplier	Volume	High	> 3 years	1%	1%	High	Independence	No data	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S22	Material Supplier	Critical	Low	> 3 years	12%	1%	High	Independence	🟢	🟡	↓	🟢	↑	🟢	↓	
S23	Subcontractor	Non-critical	High	> 3 years	0%	1%	High	Independence	No data	🟢	↓	🟢	↑	🟢	↓	
S24	Subcontractor*	Non-critical	High	> 3 years	4%	1%	High	Independence	🟢	🟢	No data 2014	🟡	↓	🟢	No data 2014	
S26	Material Supplier	Critical	Low	> 3 years	3%	1%	High	Independence	🟢	🟢	↓	🟢	↑	🟢	↓	
S28	Material Supplier	Critical	Low	> 3 years	8%	1%	High	Independence	🟢	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S30	Subcontractor*	Volume	High	> 3 years	3%	1%	High	Independence	🟢	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S31	Subcontractor	Critical	Low	> 3 years	No data	1%	High	Independence	No data	🟢	↓	🟢	↑	🟢	↓	
S34	Material Supplier	Critical	Low	> 3 years	13%	1%	High	Independence	🟢	🟢	↑	🟢	↓	🟢	↑	
S36	Subcontractor	Critical	Low	> 3 years	4%	1%	High	Independence	🟢	🟢	↑	🟢	↓	🟢	↑	
S40	Material Supplier	Special	Low	> 3 years	4%	0%	High	Independence	🟢	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S45	Subcontractor*	Volume	High	> 3 years	1%	0%	High	Independence	🟢	🟢	↓	🟢	↑	🟢	↓	
S49	Subcontractor*	Special	Low	> 3 years	10%	0%	High	Independence	🟢	🟢	No data 2014	🟢	↓	🟢	No data 2014	
S51	Subcontractor*	Special	High	> 3 years	8%	0%	High	Independence	🟢	🟢	No data 2013	🟢	↓	🟢	No data 2013	
S52	Subcontractor	Volume	Low	> 3 years	6%	0%	High	Independence	🟡	🟢	↓	🟢	↑	🟢	↓	
S54	Subcontractor	Critical	Low	> 3 years	3%	0%	High	Independence	🟢	🟢	↓	🟢	↑	🟢	↓	
S55	Subcontractor	Critical	High	> 3 years	6%	0%	High	Independence	No data	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S56	Material Supplier	Special	High	> 3 years	14%	0%	High	Independence	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S58	Subcontractor	Critical	Low	> 3 years	No data	0%	Low	Independence	No data	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S59	Subcontractor	Critical	Low	> 3 years	12%	0%	High	Independence	🟢	🟢	No data 2014	🟢	No data 2014	🟢	No data 2014	
S61	Subcontractor	Special	Low	> 3 years	12%	0%	High	Independence	No data	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S63	Subcontractor	Non-critical	High	> 3 years	4%	0%	High	Independence	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S66	Subcontractor	Critical	Low	> 3 years	No data	0%	High	Independence	No data	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S1	Material Supplier*	Critical	High	> 3 years	12%	8%	Oligopoly	Interdependence	🟢	🟢	↓	🟢	↑	🟢	↓	
S2	Subcontractor*	Critical	High	> 3 years	14%	8%	Low	Interdependence	🟢	🟢	↓	🟢	↑	🟢	↓	
S8	Subcontractor*	Volume	High	> 3 years	11%	2%	High	Interdependence	🟢	🟢	↓	🟢	↑	🟢	↓	
S11	Subcontractor*	Critical	High	> 3 years	15%	2%	Low	Interdependence	🟢	🟢	↓	🟢	↑	🟢	↓	
S12	Subcontractor	Critical	High	> 3 years	18%	2%	Oligopoly	Interdependence	🟡	🟢	↑	🟢	↓	🟢	↑	
S5	Subcontractor*	Critical	High	> 3 years	6%	4%	Low	Supplier dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S7	Subcontractor	Critical	High	> 3 years	5%	3%	Oligopoly	Supplier dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S9	Subcontractor	Critical	High	> 3 years	6%	2%	Oligopoly	Supplier dominance	🟢	🟢	↑	🟢	↓	🟢	↑	
S15	Material Supplier	Critical	High	> 3 years	3%	2%	Low	Supplier dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S16	Material Supplier	Critical	High	> 3 years	10%	1%	Low	Supplier dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S17	Subcontractor*	Critical	High	> 3 years	6%	1%	Low	Supplier dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S21	Material Supplier*	Non-critical	High	> 3 years	5%	1%	Low	Supplier dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	
S46	Subcontractor*	Non-critical	High	> 3 years	3%	0%	Low	Supplier dominance	🟢	🟢	No data 2014	🟢	No data 2014	🟢	No data 2014	
S48	Subcontractor*	Critical	High	> 3 years	1%	0%	Low	Supplier dominance	🟢	🟢	↓	🟢	↑	🟢	↓	
S53	Subcontractor*	Critical	High	> 3 years	6%	0%	Low	Supplier dominance	🟢	🟢	↑	🟢	↓	🟢	↑	
S57	Subcontractor	Non-critical	Low	> 3 years	6%	0%	Low	Supplier dominance	🟢	🟢	No data 2013	🟢	No data 2013	🟢	No data 2013	

**APPENDIX 3: Process activity mapping: Kitchen cabinet delivery and installation process in a construction project site**

<b>Process activity mapping - Kitchen cabinet delivery and installation process</b>			
<b>Process Activity</b>	<b><u>Touch Time</u></b>	<b><u>Lead time</u></b>	<b><u>Efficiency</u></b>
1. Delivery date and order agreement	2	4	0,50
2. Delivery	12	12	1,00
3. Cargo unloading	12	16	0,75
4. Unloading and transfer of goods	576	816	0,71
5. Installer introduction	1,5	3,5	0,43
6. Carrier introduction	1	10	0,10
7. Items installation	330	720	0,46
8. Waste management and cleaning	33	148	0,22
9. Modification and additional work	10	2	5,00
10. Failure and shortage deliveries	2	33	0,06
11. Invoicing	24	30	0,80
12. Installation inspection and approval	33	66	0,50
<b>TOTAL</b>	<b>1037</b>	<b>1861</b>	<b>56 %</b>