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Purchasing in Construction Companies

Purchasing in Construction Companies

Louise Bildsten

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Abstract

A significant part of the cost of a construction project, up to 90%, consists of purchased goods and services. Suppliers thereby have a large impact on the quality, price and time of projects. Purchasing management is therefore important for the outcome of a project. The aim of research covered by this thesis is to describe and analyse purchasing management and its interrelation with the supplier relationships and the production process. The research design was twofold: theory building and case studies. In the latter, the initial phase was inductive through studies of industrialized building, changing to abductive and, thereafter, deductive when tentative theories were tested within construction companies. The findings were that maintaining supplier relationships and, at the same time, retaining competition with several suppliers are desirable. The construction industry has been portrayed by some researchers as price-driven with respect to the choice of suppliers. The research reveals that the choice of suppliers is based to a large extent on long-term relationships, where the trustworthiness of suppliers plays an important part. Through long-term relationships, the project team can rely on the experiences acquired from previous purchases to overcome problems of coordination, communication and integration. It is important for construction companies to recognize that the project team possesses significant knowledge about the nature of services and products delivered by different subcontractors and suppliers. Decisions that are not made in collaboration with those involved in production can lead to lower quality, higher cost and later project delivery than might otherwise be the case. A combination of skills purchasing and construction seems appropriate for project managers. The theoretical contributions of the research consist of: (1) a framework on waste and coordination; (2) a framework comparing value-driven and market-driven purchasing; (3) a portfolio matrix considering the aspects of intensity and time perspective in purchaser-supplier relationships; (4) a framework to serve as a guide to describe and analyse the purchasing process in the companies that were examined; and (5) a portfolio matrix to portray purchasing in construction companies based on the findings.

Key words: construction, purchasing, Kraljic, buying centre, actors, roles, sourcing structures

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Purchasing in Construction Companies

Louise Bildsten

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Lund, April 2016

Louise Bildsten

Abstract

A significant part of the cost of a construction project, up to 90%, consists of purchased goods and services. Suppliers thereby have a large impact on the quality, price and time of projects. Purchasing management is therefore important for the outcome of a project. The aim of research covered by this thesis is to describe and analyse purchasing management and its interrelation with the supplier relationships and the production process. The research design was twofold: theory building and case studies. In the latter, the initial phase was inductive through studies of industrialized building, changing to abductive and, thereafter, deductive when tentative theories were tested within construction companies. The findings were that maintaining supplier relationships and, at the same time, retaining competition with several suppliers are desirable. The construction industry has been portrayed by some researchers as price-driven with respect to the choice of suppliers. The research reveals that the choice of suppliers is based to a large extent on long-term relationships, where the trustworthiness of suppliers plays an important part. Through long-term relationships, the project team can rely on the experiences acquired from previous purchases to overcome problems of coordination, communication and integration. It is important for construction companies to recognize that the project team possesses significant knowledge about the nature of services and products delivered by different subcontractors and suppliers. Decisions that are not made in collaboration with those involved in production can lead to lower quality, higher cost and later project delivery than might otherwise be the case. A combination of skills purchasing and construction seems appropriate for project managers. The theoretical contributions of the research consist of: (1) a framework on waste and coordination; (2) a framework comparing value-driven and market-driven purchasing; (3) a portfolio matrix considering the aspects of intensity and time perspective in purchaser-supplier relationships; (4) a framework to serve as a guide to describe and analyse the purchasing process in the companies that were examined; and (5) a portfolio matrix to portray purchasing in construction companies based on the findings.

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1 Introduction

This introductory chapter starts by describing the background of the research, followed by a problem statement that further explains the reasons behind the research. Thereafter, the aim and research questions are presented. The limitations in the research then follow. The chapter ends with a list of the appended papers, with their abstracts, and a list of relevant publications that are not appended to the thesis.

1.1 Background

In a construction project, there are many different kinds of suppliers and subcontractors[1]. Some might necessitate more involvement in purchasing[2] decisions than others, with the extent depending on the complexity of the product or service (Arantes et al., 2014). Purchasing decisions for products and services in a construction project lock-in a large percentage of the total cost of the project. For construction companies, purchasing can stand for as much as 90% of the total cost of a project (Karim et al., 2006; Hinze and Tracey, 1994). Purchasing decisions are therefore important for the outcome of a project. It would be fair to say that the success of a project is determined in large part by making the most appropriate purchasing decisions and, related to that, having the ability to coordinate different suppliers. The conventional criteria for purchasing decisions dating from the 1950s are to have products and services of the correct quality delivered at the right time, to the right place and at the right price from the best supplier (Van Weele, 2010; Alijan, 1958). These criteria are still valid today, not least in construction where the project schedule is likely to incorporate many interdependent activities. Purchasing within a construction company can be characterized as an amalgam of traditional practices, which might have served the company well over a long period, ongoing developments such as the introduction of supplier relationship management (Cox, 2003), strategic purchasing (Carr and Smeltzer, 1997) and the purchase of innovation through new products and services (Castaldi et al., 2011). For an efficient and effective production process, close relationships with suppliers are generally

[1] Subcontractors and suppliers are referred to all as suppliers in the more general sections, but as suppliers and subcontractors when there is a need to differentiate between them.

[2] Purchasing is the management of a company's external resources in terms of goods, services, capabilities and knowledge in order to manage the company's core business and support activities.

recommended in order to satisfy objectives in regard to quality, on-time delivery and cost (Greenwood and Wu, 2012). Even so, close relationships are not appropriate for all purchasing situations. For example, Fernie and Thorpe (2007) argued that there exists no superior form covering all relationships and that the degree of closeness is context dependent. As some purchased products and services need more interaction between purchaser[3] and supplier than others, a variety of relationships is likely to exist where some are close and others are loose (Dubois and Gadde, 2002b). Apart from the level of interaction, relationships with suppliers can also vary in length. Dyer et al. (1998) proposed that a long-term relationship does not necessarily need to be close if there is little interdependence between companies: suppliers serve purchasers in different ways. Ulaga and Eggert (2006) argued that certain suppliers are superior to others in quality, delivery, services, personal interaction, 'know-how' and joint product development. By categorizing suppliers, the purchasing process can be more efficient and cost-effective by allocating the appropriate management capacity, administrative manpower, time and finance to handle each supplier relationship in the most efficient way (Wagner and Johnson, 2004). Within the construction management literature, the attention to purchasing has mostly been on how to achieve integration in the relationship between the client and construction company (Pryke, 2009). Other relationships, such as those between construction companies and their suppliers, have received less attention (Bemelmans et al., 2012; Akintoye et al., 2000). This study concerns construction companies' purchasing of products and services from suppliers for construction projects.

1.2 Problem statement

The purchasing process – from 'determining the need' to 'following up to secure delivery' (Van Weele, 2010) – and purchasing strategies – defined as a 'problem-solving method' to be used in different situations (De Wit and Meyer, 2010) – are intertwined. In order to understand when to use certain purchasing strategies, it is necessary to understand the purchasing process and how it is influenced by different factors. These add to the complexity of a purchasing situation. Different actors are involved in the purchasing process and affect the purchasing decision (Webster and Wind, 1972). Through understanding the different roles of the actors involved, their power and influence upon purchasing decisions can be understood. Another factor to consider is the novelty of a product or service (Robinson et al., 1967). The purchasing process can become more complex, especially with newer products or

[3] Purchaser, or buyer, is the person having day-to-day responsibility for purchases of products and services within the purchasing organization. The terms purchaser and buyer are interchangeable.

services, in terms of uncertainty and the search for information (McQuiston, 1989). Each project is unique and a change from one specification to another can be of a more or less complex nature; some new products and services might therefore need more time and resources to be evaluated than others. This can include the investigation of new suppliers and the testing of new products and services. New types of components and processes can increase quality, efficiency and the ability to build; however, not all novel solutions will work in the way expected. There is also the strategic decision on how to divide responsibilities for work and materials. The division of responsibilities on what is included in each contract with suppliers is a coordinating decision or 'make or buy' decision (Williamson, 1985) that sets the boundaries between companies. How construction companies manage these purchasing situations is not, however, well documented; yet, it is important to understand how they utilize their own capabilities, as well as those of their suppliers (Teece, 2007; Penrose, 1959). The availability of a framework to represent different purchasing situations in construction companies would be beneficial for the companies and for researchers, enabling an exchange of experiences and views that might pinpoint inefficiencies, suggest improvements and contribute to a better understanding of purchasing.

To facilitate the fulfilment of the desired purchasing criteria, a classification system of different kinds of purchases could be considered fruitful. Depending of the nature of the product or service, it can be assigned a specific purchasing strategy or procedure (Kraljic, 1983) that most efficiently fulfils the purchasing criteria. Mapping sourcing structures (Cousins et al., 2007) can reveal strategies that are appropriate for a particular type of product or service. By visualizing supplier relationships for different items in a portfolio matrix[4], a mapping of suppliers' assets and capabilities can be created to serve the company. Companies can thereby move to different, more attractive positions in the portfolio matrix by substituting products, not least in terms of determining whether to split or combine purchased product and services. This thinking helps to create a better understanding of how to manage purchasing strategies for different products and services.

To sum up, purchasing, which includes the purchasing process and purchasing strategies, are important for a company's overall strategy. Collectively, they determine the outcome of a project built on the most appropriate supplier relationships.

[4] Some authors refer to matrix and others to (portfolio) model. It is one and the same.

1.3 Aim and research questions

From a holistic perspective, a construction company can be described as a production unit with an input of production factors and an output of products. The production unit can be seen as the heart of the company and the management of purchasing as the gateway for input according to the relationships with suppliers (Dubois and Wynstra, 2005). The aim of research covered by this thesis is to describe and analyse purchasing management and its interrelation with the supplier relationships and the production process (see Figure 1). Purchasing management is described and analysed from the perspective of different levels of management in construction companies. The qualitative nature of the research did not lend itself to the formulation of a hypothesis at the highest level (Fellows and Liu, 2008:129).

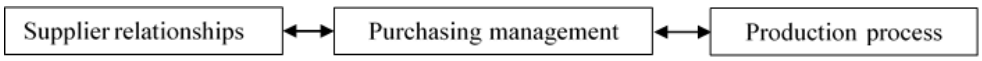

Figure 1.
The interrelationship between supplier relationships, purchasing management and the production process

The first research question was derived by analysing the coordination of activities and resources (purchasing activities amongst others) and their relationship with different types of waste in industrialized building (Paper I). Production was then studied to be able to determine how purchasing could facilitate production in industrialized building (Paper II).

> RQ 1: What is the relationship between purchasing and the needs of the production process?

This first research question concerned purchasing from a production perspective in industrialized housing, whereas the second research question was derived from analysing the purchasing process, how different purchasing situations occur and the people who are involved. This was studied in the context of traditional, on-site construction in order to obtain a deeper insight into the area of purchasing management in construction as a project-based industry (Paper IV).

> RQ 2: How can a framework assist in understanding different purchasing situations?

The third research question was derived from analysing the purchasing and supplier relationships of different kinds of products and services through the Kraljic (1983) matrix and determining whether or not there was a pattern in how different products and services were purchased in industrialized house-building (Paper III) and in traditional, on-site construction (Paper V). Moreover, it was intended to determine how purchasing situations can be related to purchasing strategies (Paper IV).

RQ 3: How can purchasing situations be related to purchasing strategies for different products and services?

1.4 Limitations

This study is limited to an investigation of purchasing from the perspective of construction companies. Data collection was, therefore, carried out in construction companies. Construction is a project-based industry where each project involves different entities to a greater or lesser extent. Apart from construction companies there are developers, architects, other consultants and suppliers that have stakes in how the projects should be carried out and what products should be used. These entities have not been studied.

1.5 Structure of the thesis

Chapter 1: The first chapter introduces the reader to the research area of purchasing decisions in construction. In addition, it presents the research questions, aims and objectives, limitations, structure and appended papers.

Chapter 2: The second chapter describes the philosophies connected to the research methodology. Thereafter, it explains the research process, discusses theory building, the choice of case studies and describes how data were collected in Sweden and in Australia.

Chapter 3: The third chapter describes and analyses theories of purchasing management from which frameworks suitable for construction are deduced. Whilst this chapter covers a large body of literature, other literature studies have been undertaken and are reflected throughout the rest of the thesis.

Chapter 4: The fourth chapter presents an overview of the findings from the appended Papers I-V. Thereafter the findings and analyses of each of the Papers I-V are presented.

Chapter 5: The fifth chapter is a discussion on the relationship between the theoretical findings and those derived from the empirical studies, with some reflections on the interpretation of the results of the research.

Chapter 6: The sixth chapter presents the conclusions, particularly the theoretical contributions and practical contributions. Last, the potential for further research is briefly discussed.

1.6 Appended papers

This research is based on five papers (Appendix I), which are as follows.

Paper I

Sandberg, E. and Bildsten, L. (2011) Coordination and waste in industrialised housing, *Construction Innovation*, 11 (1), 77-91.

Abstract

This study maintains that there is a need for proper execution of coordination mechanisms as a means to reduce waste. The purpose of this paper is to explore the relationship between the coordination of activities and resources on the one hand, and the occurrence of different types of waste on the other. The empirical context of this paper is a case study at a Swedish construction company that has applied the industrialized housing concept; a concept which has increased in popularity in recent years. The core concept of industrialized housing means that houses are (more or less) pre-manufactured in specific production units, i.e. factories, and thereafter assembled on-site. The analysis highlights the importance of having the right type as well as the right amount of coordination. In addition, obstacles and challenges for proper coordination are discussed. Even if not all waste can be explained and eliminated by appropriate coordination, this research shows that coordination theory provides lean researchers with a new tool for analysis of the supply chain and how waste can be eliminated.

Paper II

Bildsten, L., Björnfot, A. and Sandberg, E. (2011) Value-driven purchasing of kitchen cabinets in industrialised housing, *Journal of Financial Management of Property and Constructio*n, 16 (1), 73-83.

Abstract

The purpose of this paper is to hypothesize that value-driven purchasing of customized kitchen cabinets is more profitable than market-driven purchasing in industrialized housing construction. The hypothesis is examined through a case study of kitchen carpentry at one of the Sweden's largest producers of industrialized prefabricated multi-storey housing. By comparing characteristics of market- vs value-driven purchasing, this paper aims to further clarify the benefits and drawbacks of these two strategies. By comparing characteristics of market- vs value-driven purchasing, a theoretical framework is proposed that clarifies the benefits

and drawbacks of the two strategies. An explorative case study of kitchen carpentry at a house manufacturer illustrates purchasing of kitchen cabinets in the industrialized housing industry in relation to the proposed framework. The case study results indicate that, from a value perspective, a long-term relationship with a dedicated local smaller supplier is a preferable choice over a short-term relationship with a low-price mass producer. This is a single-case study that should be verified by further empirical work of a test delivery from the local sub-system manufacturer. Such a study would provide more insights into this area of work and make it possible to thoroughly evaluate potential risks. The indicative results in this paper can be made conclusive through quantification of the proposed lean purchasing characteristics. A comparison of value- and market-driven purchasing is carried out in theory and applied to a real case study that brings new perspectives to purchasing. In this way, the paper proposes alternative purchasing strategies for the construction industry.

Paper III

Bildsten, L. (2014) Buyer-supplier relationships in industrialized building, *Construction Management and Economics*, 32 (1-2), 146-59.

Abstract

Close collaboration is considered important; but is close collaboration for all purchases necessary to create value-in-production? In construction as well as in other industries, companies purchase a variety of items that require different amounts of attention to the relationship with suppliers. Buyer-supplier relationships are investigated in relation to how they bring value-in-production in the industrialized building sector. An adaptation of the Kraljic matrix is applied to the context of industrialized housebuilding in Sweden. Different relationships and different purchased items are classified with the aim of revealing patterns that may prove useful when determining purchasing strategies intended to create value-in-production. Purchasing strategies were studied through data collection at four industrialized housebuilders. Analysis of these strategies suggests that the total product offer from suppliers in terms of customization, logistics and standardization plays an important role in the choice of suppliers in order to satisfy the requirement for efficient production. Long-term relationships enable the development of a specific way of working that adds value-in-production. A new purchasing portfolio matrix for determining the effectiveness of purchasing strategies on the production process is thus presented, where products are classified according to value-in-production.

Paper IV

Bildsten, L. and Manley, K. (2016) A framework for understanding purchasing in building construction companies, *Construction Management and Economics*, DOI: 10.1080/01446193.2016.1164325.

Abstract

Purchasing on the part of a building construction company involves actors inside and outside the organization. These actors are driven by different motives that influence purchasing decisions in different situations. An explicit framework that assists in understanding the different purchasing situations would be of benefit to companies and researchers. Through a study of purchasing theory and practices, including interviews with building construction companies, a framework of purchasing is proposed. The framework covers all stages in the purchasing process and focuses on four factors: (1) purchasing situations; (2) level of complexity; (3) active roles; and (4) supply chain involvement. The interrelationships between these factors are discussed from the perspective of the companies.

Paper V

Bildsten, L. (2016) The purchasing strategies of Australian construction companies *(Submitted to the Journal of Purchasing and Supply Management)*

Abstract

For a construction project to be delivered on-time and to an agreed cost in accordance with the specification, it is important to have an appropriate purchasing strategy. The construction industry is criticized for having short-sighted relationships with its suppliers by focusing on the price of products and services alone. Project success is due to many factors of which price is one alongside timely delivery and quality. Formal purchasing strategies are common in industry in general, but are less developed in construction. The paper argues that purchasing strategies suited to the project-based nature of construction would improve project delivery and other success factors. The Kraljic matrix forms the foundation for an approach that integrates different sourcing structures and which takes account of the specific context of construction. Analysis of the literature to support the adaptation of the Kraljic matrix to take account of sourcing structures and industrial context led to an empirical study whose aim was to determine if the modified matrix could assist construction companies in formulating their purchasing strategies. Case studies of five Australian companies' purchasing strategies were undertaken to support this work. There is evidence that, in order to remain competitive, it is necessary for companies to develop a network of well-established relationships with

suppliers. Purchasing strategies need to be adapted to each purchasing situation as projects are rarely, if ever, the same. It is necessary, therefore, to adopt an approach that combines the best commercial deal and most effective collaboration. In order to achieve this position, the companies use a parallel sourcing strategy when purchasing product and service packages from proven subcontractors in competition. An extension of this hybrid approach covers products and services of lower value that also have to be efficiently sourced, whilst maintaining continuity of supply through subcontractors.

1.7 Distribution of work

Table 1 presents the distribution of work for the appended papers.

Table 1.
Distribution of work for Papers I-V

Paper	Distribution of work
Paper I	Bildsten contributed the empirical part while Sandberg wrote most of the theory. 24 of the interviews were carried out by students and one interview was conducted by Bildsten and Sandberg together. Factory visits were made by Bildsten, Sandberg and the students.
Paper II	Bildsten wrote most of the theory as well as collecting and reporting on the empirical data with the support of Björnfot. Sandberg commented on the paper.
Paper III	Bildsten is sole author.
Paper IV	Bildsten designed a first draft of a theoretical framework which thereafter was elaborated through discussions with Manley. Data were collected and reported by Bildsten with the support of Manley.
Paper V	Bildsten is sole author.

1.8 Other publications not appended

Conference papers

Bildsten, L. (2015) Purchasing strategies in Industrial building – a comparison of Australian and Swedish companies, *Procedia Economics and Finance*, 21, 594-600.

Bildsten, L. (2013) Implications for strategy in industrialized house-building: a longitudinal case study. *Proceedings of the 7th Nordic Conference on Construction Economics and Organization*, 12-14 June, Trondheim, Norway.

Bildsten, L. (2013) Purchasing decisions: enablers and barriers to innovation in construction. *Proceedings of the CIB World Congress*, 5-9 May, Brisbane, Australia.

Bildsten, L. (2013) Purchasing and innovation in construction: a tentative conceptual framework. *Proceedings of the HKU-HKHA International conference 2013 on Construction and Housing in the 21st century*, 2-3 May, Hong Kong, China.

Bildsten, L. (2011) Exploring the opportunities and barriers of using prefabricated house components. *Proceedings of the 19th Annual Conference of the International Group for Lean Construction*, 13-15 July, Lima, Peru.

Bildsten, L. and Guan, W. (2011) The study of a kitchen assembly process in industrial housing. *Proceedings of the 6th Nordic Conference on Construction Economics and Organization*, 13-15 April, Copenhagen, Denmark.

Björnfot, A., Bildsten, L., Erikshammar, J., Haller, M. and Simonsson, P. (2011) Lessons learned from successful value stream mapping (VSM). *Proceedings of the 19th Annual Conference of the International Group for Lean Construction*, 13-15 July, Lima, Peru.

Bildsten, L., Rehme, J. and Brege, S. (2010) Applying the Kraljic-model to the construction sector – the case of a prefab housing factory. *Proceedings of the 26th Annual Conference of the Association of Researchers in Construction Management*, 6-8 September, Leeds, UK.

Bildsten, L., Björnfot, A. and Sandberg, E. (2010) Value-driven vs market-driven purchasing of kitchen cabinets. *Proceedings of the 18th Annual Conference of the International Group of Lean Construction*, 14-16 July, Haifa, Israel.

Reports

Erikshammar, J., Bildsten, L. and Haller, M. (2014) *Value stream mapping: a case study of an inner wall manufacturer*. Technical report. Luleå University of Technology.

Licentiate thesis

Bildsten, L. (2011) *Towards partnerships in industrialized housing*. Licentiate thesis. Linköping University.

2 Methodology

This chapter opens by describing perspectives on research philosophies. The research design is then described, including discussions on theory building and case studies. Thereafter, the data collection for the case studies is described followed by an outline of the methods for structuring and analysing the data.

2.1 Research philosophies

The philosophical perspective of a researcher depends on his or her ontological and epistemological positioning. The ontological positioning is a philosophical assumption about the nature of reality. The epistemological positioning is a philosophical assumption of how to investigate the nature of reality. There are two polarized epistemological views: positivism and constructivism. In between these two views is a third view known as the critical realist, which is a mix of positivism and constructivism (Danermark et al., 2002). The positivistic view is that the reality of the world exists externally and can be measured by an objective method. The constructivist, sometimes called the interpretive view, assumes that the reality of the world can be measured through people, ideas and reflections rather than objective measures. Critical realism combines measurement through people and objective measures.

A characteristic of constructivism is that it is context-dependent and cannot be generalized. In this research, multiple cases and several types of data collection methods have been used to enable a limited degree of generalization. The context does, however, play a role in the interpretation of the interviews and it is also important to take into account the environments of those conversations (Cameron, 2001). Each conversation is unique and takes place in a unique setting. As Cameron argues, it is important to consider communicative acts in their original context; therefore, the transcripts of interviews were analysed manually after each session to take into account the story behind each piece of information. Otherwise, there could be a risk of losing sight of the interpersonal factors that motivated the informant to produce the particular response at just that moment. By interviewing senior managers in construction companies, there is a risk that these informants attempt to present themselves as certain kinds of people (Cameron, 2001), who comply with the goals of the company.

The above factors were taken into account when constructing the interview guide and when analysing the answers. Interviewees and interviewers are affected by their discursive environment, i.e. work places, professions, local culture and disciplines, among other factors. One interviewee might also use several discourses, sometimes contradictory in the same interview (Talja, 1999). Gubrium and Holstein (2001) argue in the same way that interviewees use several voices and might take different subject positions in an interview. There might also be contradictory views between different people about the same subject (Cameron, 2001). This tendency has been criticized by traditional researchers who are seeking the 'objective truth'. Normally, the reality is more complex and there are multiple ways of understanding the world. According to Cameron (2001), there are usually multiple and shifting understandings and these might be particularly interesting and provide valuable data.

The analysis of qualitative interviews has become increasingly sophisticated, not only in terms of 'what' is said but also 'how' it is said and how it relates to what was said before (Gubrium and Holstein, 2001). Cameron (2001) also states that research subjects' talk is not just data, it is also discourse, and it can be fruitful to approach it as a discourse by using techniques and insights of discourse analysis. During the interviews, it was useful to keep in mind 'how' things were said. By letting the interviewee speak freely around each topic that came up during the interview, simple answers like 'yes' or 'no' were avoided as those answers could be less well considered by the interviewee. Sometimes, follow-up questions were asked to confirm the truthfulness of the answers (see section on 'Interviews' later in this chapter).

There are many variables to consider in purchasing decisions such as wishes from clients, personal relationships, business relationships, trust and profit; yet, there was a pattern. The approach in this research was to create a categorization of purchases, which was a characteristic of constructivism; whilst, at the same time, it was important to strive for an 'objective truth' through the study of documents and theory (see below) in a sort of triangulation. Documents are, however, created by people and the text of those can be analysed through the eyes of constructivism. In summary, through taking into account how things are said or written and through the use of many cases and data collection methods, the 'subjective truth' and 'objective truth' can be combined, as in this study, into a 'critical realist truth'.

Truths are generally associated, or considered synonymous, with theories (Hunt, 1990), which are used to explain something that can be relied upon until such time as it is disproved or modified to take account of other factors or conditions. In purchasing, there are theories covering purchasing strategy and purchasing situations that are held to apply to purchasing in general. Gann (1996) studied construction as a manufacturing process by arguing that a wider range of choice can

be delivered through managing the whole production system top-to-bottom (Juran, 1992), balancing the use of standard components with flexibility in assembly rather than solely attempting to optimize control in discrete parts of the system (Deming, 2011). Winch (2003) further elaborated on the use of theories developed for manufacturing in construction and suggested that models of manufacturing derived from the industries where complex systems are commonplace can be considered useful. By definition, they could be considered to hold true for most cases; however, it has been accepted that theories developed for industry in general, e.g. manufacturing, do not necessarily take account of the conditions found in a project-based industry, e.g. construction (Winch, 2006), although do provide a baseline from which to work. In other words, the general theories apply but to a certain extent only. This means that a given theory might need to be modified to explain a specific context which, in this case, is construction.

2.2 Research design

The research design, or plan (Yin, 2009), is twofold: it consists of theory development on the one hand and case studies on the other hand. The subsequent chapter on "Theories of purchasing" is one part of a study where theories were developed for testing through empirical research. Literature studies were undertaken throughout the research process to support specific lines of enquiry. The first case studies were of an inductive character; but, as more literature studies were undertaken, the character of the research changed to abductive in the third case study and then, finally, deductive in the fourth case study. The first three case studies that will be presented later in this chapter formed a basis for theory development for the fourth case study. Below is an explanation of how theory was developed, followed by a description of the four case studies.

Theory development

Theory is something that we know and which can be regarded as the truth, until proved otherwise (Chalmers, 2013). When building theories, the basis of the theories might exist but are hard to find because we often look in the wrong places and directions; but when the theory is found, it is simple (see below).

> "We are like people looking for something they have in their hands all the time; we're looking in all directions except at the thing we want, which is probably why we haven't found it." (Plato, 380BC)

Plato's writings were simple, reflecting his greatness as a philosopher, and might explain why his work has endured for thousands of years. Philosophy is fundamentally important to humanity, that without it, without truth, there can be no wisdom – which leaves humanity blind and the future treacherous. To accept a theory as a basis for action is to accept it as being more or less true (Newton-Smith, 1981).

Theory development requires that the theorist formulates initial ideas in a way that depicts the current, best and most informed understanding and explanation of the phenomenon, issue or problem in the relevant world context (Dubin, 1978). According to Lynham (2002), the process of theory development includes the development of the key elements of the theory, an initial explanation of their interdependencies, and the general limitations and conditions under which the theoretical framework can be expected to operate. This tentative framework provides an initial understanding and explanation of the nature and dynamics of the issue, problem or phenomenon that is the focus of the theory which often takes the form of a framework and/or metaphor (Kaplan, 1964).

Lynham (2002) argues that to obtain trustworthy and confident theory development, the theoretical framework should be applied to, and empirically confirmed in, the world in which the phenomenon, issue or problem occurs. In order to achieve this necessary confirmation, the theoretical framework must be translated, or converted, into observable, confirmable components/elements. Furthermore, the framework should be the subject of studies to purposefully inform and intentionally confirm or reject the theoretical framework central to the theory. When adequately addressed, this results in a confirmed and trustworthy theory that can then be used with some confidence to inform better action and practice.

In this study, general theories about purchasing were applied to the specific context of a project-based construction environment to produce tentative frameworks (see Table 2 and Figure 9 in the chapter on 'Theories of Purchasing') about purchasing situations and purchasing strategies. Thereafter, the frameworks were tested through the case studies presented below. A description on how the data were structured and analysed is presented in the section on "Methods for structuring and analysing data".

Case studies

According to Ellram (1996), case study research is suitable for investigating purchasing for reason of the qualitative aspects of the phenomenon. The investigation of such phenomena also includes contextual factors, for example industry idiosyncrasies (Johnston et al., 1999). The first two case studies were single-case studies. Flyvbjerg (2001) argues that a limited number of cases that are context dependent can provide superior evidence through a description of a

phenomenon in the pursuit of a perfect explanation. Case study 3 and 4 are multiple-case studies where the number of cases falls within the recommended range of between four and ten as established by Eisenhardt (1989) in order to achieve data saturation. This position is supported by Yin (2009), who argued that sampling logic and the typical criteria for determining sample size should not be used for case studies and that the number of cases is "a matter of discretionary, judgmental choice" (Yin, 2009:58) to be determined from the outcome of each successive case examined. A case study is especially suitable for examining organizational processes (Pratt, 2009) and was therefore regarded as appropriate for a study of the purchasing process. Also, as Eisenhardt (1989) observes, a case study approach is often employed as a means for building theory. Eisenhardt argues that it is important to start by identifying theoretical constructs. Then, it is necessary to select relevant cases, crafting instruments and protocols, and to carry out the analysis during the course of the data collection as well as after for 'within-case' and 'cross-case' patterns that can be compared to the theory.

Initial study: industrialized building (part 1) – general organization

The initial study was about coordination and waste in an industrialized building construction company. The research could be labelled explorative and was based on a case study approach (Ellram, 1996). The study was carried out through personal interviews with the management and factory workers, as well as observations in the factory. The case company was chosen not for being representative of the construction industry or of the industrialized building concept, but because it was expected to replicate or extend the emergent theory (Eisenhardt, 1989). Several companies have more recently adopted the industrialized building concept, which means there are initial, temporary problems related to unawareness and an inability to fully understand the impact of the concept in the organization. In comparison, the chosen case company has been working with the industrialized housing concept for many years and is well-known in the construction industry in Sweden.

Second case study: industrialized building (part 2) – workflow and purchasing

The second case study was carried out in another industrialized building construction company. This time the workflow of the assembly line was studied through observations to provide information for a make-or-buy decision in regard to kitchen cabinet installations. To develop theory from data, much interaction between the researcher and the observed phenomenon is needed over a long period and can be exhaustive (Fellows and Liu, 2008). Data collection was carried out over three years, including participatory observations, formal and informal interviews, phone calls, emails, meetings and workshops. This choice of case company can be seen as an information-oriented selection (Flyvbjerg, 2001). The experiences were considered valuable in a puzzle-solving analysis in relation to the initial study.

Third case study: industrialized building (part 3) – purchasing in general

The investigation of more companies in a multiple-case study approach was carried out in order to understand how, why and to what extent different purchaser-supplier relationships occur and then to categorize them. Morse (1994) suggested that the research process in a case study involves comprehension, synthesis and saturation. Comprehension is a first literature review and initial data collection to understand the context. Synthesis includes a first analysis of the data followed by iterative data collection until a full understanding is reached, i.e. saturation. Finally, generalization can be attempted from additional iterations. Thus, an iterative process of literature searching, data collection and analysis was applied to find the most plausible explanation, which thus became abductive in nature (Dubois and Gadde, 2002a). No company is exactly the same as any other; there are differences in size, product offers to clients, ownership, location, plant and machinery, organization of workers and so on. A purchasing strategy for one company might therefore not be right for any other. To capture this phenomenon and pinpoint the motives for differentiated purchasing strategies that might occur between organizations within a sector, companies with the same type of business were investigated. The multiple-case study focused on four companies, all of which were producers of timber-framed, multi-storey buildings. The companies were chosen because of similarities in production methods, e.g. producing houses from timber components and because they had adopted advanced methods of production.

Fourth case study: traditional construction, purchasing organization and strategies

In order to test the framework (see Table 2) and the matrix (Figure 9), a multiple-case study, consisting of nine individual cases, was conducted in Queensland, Australia, where each case represented the purchasing process of one building construction company. To further investigate purchasing in construction, companies more typical of the construction industry were chosen. The choice of company was based upon its focus on construction management. All of the case companies acted as construction managers, having their own project team to formalize contracts with the contractors responsible for executing various work packages (cf. Murdoch and Hughes, 2007). Potential interviewees were identified through personal inquiry and were followed by the offer of introductions to other individuals/companies who might be prepared to contribute to the study, i.e. an example of snowball sampling (Biernacki and Waldorf, 1981). The latter has been acknowledged as creating dynamic moments where unique social knowledge of an interactional quality can be generated (Denzin and Lincoln, 2005). The goal was to have a spread of companies from large to small in order to capture similarities and differences in regard to the purchasing process, while also reflecting the size distribution of the population. In this sense, the snowball sampling was directed. Whilst the unit of analysis was the purchasing process within the company, the unit of observation was a manager with

sufficient seniority “to speak for the company” about the purchasing process, typically the general manager, the contracts manager, a senior project manager or the managing director and chairman in two cases. Their different positions, views and understanding could be captured to test the framework (Table 1) and the matrix (Figure 9) in a puzzle-solving analysis (Morgan, 1980).

2.3 Data collection

Interviews

> “Life is in many ways a series of conversations”
>
> - Deborah Cameron

As the research is concerned with asking companies how they make their purchases, there is a sort of narrative story at work here. The purpose is to understand the purchasing process in which people and purchasing situations are involved and from that to derive strategies for how purchases are, or should be, handled. According to Cameron (2001), oral narrative is an artful speech genre and choices about how to tell a story may be for the purpose of aesthetics, or for other reasons. Labov and Waletsky (1967) was cited in Cameron (2001) in regard to how one can make a structure about how narratives are told. The structure contains five sections: abstract, orientation, complicating action, coda and evaluations. The abstract consists of a clause that summarizes the point of the story or how it is supposed to be taken. The orientation contains a series of clauses that fills in the background information, for example the characters, locations and time of the story. The complicating action comprises a series of clauses each of which describes an event. The order of the clauses represents the order of events in reality and moves the story forward in time. This section typically has action verbs in the past tense. The following section is coda, which shifts to the present to explain the meaning or moral of the story. Here, the important point of the story can be revealed. The last section of the narrative is referred to as evaluations. This is a talk in which the action has been temporarily suspended and the narrator comments on the actions from outside the world of the story. Typically, this might be signalled by a shift of tense, away from the narrative timeframe. The narrative is a form of interview where the interviewer is rather passive and lets the interviewee speak freely. Gubrium and Holstein (2001) argued that the passive interviewer acts as a passive facilitator to provide a situation for interviewees to speak out on feelings, opinions and experiences. If the interview is more structured with questions, the interviewee might become more passive and might simply inform on experiences and opinions

within the subject, i.e. the interview guide. In the active approach, i.e. an interview that is more structured and controlled by the interviewer, both parties might collaborate to construct narratives and experiences that were not there to start with. A small question could perhaps help make the interviewee speak more freely if hesitant. To invite the interviewee to speak openly about something is called "the grand tour" by Johnson and Weller (2001). These questions might be to ask for how a typical procedure is carried out as, for instance, in the case a new product, supplier or service. This form of interviewing can make the interviewee more at ease and so the relationship is enhanced between the interviewer and the interviewee. Latham and Millman (2001) also write that, traditionally, an interview needs to be structured to obtain sufficient reliability and validity, and in order to support a comparison between different interviews. Moreover, situational questions and patterned behaviour description questions are the two primary types of questions used in structured interviews. In this research, a distinction is drawn between types of buying situations and strategies for these situations. Questions involving products and services and the behaviour when buying them are therefore asked. One structured interview technique that would fit well with categorizing products and processes is the taxonomic approach that Johnson and Weller (2001) mention. In the taxonomic approach, questions such as "What's that? What kind ___ of is it? Are there other kinds of ___?" can be used to elicit categories. Furthermore, domains can be elicited by asking questions such as "What kinds of ___ are there?" These can be seen as a semi-structured type of question as the answers are open-ended.

In terms of specific steps and actions, interviews were carried out with managers and construction workers in the initial case study, supported by visits to the case company's two factories and its headquarters. During the overall research project, which covers more areas than described here, 25 interviews were conducted. The factory visits made it possible to follow and better understand the physical flow of goods and pose more detailed questions about the operations there. The empirical material presented is, however, limited to include data from one of the factories only. In order to secure validity and reliability, this research follows the guidelines suggested by Ellram (1996). In regard to reliability, this includes the use of a case study protocol utilizing the interview guide and a plan for how to analyse the answers from interviewees. For the purpose of validity, the use of multiple data sources (triangulation between respondents and own observations in the factory), establishment of a chain of evidence (the logic between research questions, research plan, interview protocol and individual interview summaries) and draft review of key informants (i.e. interviewees) have been applied.

In the second and third case study, most data were collected over a three-year period and covered three industrialized building construction companies. A fourth company was investigated at the end of the three-year period. Over the first three

years, discussions were ongoing in regard to the purchasing operations of the companies. The researcher chose seven purchased items in order to study purchasing operations. These were: (1) heating, ventilation and air conditioning (HVAC) and electrical installations; (2) studs; (3) kitchen cabinets; (4) windows; (5) gypsum boards; (6) fastenings; and (7) assembly site items. The decision authority for the different kinds of materials and services was examined, together with information about suppliers. Of particular interest was the company's interaction with its suppliers, the reason for the choice of supplier in the first place and how easy it was to find a replacement. This was an iterative learning process in which owners, CEOs, purchasing managers and production managers were questioned and was supplemented by observations of how the materials arrived and were used in production.

Interviews were chosen as the primary method for data collection in the fourth case study, with a minimum of one interview undertaken per case: in all, 18 interviews were conducted with nine companies. According to Eisenhardt and Graebner (2007), interviews are "a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic and infrequent"; furthermore, they claim it might be the only way to capture strategic decision making within companies. A semi-structured format was chosen, where the questions served as a guide for capturing data to test a synthesis of theory presented in the chapter on "Theories of purchasing". Each interview lasted for 45-60 minutes and was later transcribed to enhance reliability in the interpretation of the data.

Observations

> "We live in space, in these spaces, these towns, this countryside, these corridors, these parks. That seems obvious to us. Perhaps indeed it should be obvious. But it isn't obvious, not just a matter of course. It's real, obviously, and as a consequence most likely rational."
>
> - George Perec

George Perec wrote a novel about his observations and classifications of how he viewed his surrounding world in Paris. It is a form of direct observation of everything around him. Direct observations can be carried out through visits, for example to a factory for witnessing their work (Lekvall and Wahlbin, 2001). In the initial stages of this study, direct observations were an important part of the data collection because they constituted a significant amount of the data that were collected for the initial study and formed the empirical basis for the first, second and third papers. During the direct observations, the activities on the shop floor of both industrialized housing factories were observed. In the second case study, the kitchen cabinet installations were studied in detail, covering each step of the procedure and

the cycle time for each step. The purchasing, sales and design managers were asked to describe their workflow from first contact with the client to delivery. The factory's workers were observed over four months, when questions were asked where appropriate to clarify how and why they did, what they did. The installation of the cabinets was rather complex and consisted of several steps that were observed in detail. The cycle time for all of the different steps was measured for ten kitchens. All observations at the company were carried out by asking "five why's" to get to the source of problems (Ohno, 1988). This observation was a structured observation because schedules were drawn-up in advance on how to register the phenomenon (Lekvall and Wahlbin 2001). The schedules were, in fact, value-stream mapping diagrams, designed according to the methodology described in Rother and Shook (2001). These diagrams were to be completed with the measured cycle time for each of the installation steps as well as the intermediate waiting times. Lekwall and Wahlbin (2001) also describe observations as open (people know they are being observed) or hidden (people do not know they are being observed). In this study, all observations were open. Two workshops were conducted with the purchasing manager, one with the 'lean coordinator', two representatives from the local cabinet supplier and two university colleagues. The first workshop was an open discussion. The second workshop was a presentation of the cycle times and detailed descriptions of the steps involving the kitchen installation with a discussion of the results.

Another kind of observation is participant observation, which involves direct participation in the studied environment, such as an employee in a company (Lekvall and Wahlbin, 2001). Participant observation is closely aligned with action research and is often used to study a current situation in order to improve it. The approach can also be used to reproduce something that has been proven to work elsewhere. A typical characteristic of action research is the self-involvement of the researcher in the environment under investigation (Mckay and Marshall, 2001). Action research implies both a contribution to common knowledge, whilst acting as a problem-solver for the case company (Kock et al., 1997). In the studies for the second and third papers, the visits to the factory ran for four months on an almost daily basis, with the author participating in meetings with the management team. This involved collaborating with the management team in the data collection process. The degree of involvement in those meetings could be likened to employment within the company and so it can be regarded as an active participant observation.

Documents

Documents can often be highly relevant in case studies. Yin (2009) points out that it is important to consider how the data were created. How companies present themselves in documents was a form of identification. One part of identification is,

according to Fairclough (2003), what people commit themselves to in what they say or write with respect to truth and obligation, i.e. modality. Moreover, their text can be analysed in terms of the way they use assumptions. Company documents, including webpages, often express the values of the company. Closely linked to values are assumptions. As Fairclough (2003) noted, texts inevitably make assumptions. He regards an assumption as "what is said in a text, is said against a background of what is unsaid, but taken as given". Fairclough distinguishes between three kinds of assumptions: existential, propositional and value. Existential assumptions relate to what exists. Propositional assumptions are concerned with what is or can be or will be the case. Value assumptions are about what is good or desirable. The documents that were studied involved the case companies' account information, purchasing orders, webpages, interview transcripts, purchasing guidelines and drawings.

2.4 Methods for structuring and analysing data

In order to organize data collection in an efficient and effective way, different methods were used. As previously described, the first two case studies were of an inductive character and a framework for structuring and analysing the data was created once data collection had concluded. The third case study had an abductive character and the fourth was deductive. Below follows the method for structuring and analysing the data collected for the different case studies.

During the initial case study, the major functions that were included in the case company's value chain were identified. To structure the data, the case company was divided into four main functions: sales and design, purchasing, production and assembly. These four functions cover the operations in the production and physical flow, and represent the primary functions in the company's value chain. The study focused on cross-functional coordination and waste related to this, and so coordination issues internally in a function fell outside the scope of this study. During the interviews and the factory visits, value-creating activities vs. non-value adding activities were also discussed with the interviewees. For the four different functions in the value chain, different types of waste were identified in the ongoing operations. Using a "pattern matching technique" (Yin, 2009), the data from the interviews were matched against the seven kinds of waste discussed by Ohno (1988). The identification of waste was achieved through a mixture of qualitative judgements and quantitative figures, mainly in the form of the company's own calculations on differences between expected, estimated costs and actual costs for different projects. Judgements and estimations of waste have also been triangulated (Yin, 2009) between different interviewees.

In the second case study, the collected data were analysed and discussed during the course of the data collection. Notes were taken that were analysed manually and discussed with construction workers, managers and senior researchers. The measurements depended on many contextual factors and achieving data saturation was a challenging task. The measurements were then presented in a diagram to visualize the findings. The diagram and the contextual factors affecting it were discussed with the management team, a potential sub-system supplier and the two university colleagues.

In the third case study, the selected items and their purchasing attributes were inserted into a matrix in order to categorize purchaser-supplier relationships. The specific purchasing attributes were assigned to each of the items by the researcher based on the discussions in the interviews. The buyer-supplier relationships for the different items and companies were placed directly into the portfolio matrix redefined from Kraljic (1983) in accordance with the purchasing attributes. These attributes were analysed to highlight both common and different patterns and their possible reasons. The unit of analysis was the buyer-supplier relationship. The reliability of the data collection is high, because collection was followed up by at least one additional interview to ensure the accuracy of information about purchasing attributes for each item. The initial study of observations provided an understanding of the items in context which further enhanced reliability. In this way, triangulation of the data was achieved. The validity of the study is considered sufficient because the purchasing attributes in the data collection were also used in the portfolio matrix (see Paper III). The character of the matrix might enable generalization to other industrialized building companies and, perhaps, construction companies.

In the fourth case study, the interviews were analysed during the course of the data collection from field notes. The testing of the framework (Table 2 in the chapter on ‘Theories of purchasing’) was based on discussion with the interviewee and then sketching the framework from the perspective of how it appeared to work in the company, with comment ensuing. Visual language can, according to Comi et al. (2014), lead to the generation of richer data and greater involvement of interviewees. This meant that the interview could accommodate a more exacting discussion in order to obtain the necessary information for the framework. As Eisenhardt (1989) points out, the questions can be adapted as the study proceeds, thus helping to test the framework in an iterative manner, comparing theory with practice. Questions can be interpreted differently and a small discussion around each question did, in fact, serve to avoid misunderstandings and improve accuracy and reliability. Different angles to the questions were adopted to test the framework and, over the course of the interviews, the responses started to converge. The point of data saturation for was achieved after five cases, beyond which it was expected that no significant, new data would be forthcoming (Eisenhardt, 1989). Other questions

were constructed to reveal the position of products and services in a modified form of the Kraljic matrix (Figure 9 in the chapter on 'Theories of Purchasing'). The responses were used to align the products and services with relevant attributes which, according to theory, were typical for a specific position in the matrix. Different angles to the questions were adopted and, over the course of the case studies, the answers started to converge. The point of data saturation for the matrix (Figure 15 in the chapter on 'Findings') was achieved after nine cases, beyond which it was expected that no significant, new data would be forthcoming (Eisenhardt, 1989).

2.5 Closing remarks

The research design for this thesis covers theory development, as a basis for reasoning and for investigating the phenomenon through an empirical investigation, where a qualitative approach utilizing case studies has been adopted. Case studies were considered appropriate, because they support reasoning from underlying causes that could be missed in a quantitative approach. Case studies also provide opportunities for explaining and interpreting questions in discussion with interviewees. In this way, misunderstandings about questions can be avoided or, at least, greatly diminished.

3 Theories of purchasing

This chapter begins with an overview of the development of purchasing management. It explains purchasing as a process, different purchasing situations and influences on the purchasing process that together form a framework of purchasing situations. Thereafter, purchasing situations are connected to purchasing strategy by considering sourcing structures and the context of the purchase. The latter forms a matrix that inherits many of the characteristics of the original Kraljic matrix.

3.1 The development of purchasing management

Purchasing has gained increased recognition from industry professionals and academics as an important function in a company (Monzka et al., 2016). Purchasing has not always been regarded as something of strategic importance; instead, it has tended to be seen as an administrative task (Van Weele, 2010). Some decades ago, purchasing was mostly regarded as a clerical function that served production according to the *five rights* of purchasing. These *five rights* are the right *price*, at the right *time*, with the right *quantity* and right *quality* from the right *supplier* (Alijan, 1958).

For a long time, the *five rights* were claimed to be the basic rules of purchasing with little consideration of a strategic focus. With purchasing regarded as a clerical function, the tasks of purchasing are considered mainly operational and administrative, focusing on the business transaction (Van Weele, 2010). This traditional approach to supplier management is characterized as reactive and opportunity-driven with arms-length relationships for many suppliers, taking the lowest bid that meets the functional requirements of the product. According to Spekman et al. (1998), purchasing managers have moved from being transaction accountants to information brokers and now managers of externally-sourced manufacturing. This means fewer suppliers and more complex products and services. Through collaboration with specialist suppliers/contractors, purchasing can then provide a basis for more effective and efficient production.

A move towards strategic purchasing is, however, evident in the literature. According to Paulraj et al. (2006), strategic purchasing is: (1) formal long-range planning; (2) part of the overall strategic goals and planning of the company; and (3) visibility for purchasing professionals. This can be interpreted as a combined top-down and bottom-up perspective, where there is awareness and communication

between senior management and operations. The views of Paulraj et al. (2006) should be extended by a fourth dimension – the interaction between purchasing and production – since everything has to 'fit together in the end'. In small construction companies, it might be feasible to have a line of sight to production from the top and, similarly from the bottom upwards; however, strategic purchasing can be a challenging task in large companies. As construction is a project-based business, there can be different views between the project teams and the purchasing department (Ellegaard and Koch, 2014). Usually, some decisions are delegated to the project team and specialist subcontractors. It is vital that the person responsible for the purchasing decision has knowledge about the construction process in order to make the correct choices (Carr and Smeltzer, 1997). This means that everything does not need to be centrally controlled, just centrally coordinated. Depending on the size of the company, its nature and the environment, there could be different degrees of what is centrally coordinated and what is centrally controlled. Understanding the nature of the relationship between the purchaser and supplier/subcontractor on a strategic business level is therefore appropriate.

3.2 Purchasing as a process

The act of purchasing involves several stages. Robinson et al. (1967) conceptualized the activities of a purchase in general in the form of a process starting with: (1) anticipation of a client's need; (2) determination of the characteristics and the quantity of the item needed; (3) description of the characteristics and quantity of the item; (4) search for and qualification of potential sources; (5) acquisition and analysis of proposals; (6) evaluation of proposals and selection of suppliers; (7) selection of an order routine; and (8) performance feedback and evaluation. Webster and Wind (1972) emphasized the first part of the process in terms of a classification of decision-making stages: (1) identification of need; (2) establishing the specification and scheduling the purchase; (3) identifying purchasing alternatives; (4) evaluating alternative purchasing actions; and (5) selecting the suppliers. Van Weele (2010) consolidated the eight stages defined by Robinson et al. (1967) into five: (1) specification; (2) selecting the supplier; (3) negotiation and contracting; (4) issuing the contract or order; and (5) following up to secure delivery. By combining the above frameworks of purchasing, an alternative process can be extracted: (1) identifying the need; (2) establishing the specification and scheduling the purchase; (3) identifying purchasing alternatives; (4) evaluating alternative purchasing actions; (5) selecting the supplier; (6) negotiation and contracting; (7) issuing the contract or order; and (8) following up to secure delivery. This conceptualization is persuasive because it is a direct way of portraying purchasing and is reflective of building construction industry practices.

1	2	3	4	5	6	7	8
Identifying need	**Establishing specification and scheduling the purchase**	**Identification of supplier**	**Evaluation of supplier**	**Selection of supplier**	**Negotiation and contracting**	**Issuing the contract or order**	**Following up to secure delivery**

Figure 2.
The purchasing process (a combination of the works of Robinson et al., 1967, Webster and Wind, 1972 and Van Weele, 2010)

There is a connection between this purchasing process and the innovation process, which Barrett and Sexton (2006) highlighted when they defined the process of innovation in small- and medium-sized companies as "behavioural in nature, being a cyclical process of diagnosing, action planning, taking action, evaluating and specifying learning. The cycle starts with sensing an opportunity or need to change in response to market, project and/or client conditions".

This cycle has similarities with the stages in the purchasing process in determining needs and in diagnosing and taking action on alternative purchases. Novel products and services can be seen, therefore, as an integral part of a process of continual improvement to be implemented at any time in regard to existing products and their associated services. Bildsten (2013) found that the purchasing process was facilitated by established relationships with suppliers participating in the specification stage. The suppliers contributed their technical knowledge so that the designer and suppliers could "cocreate" building solutions (Edvardsson et al., 2005). The selection of suppliers was found to be challenging, because the designer had his or her supplier relationships while the company had its own. In effect, the company was attempting to change the products originally specified by the designer. The purchasing decision was further influenced by clients who stressed that it was important to have guarantees for products and workmanship, as well as competitive bidding to secure the lowest price.

3.3 Different purchasing situations

One of the challenges of purchasing in the particular context of the building construction industry is that each project is different and has a unique set of requirements. The seminal work on purchasing by Robinson et al. (1967) identified different purchasing situations: (1) new-buy; (2) modified rebuy; and (3) straight rebuy, known as the BUYGRID classification. A new-buy is a purchasing situation that occurs when a 'new to firm' product is purchased and where the need for new suppliers might have to be considered. A new-buy generally presents significant challenges, not least in identifying needs correctly. A modified rebuy is when the

product is known but something in the supplier offering has changed from previous purchases or it might involve a new supplier altogether. They are project-specific. Straight rebuys are recurrent situations involving known products that do not require any new information and which are handled on a routine basis with little or no motivation for finding new suppliers. Figure 3 illustrates how different purchasing situations occupy different parts of the purchasing process.

<table>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th></tr>
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<tr><td></td><td colspan="7">Modified rebuy[a]</td></tr>
<tr><td colspan="6"></td><td colspan="2">Straight rebuy</td></tr>
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[a] A modified rebuy implies a change of specification or new supplier

Figure 3.
Different purchasing situations occupy different parts of the purchasing process (abstracted from Van Weele, 2010)

At the level of 'new to firm', the BUYGRID classification represents the different degrees of newness of a purchase, with new-buys and modified rebuys constituting some degree of change. The BUYGRID framework can be related to innovation and, in turn, arguably the most widely cited definition of innovation in construction, provided by Slaughter, can be related to purchasing: "the actual use of a nontrivial change and improvement in a process, product, or system that is novel to the institution developing the change" (Slaughter, 1998: 226).

By combining the contributions of Robinson et al. (1967) and Slaughter (1998), new-buys and modified rebuys can be seen as innovations since they are novel to the organization – an interpretation that is consistent with the oft-quoted definition of innovation by the OECD: "the implementation of a new or significantly improved product (goods or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (OECD, 2005: 46). Hence, a new-buy involves a new product from a new supplier which makes the purchasing process, i.e. the purchaser-supplier relationship, and the purchased product new. The definition of an innovation can thus be extended to involve a relationship. This is also in line with the OECD (2005) definition, covering new "external relations" and, in the construction context, it aligns with Bröchner (2010) who includes new relationships and new services in his definition of an innovation. Services can, in the same way as products, be analysed through the BUYGRID classification.

Depending on the newness of a purchase, different activities are involved. A new-buy involves more tasks than a modified rebuy or straight rebuy. In line with Dawes et al. (1998), who studied the buying centre of different firms when purchasing 'new

to firm' products, the purchasing of a novel product or service can generally be considered to be more complex than a straight rebuy because of a, typically, lengthier process. Moreover, technical personnel were found to have a significant impact on the purchasing decision. The uniqueness of each product in building construction leads more or less to a 'new-buy situation' for each project. This is because the designer has to specify the products in the design of each new or refurbished building. The designer can be seen as a driver of change and someone who pursues new products. In the designer's eyes, purchasing is always a 'new-buy situation' that involves the collection of information about the design, the context in which certain products are to be used and supporting technical specifications. Even so, a study of three building construction projects in southern Sweden by Bildsten (2013) revealed that most products had been used before, particularly in relation to the building's shell. New products and new suppliers were proposed for a small percentage of specified products. When it comes to supposedly new products from known suppliers, the study found that almost all products represented a modification of something existing, typically a standard product; therefore, these purchases could be classified as modified rebuys. These represent a change in something existing and would normally be expected to involve less effort and time than new-buys. Purchases by the project team are, in general, adapted to each project and so are categorized as modified rebuys. Examples are those that involve a service, such as plumbing, electrical and mechanical installations.

Some bulk materials and standard services are called off just-in-time from suppliers with which the company has a framework agreement, based on a preferred list of suppliers from which it expects to achieve greater cost efficiency. These products (i.e. materials and services) can be categorized as straight rebuys. Frödell et al. (2013) undertook a study of a large building construction company in Sweden that aimed to implement straight rebuys for 50% of its total purchasing volume. This was achieved by concentrating purchasing into framework agreements. The straight rebuys were, however, found to be difficult to incorporate as the framework agreements had a subordinate status when compared with purchase orders generated by the project team. Inconsistent ways of working within the projects, suppliers finding it hard to adapt their ways of working, products specified by clients, the geographical distribution of suppliers and market changes over time were barriers that led to the company to reject centralized purchasing for the main part in favour of purchasing on the project level.

The above discussion suggests that the level of newness of purchases in building construction is rather high, as modified rebuys account for a significant proportion of the purchase value. Furthermore, 'newness' requires the presence of technical expertise in evaluating alternative products and suppliers. To ease understanding of the purchasing process, straight rebuys can be regarded as offering the most direct approach. However, cost-saving/value-adding options are not considered, neither is

the opinion of the designer. Nevertheless, straight and modified rebuys might dominate purchasing because of uncertainty as to whether or not new products and services meet regulatory requirements, thereby reducing the incidence of novel design solutions (Tatum, 1987). This situation inhibits purchases from new suppliers who might be unfamiliar with requirements and how to satisfy them. If a new supplier is to be considered, products from that supplier must be shown in the context of a successful, finished project (Biong, 2013). In addition, price agreements – implying straight rebuys – with some suppliers must be followed strictly, making it difficult for new suppliers to be considered. It is argued that negotiation and contracting have become more efficient through long-term price agreements with suppliers of multiple products (Swift, 1995); but, clearly, this has the potential to prevent purchases from new suppliers.

3.4 Influences on the purchasing process

Another challenge in building construction is the many actors that are involved in projects. The purchasing process can become complex due to decision making and communication that takes place over time, involving several project actors and relationships with external organizations. Webster and Wind (1972) defined organizational purchasing as "the decision-making process by which formal organizations establish the need for purchased products and services, and identify, evaluate, and choose among alternative brands and suppliers". They argued that organizational purchasing is more complex than consumer buying for the following reasons: (1) more people are involved and occupy different roles; (2) purchasing decisions often involve technical complexities related to the purchased product or service; (3) purchasing decisions often need long evaluation due to uncertainty, large sums of money and long-term commitments; (4) the lengthy process is hard to coordinate with lags between marketing efforts and purchasing responses; (5) all organizations are unique in objectives, resources and capabilities; and (6) organizational members in the purchasing decision are people whose actions and behaviours are influenced by work-related and non-work related factors. Moreover, purchasing decision making is argued to be more complex than most other organizational decision processes. This depends, according to Webster and Wind (1972) on four factors: (1) the purchasing workflow, which is often crosswise in the organization rather than along the chain of command, i.e. the purchaser's relationships are horizontal; (2) formal authority over purchasers can be in the hands of either a purchasing manager or an operating division manager (in the case of decentralization); (3) a major part of the purchaser's work is with people outside the organization; and (4) purchasing is a service function and there is no clear-cut decision-making authority between, for instance, the engineering department and

the purchasing department. Indeed, Castaldi et al. (2011) found in a study of 12 organizations from a variety of industries in the Netherlands that aligning knowledge between the purchasing function and the expertise of personnel associated with other functions can be a challenge, but it is necessary when novel products and services are involved.

It can be concluded that because of the novelty in many of the purchasing situations in construction, it is important that the purchaser has sufficient knowledge to make the right decisions for the project.

3.5 Actors and roles in the purchasing process

Different actors in purchasing decisions interact with one another, sharing knowledge and attempting to influence the outcome of the process to their advantage. An evaluation of the demands and influence of different actors is important throughout the design, construction and handing-over stages of building construction projects (Olander and Landin, 2005) if there is to be sufficient control over outcomes.

Webster and Wind (1972) developed a framework called the 'buying centre', which is a framework of actors whose roles affect the purchasing process inside and outside the purchasing organization. The influence of different actors can depend on the environmental, economic, political, social and technical context. Since different people are involved in purchasing decisions, interest in purchasing should not only include the purchaser (as a member of the purchasing department) but the buying centre, which includes all those individuals and groups who participate in the purchasing decision-making process and who share the common goals and risks arising from the decisions. As Olander and Landin (2005) have made clear, it is essential to identify actors who affect project decisions in construction and to recognize that the nature of their engagement changes over the project life cycle (Widén et al., 2014). Through understanding the roles in the buying centre, the nature of interpersonal influences in purchasing decisions can be understood. The roles of *users*, *influencers*, *deciders*, *purchasers* and *gatekeepers* can be identified in most purchasing situations (Webster and Wind, 1972). Several individuals can occupy the same role and one individual can occupy two or more roles. Each is now discussed.

Users might exert their influence either individually or collectively. In building construction, users can be the end-user, but also a client organization that initiates the purchasing process and which formulates specific purchasing requirements. Whyte (2003) studied how different users in different contexts within building

construction in the UK and US have diverse requirements that demand tailored solutions. Suppliers might select an existing or previous client or user as a reference for a purchasing organization (Hada et al., 2013). Users can influence purchasing decisions in a positive way by suggesting the need for certain materials and by defining standards of product quality or, in a negative way, by refusing some products.

Influencers are generally people who directly or indirectly affect purchasing or usage decisions by exerting their influence either by defining criteria that constrain the choices to be considered in the purchase decision or by providing information with which to evaluate alternative purchasing actions. In industry in general, the influence of an individual depends to a large extent on his or her expertise (Spekman, 1979). Technical personnel are known to be significant influencers of the purchasing decision, especially in situations involving the development of new products to be manufactured by the purchasing organization and in the purchase of equipment to be used in the production process, especially where new technology is concerned. Moreover, the adoption of novel products and services from suppliers has generally been argued to depend on key individuals, so called *innovation champions* (Chakrabarti, 1974). The role of champions has also been recognized in the building construction context – see, for example, Nam and Tatum (1997), Barlow (2000) and Leiringer and Cardellino (2008).

Purchasers are generally those members of the buying centre with formal authority for selecting suppliers and arranging the terms of purchase. Webster and Wind (1972) noted that the purchaser might have formal authority for negotiating with suppliers and for committing the organization to supply contracts; however, the choices available to the purchaser might be significantly limited by the formal and informal influence of others. For instance, technical personnel might have authority for establishing specifications and could do so in a manner that forces the purchaser to deal with a particular supplier. The influence of the purchaser might be at different stages of the purchasing decision process; but it is especially marked when considering prospective suppliers and then in selecting individual suppliers. The purchaser's influence is affected by the nature of the purchasing task. The decision can be a routine process of applying previously established criteria to a limited range of acceptable alternatives – an essentially clerical function – or it might be more complex if there is the need to negotiate prices and other terms and conditions before formalizing the contract. In more complex situations, it might be necessary to define specifications and evaluate available alternatives to determine the most economical way of solving a purchasing problem.

Deciders are those who have either formal or informal power to determine the final selection of suppliers. Webster and Wind (1972) argued that, in general, the purchaser might decide; but it is also possible that the purchasing decision will be

made by somebody else and left to the purchaser for implementation. Sometimes, it can be hard to determine when a decision is actually made and who makes it. In building construction, a de facto purchasing decision might be made by the designer who develops a specification that can be met by one supplier only (Van Weele, 2010). Thus, although the purchaser may be the sole person with formal authority to sign a purchase order or contract, this actor might not be the true decider. In a study by Gajendran et al. (2014), the CEO made the final decision on the purchase of a new product. Purchasers usually have an upper limit on the financial commitments they are permitted to make, reserving larger decisions for other members of the organization such as the board of directors (Bellizzi and McVey, 1983). Where organizations are publicly-quoted corporations, they will be bound by financial governance that will define authorities and procedures.

Gatekeepers control the flow of information into the buying centre. They are generally seen to be important in development projects where, for instance, the technology is changing, as revealed by Tushman and Katz (1980). They defined gatekeepers as those key individuals generally in projects who are both strongly connected to internal colleagues and strongly linked to external domains. Gatekeepers are at the junction of different communication channels and are, therefore, usually in the position to regulate the flow of demands and, hence, decision outcomes (Pettigrew, 1972). According to Webster and Wind (1972), a gatekeeper in an organization might be the purchaser who has formal responsibility and authority for managing the relationships between the organization and vendors both existing and potential. In these situations, the purchaser might have formal authority for allowing salesmen to contact the engineering department or might be responsible for maintaining a library of catalogues or their digital equivalent. There might, however, be other gatekeepers than purchasers in the organization. Technical personnel in particular are likely to be exposed to information about new products and new technology of possible interest to the organization. Architects gather catalogues (or their digital equivalent) for building construction projects, which might make the architect a gatekeeper (Van Weele, 2010). Vendors employed by the purchasing organization can be a significant source of information about the availability of products and services in the marketplace. General managers can also be exposed to important sources of information. In a study of small and medium-sized building construction companies by Gajendran et al. (2014), the founder, managing director or CEO was responsible for initiating changes. This finding is in line with Webster and Wind (1972) who, far earlier, had noted that gatekeepers exert their influence primarily at the stage of identifying purchasing alternatives. Consequently, they also significantly determined the outcome of the purchasing decision.

As established earlier, users and influencers have an impact on the identification of need, establishing specifications and scheduling the purchase, identifying

purchasing alternatives, evaluating alternative purchasing actions and selecting suppliers. In building construction, the client and the designer can be viewed in this process as influencers in a ‘design and construct’ contract. In a ‘design and build’ contract, the client has less involvement. This is because in a ‘design and build’ contract, the designer is employed by the building construction company (i.e. the main contractor); whereas, in a ‘design and construct’ contract the client employs the designer directly (Harris and McCaffer, 2013). In a ‘design and build’ contract, the company can have a significant impact on the above activities and throughout the remainder of the process involving negotiations, contract award and following up. Deciders, for example project managers or general managers, will place much dependency on monetary value (Bellizzi and McVey, 1983) and can, therefore, have a large impact on determining the specification, schedule and final selection of suppliers. Gatekeepers exert their influence when identifying purchasing alternatives. This person can, depending on the nature of the contract, be the client, architect or project manager. Figure 4 summarizes the roles applying to different stages in the buying centre.

	User	Influencer	Purchaser	Decider	Gatekeeper
1) Identifying need	x	x			
2) Establishing specification and scheduling the purchase	x	x	x	x	
3) Identifying purchasing alternatives	x	x	x		x
4) Evaluating alternative purchasing actions	x	x	x		
5) Selecting the supplier	x	x	x	x	

Figure 4.
Decision stages and roles in the buying centre (after Webster and Wind, 1972)

The concept of the buying centre has been studied by several researchers. For example, Bellizzi and McVey (1983) examined 140 US building contractors’ perceptions of influences in different purchasing situations and found that much depends on the nature of the product in terms of its cost rather than *newness*. Kohli (1989) investigated how individuals in the buying centre exerted power in new-task situations across different manufacturing industries in the US involving more than 250 purchasing decisions. Kohli’s investigation found that *expert power* had the greatest influence inside large buying centres that were not under pressure of time and when there were few attempts to influence decisions. Conversely, *reinforcement*

power was found to have a strong influence inside small organizations under pressure of time. Other kinds of power, namely *referent power*, *departmental power* and *information power*, tended to play smaller roles.

Bunn (1993) developed an extension of purchasing situations into a framework based on four situational factors: purchase importance, purchase task uncertainty, extensiveness of choice and perceived purchaser power. In addition, her framework considered purchasing activities, namely search for information, analysis techniques, proactive issues and reliance on control mechanisms. Since building construction projects bring together many organizations and the actors within them, their influence in different purchasing situations is of particular interest. Throughout the purchasing process – from the specification stage through to following up to secure delivery (see Figure 2) – some actors are generally seen to exert more influence than others (Kohli, 1989). For example, project managers can have the expertise and informational power on 'what' and from 'whom' to purchase, while reinforcement power can be exerted by designers and previous clients of suppliers can have referent power. The influences are driven by different interests and motivations (Sheth, 1973), which can involve high complexity (Andersson et al., 1987). Whilst Robinson et al. (1967) adopted a process view of purchasing activities, there are other frameworks that address the characteristics of an individual's influence over purchasing decisions. For example, Sheth (1973) considered organizational purchasing behaviour, highlighting the role of individual expectations associated with purchasing variables related to the product, organization, politics and broad context. Sheth proposes that a purchaser's reactions to external variables depend on each organization's unique structure. In contrast to Webster and Wind (1972) and Sheth (1973), who focused on interactions both *inside* and *between* organizations, Håkansson and Johanson (1992) adopted a supply chain management perspective to propose a purchasing framework based solely on interactions *between* organizations. By adopting an ARA model (actors-resources-activities), the content of a business relationship was described in terms of three layers: actor bonds, resource ties and activity links. These actor-resources-activities can be seen as the environmental and organizational dimension of the buying centre surrounding the individual and interpersonal relationships within each organization. Within the construction context, Håkansson and Ingemanson (2013) examined how the interaction between organizations, actors, activities and resources might transform into renewed products and processes. The types of interactions that form renewal are argued to be long-term, as opposed to purely transactional relationships based on a bidding process (Gadde and Håkansson, 1993) that often characterizes the supply chain in building construction (Bygballe et al., 2010). However, long-term does not necessarily mean a close relationship and short-term does not have to mean purely transactional or loose as Gadde and Snehota (2000) pointed out. From

an organizational purchasing perspective, the underlying causes of this behaviour were attributed to the preferences of the different actors within each organization.

3.6 A framework of purchasing situations in building construction

A framework of purchasing situations in building construction based on purchasing stages can be derived from the analysis presented thus far. The purchasing process consists of the stages of: (1) identification of need; (2) establishing specification and scheduling the purchase; (3) identifying purchasing alternatives; (4) evaluating alternative purchasing actions; (5) selecting the supplier; (6) negotiation and contracting; (7) issuing the contract or order; and (8) following up to secure delivery. This process has been derived primarily from a synthesis of the work of Webster and Wind (1972), Robinson et al. (1967) and Van Weele (2010).

As shown in Figure 3, different purchasing situations occupy different parts of the purchasing process. New-buys occupy the whole process, whereas modified rebuys require a defined specification since they represent a change in something existing and are project specific. Straight rebuys are not project specific and simply require an order to be issued. Purchasing decisions can vary in complexity from studies required to identify and define needs, on the one hand, to simply issuing an order. Once the specification has been agreed, complexity decreases; when the supplier has been chosen the process is relatively straightforward.

The stages of the purchasing process involve different roles in the buying centre. Through defining which roles are involved in the different stages of the purchasing process, the mechanisms for implementation can be better understood. Users and influencers are present in the stage of determining the need. Purchasers and deciders are added in the subsequent stage of establishing the specification and scheduling the purchase. Deciders need to sign-off on the specification and later on the choice of supplier. In identifying purchasing alternatives, the gatekeeper is added and the decider is excluded. The evaluation of alternative purchasing actions involves the user, influencer and purchaser. The subsequent stage is where the selection of suppliers occurs and for this stage the decider is added. Later on, when the emphasis shifts to mostly administrative work, it can be assumed that it is just the role of the purchaser that is active. Identifying roles involved in the purchasing process, and classifying according to roles relating to their impact, allows managers to be aware of the organizational and interpersonal forces involved in implementation, not least where some degree of change is involved.

The construction client as the *de facto* owner of the final product will use or represent users and influence decision making by making demands according to his or her needs. The designer works as a major influencer in fulfilling the needs of the client with the help of suppliers. In the specification stage, where purchases are planned, the schedule is more or less set for the project and deciders enter the process. The level of decision making in these cases can vary between organizations, but the role of the decider is present at this stage in the form of the project team, general manager or a combination of them. Once the specification and scheduling of purchases have been concluded, the identification of purchasing alternatives occurs. In the case of a 'design and build' contract, the client has a limited say at this stage, although a designer is always present as an influencer. All supply chain participants involved in the identification of suppliers might act as gatekeepers. The project team acts as the purchaser on the behalf of the client from specification throughout the rest of the process. In the evaluation of alternative purchasing actions, the roles remain except for that of the gatekeeper, which is no longer present. After the evaluation of suppliers, the selection of the most advantageous bid occurs. Normally, it is the project team and, in some cases, the client or designer who makes this decision. If the monetary value exceeds a certain level, the decision might also have to involve the general management of the company. Commonly, the project team as purchaser takes care of the rest of the process such as issuing the contract or the purchase order and securing delivery.

A distillation of the earlier analysis of the literature and the issues raised in the above discussion lead to the formulation of a framework of purchasing situations in building construction (see Table 2). This framework was then tested among construction companies (see the chapters on Methodology and Findings).

Table 2.

A framework of purchasing situations in building construction

	Stages in the purchasing process							
	Identification of need	**Establishing specification and scheduling the purchase**	**Identifying purchasing alternatives**	**Evaluating alternative purchasing actions**	**Selecting the supplier**	**Negotiation and contracting**	**Issuing the contract or order**	**Following up to secure delivery**
Purchasing situations	New-buy	New-buy Modified rebuy[a]	New-buy Modified rebuy	New-buy Modified rebuy	New-buy Modified rebuy	New-buy Modified rebuy	New-buy Modified rebuy Straight rebuy	New-buy Modified rebuy Straight rebuy
Level of complexity	High	High	Moderate	Moderate	Moderate	Low	Low	Low
Active roles	Users Influencers	Users Influencers Purchasers Deciders	Users Influencers Purchasers Gatekeepers	Users Influencers Purchasers	Users Influencers Purchasers Deciders	Purchasers	Purchasers	Purchasers
Supply chain involvement	Client Designer Supplier	Client Designer Supplier Project team General manager	Client[b] Designer Supplier Project team	Client[b] Designer Project team	Client[b] Project team General manager (if high value)	Project team	Project team	Project team

[a] A modified rebuy is project specific and a change in something existing.

[b] In a ‘design and build’ contract, the client has limited impact in these stages.

3.7 Connecting purchasing situations to strategy

In order to enhance the use and meaning of the framework of purchasing situations it can be useful if this is related to purchasing strategy. The latter can be seen as a problem-solving method to be used in different situations. Strategy was originally a military concept. It comes from the word *stratego*, which means army and *ageio* which means to lead. The military rely on the coordination of many units of soldiers, each fighting in close formation and so strategy has become a metaphor of business competition (De Wit and Meyer, 2010). It could also be seen as a metaphor for leading many subcontractors in a construction project. Logistics also has its roots in the military. For example, Alexander the Great paid considerable attention to his army's supply lines and during the Second World War, German U-boats sought to interrupt the Allies' supply lines (Cousins et al., 2007). Logistics began to receive attention as a business unit in the 1950s, but it was not until in the 1980s that purchasing began to be recognized as having a role in business strategy. In 1983, a McKinsey consultant named Peter Kraljic wrote a ground-breaking seminal paper for the Harvard Business Review, entitled "Purchasing Must Become Supply Management." Kraljic's paper, perhaps viewed as the most important paper in purchasing literature, describes the principles of modern strategic sourcing and argues that the purchasing function should go from being clerical to a strategic role of optimal supply. Kraljic (1983) made a classification of purchasing strategies for different kinds of products, divided into four types: non-critical items, leverage items, bottleneck items and strategic items, and depicted them in a matrix. This portfolio approach to purchasing has been of considerable interest over the years because it acknowledges that there is not just one purchasing strategy that could be applied to all products and services. It has been used primarily in manufacturing sectors: see, for example, Gelderman and Donald, 2008 (logistics); Lee and Drake, 2010 (lifts/elevators); Pagell et al., 2010 (sustainable sourcing); and Padhi et al., 2012 (commodities). Some authors have introduced variations on the matrix theme (see, for example, Elliott-Shircore and Steele, 1985; Olsen and Ellram, 1997; Syson 1992; and Lilliecreutz and Ydreskog, 1999). Even so, no significant changes have been made to the original Kraljic matrix. The matrix has also been considered from the perspectives of power and dependence (Caniëls and Gelderman, 2007) and culture (Kibbeling et al., 2009). The Kraljic matrix has become established as the standard for purchasing portfolio matrixes (Gelderman and Van Weele, 2005; Pardo et al., 2011).

The Kraljic matrix is based on two dimensions: importance of the purchase, e.g. its cost, and complexity (see Figure 5). The cost of purchases represents a significant proportion of a company's turnover – typically in the range of 70-80% (Axelsson,

2005) but as much as 90% (Hinze and Tracey, 1994) – and so it is of particular importance. The complexity dimension is the risk impact of standing without materials in production, which more specifically relates to scarce supply, monopoly or oligopoly conditions and logistics. Purchased products and services are aligned against the two dimensions and positioned within one of four categories: *leverage items*, *strategic items*, *bottleneck items* and *non-critical items*. The attributes of each product or service are shown in the respective category in Figure 5.

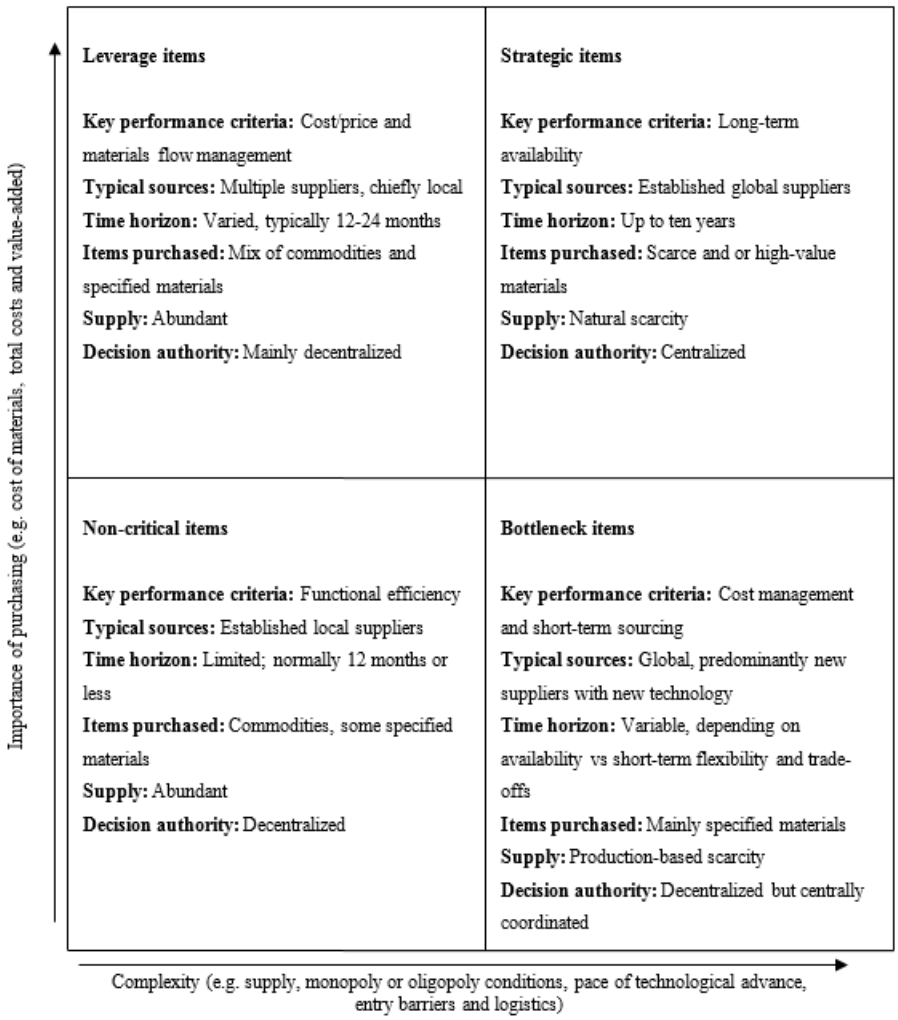

Figure 5.
Stages of purchasing sophistication (after Kraljic, 1983:111)

The upper-left category of the Kraljic matrix covers *leverage items*. The limited interaction needed for these standardized (commodity) items means that they can be

considered a loose purchaser-supplier relationship (Dubois and Gadde, 2002b). Multiple sourcing and a 12–24 months' framework agreement would, for example, imply little collaboration; however, renewed contracts on a long-term basis are still possible. Key performance drivers are cost/price and material flow, with an abundant supply and mainly decentralized decision authority. Leverage items are responsible for a large part of the project cost which means that companies can take advantage of their purchasing power.

The upper-right category of the Kraljic matrix covers *strategic items*. These are high-value materials, where the time horizon is long term (i.e. up to ten years) and sourced from established global suppliers, with long-term availability as a key performance driver. The supply is scarce and the decision authority level is centralized. The intense interaction and need for long-term availability make this a close and long-term purchaser-supplier relationship. Strategic items can be seen as specialized solutions and so the capabilities of these suppliers can add value that does not exist within the purchaser's company (Kale and Arditi, 2001).

The lower-right category of the original Kraljic matrix covers *bottleneck items*. These are mainly specified materials, where the time horizon is variable and depends on availability vs. short-term flexibility. The products are sourced from specialist suppliers with cost management and reliable short-term sourcing as key performance drivers. The supply is scarce and the decision authority is decentralized, but centrally coordinated.

The lower-left category of the original Kraljic matrix covers *non-critical items*. These are mainly commodities and some specified materials, with a limited time horizon (i.e. less than 12 months), which are sourced from non-specialist suppliers and where key performance is a matter of functional efficiency. The supply is abundant and the decision authority is decentralized.

Regardless of its popularity, the portfolio approach has received criticism concerning, for example, implementation difficulties, lack of precision and subjectivity (Ramsay, 1994; Cox, 2001). Its primary purpose is to serve as a tool for discussing the relative positioning and strategy for products and services and not as an exact measure of purchasing. To facilitate implementation, discussions are likely to be most fruitful across departments of production and purchasing in order to make the company more efficient. Ferreira et al. (2015) undertook a single-case study of a construction company where they emphasized the involvement of project team members, i.e. close to production, in the placement of different kinds of purchases in the Kraljic matrix. Apart from this study, the application of purchasing portfolio matrices (or models) to project-based industries, such as construction, has been particularly limited. It is appropriate, therefore, to consider their use in project-based industries such as construction, because of the need to find a matrix to support purchasing decision making in construction companies.

3.8 Sourcing structures

The different ways in which construction companies can work with suppliers can be represented as sourcing structures. Cousins et al. (2007) defined four primary structures: *single*, *multiple*, *delegated* and *parallel* (see Figure 6). The different structures are part of a purchasing strategy and depend on the prevailing situation and the needs of the company.

Single sourcing is when a purchaser has only one source for a product or service. This might depend on the high cost or the strategic importance of the end product (Kraljic, 1983). The client or the architect might have specified a particular product. Sometimes, there might be just one source of supply because of the market structure. The advantages of single sourcing are that it is easier to exchange ideas for new product development; there is also the opportunity to redesign products and processes and to move towards cost transparency. The downside is that there is only one source of supply and that could put the purchaser in a position of weakness if the relationship is not maintained (Faes and Matthyssen, 2009). Another scenario could be that the supplier goes out of business, which would then create problems for the purchaser. Furthermore, single sourcing could limit the purchaser's flexibility to acquire innovation (Yusoon et al., 2015).

Multiple sourcing means securing multiple suppliers for a product or service. The supplier is chosen primarily on the basis of price (Zeng, 2000). In this type of structure, the purchaser is able to choose and compare capacity constraints with supplier performance before placing an order. The relationships between purchaser and suppliers are, in this case, loose with a high degree of competition, low switching costs and low levels of technical competence. With this approach, continuity of supply is maintained on a short-term basis, enabling price-reduction; however, if demand exceeds supply then the price is likely to increase. In addition, there might be more focus on price than total cost (Ellram and Siferd, 1993).

Delegated sourcing was pioneered in the aerospace and automotive industries – see Womack et al. (1990) and Lamming (1993). This structure applies when there is one supplier for a sub-assembly as opposed to an individual part. For example, a building construction company might delegate authority for a sub-assembly to a key supplier known as the first-tier supplier. The first-tier supplier in turn works with the suppliers of components for the sub-assembly. The advantage for the construction company, when adopting the delegated sourcing structure, is that it reduces the number of suppliers with which it has close collaboration and is, therefore, able to reduce transaction costs (Ireland, 2004).

Parallel sourcing was developed as a concept through game theory by Richardson (1993) to optimize supplies for the purchaser. This structure is a combination of

single and multiple sourcing that aims to have the advantages of both, whilst excluding the disadvantages. Parallel sourcing occurs when a purchaser has a single sourcing relationship for the components within a product group, whilst having a multiple sourcing relationship across product groups. For example, two construction projects have two types of subcontractors, A and B, as shown in Figure 6. Type A subcontractors, for instance for electrical installations, are different companies in the two projects. Type B subcontractors, for instance for mechanical installations, are similarly two different companies in the same two projects. In this way, the purchaser has alternative sources of supply if necessary. The purchaser can thereby maintain price competition and avoid capacity constraints while still working closely within each product group.

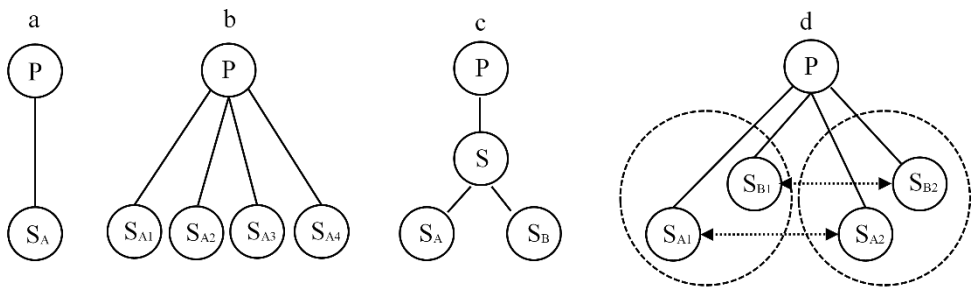

Figure 6.
(a) Single sourcing; (b) Multiple sourcing; (c) Delegated sourcing; (d) Parallel sourcing (after Cousins et al., 2007)

Companies use a mix of the different sourcing structures for different products and services and the most appropriate structure depends on the characteristics of the product and supplier market. The various sourcing structures can be mapped to purchasing strategies through the Kraljic matrix (1983) to create an improved understanding of how to handle the purchase of different products. Figure 7 is a mapping of sourcing structures developed by Cousins et al. (2007). They regarded the leverage group as having a delegated sourcing structure or it could be parallel, where one of several well-known options is available. The supply structure of the strategic group can be single, delegated or parallel. The bottleneck group is single or, possibly, parallel sourced. The non-critical product group has a multiple or, possibly, parallel sourcing strategy.

The relationship between the sourcing structures and the Kraljic matrix (see Figure 7) is interesting from a make-or-buy perspective to analyse *which* party should be responsible for what. Moreover, it offers insight from a strategic perspective regarding decisions on the form of relationships with different suppliers of products and services. The delegation of purchasing tasks inevitably leads to the question of outsourcing. The construction of a building is a complex undertaking (Gidado,

1996) and can indeed be viewed as an opportunity for outsourcing. A reason for this can be derived from transaction cost theory (Williamson, 1985), where outsourcing is regarded as a means for decreasing complexity. Through purchasing, companies can outsource and thereby generate higher value from suppliers' capabilities and be more flexible with external parties handling part of the production (Quinn, 1999).

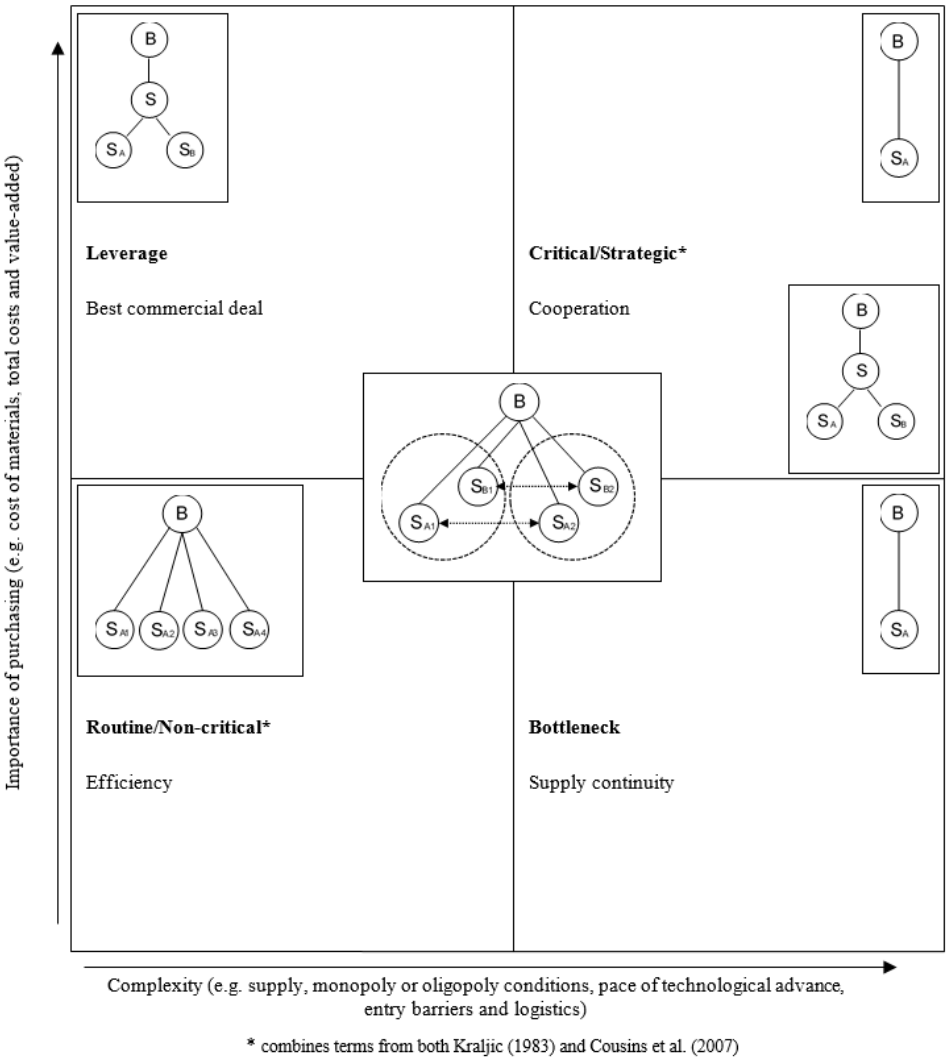

Figure 7.
Generic mapping of purchasing strategy and sourcing structure (redrawn from Cousins et al., 2007:56)

Building construction involves many tasks that require the services of specialists. According to the core competence concept (Prahalad and Hamel, 1990) and delegated supplier structure (Womack et al., 1990), companies should concentrate

on what they do best. This should define the boundary of the company and determine what it should be doing. It can sometimes be hard to know where the boundaries are between companies. Some companies undertake some construction work and outsource other services, which can make the boundaries fuzzy. This is typical in traditional construction where many organizations work together. The boundaries surrounding key components of the internal business processes can be regarded as a business model (Morris et al., 2005). However, business models are affected by the extent of interaction with external stakeholders beyond the boundaries (Zott et al., 2011) and this must, by definition, include the client. How the boundaries occur depends both on transaction costs as well as on internal and external capabilities (Argyres and Zenger, 2012). The "glue" between the boundaries and the external capabilities found in the environment can be represented by a supply or sourcing structure. The chosen structure depends on the particular situation, confirming the utility of the sourcing structure proposed by Cousins et al. (2007). Faes and Matthyssen (2009) made a connection between the purchasing strategy and product life cycle through a new interpretation of the Kraljic matrix (see Figure 8).

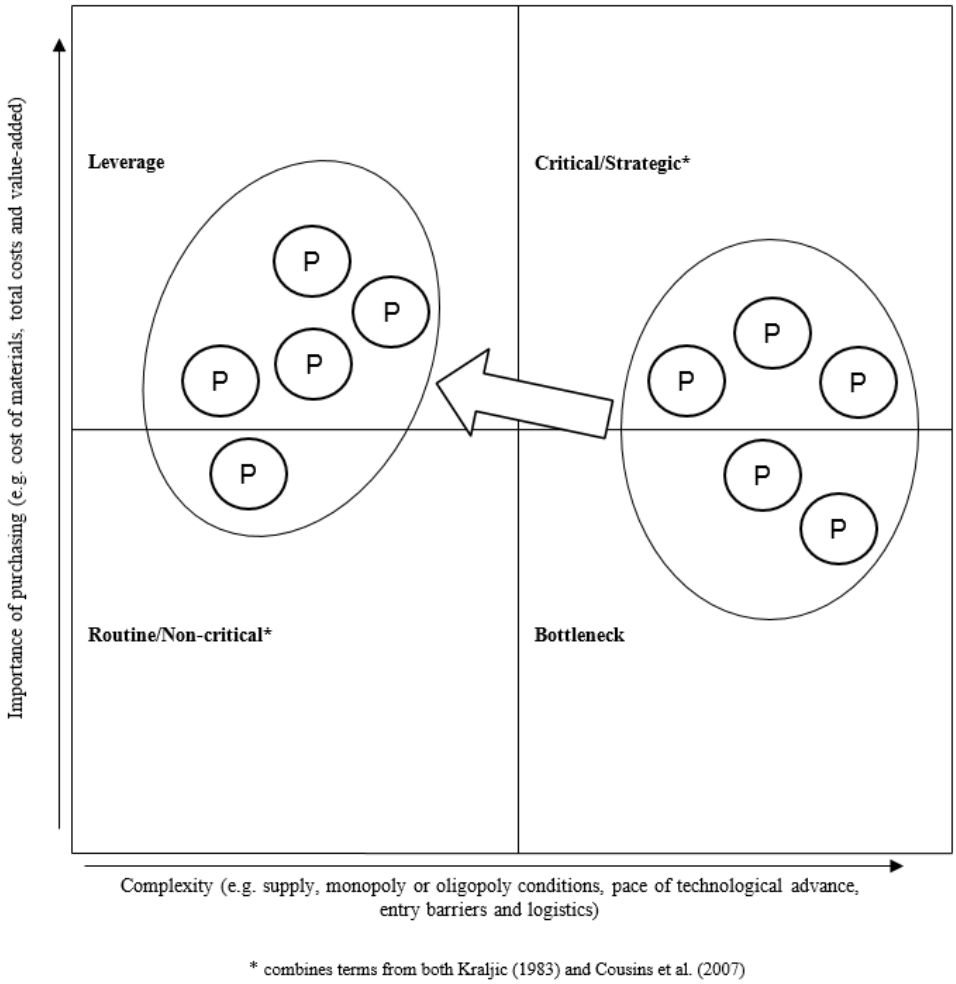

Figure 8.
Dynamic path of a product or service in the matrix (after Faes and Matthyssen, 2009)

They regard the purchase of new products as risk-taking coming from the right-hand side and moving through the matrix to the left-hand side when the product has become an established purchase. This implies that new-to-firm products would move through the categories of *bottleneck items* and *critical/strategic* and end up as *routine/non-critical* or *leverage items*. New-to-firm products are risky as they involve uncertainty and the highest supply risk is on the right-hand side of the matrix. In the context of the sourcing structures discussed by Cousins et al. (2007), we can see sole sourcing and delegated sourcing on the far right. These then become the gateway for new products and services too. This is not surprising as new product development requires collaboration. It might initially require investment and has, therefore, a rather low position on the importance of purchase dimension. As other

suppliers begin to produce the same items, the product or service becomes fully developed and regarded as a common product or service. In this way, the risk of the purchase becomes lower and the product or service is considered more valuable, gradually migrating towards the upper-left corner of the matrix.

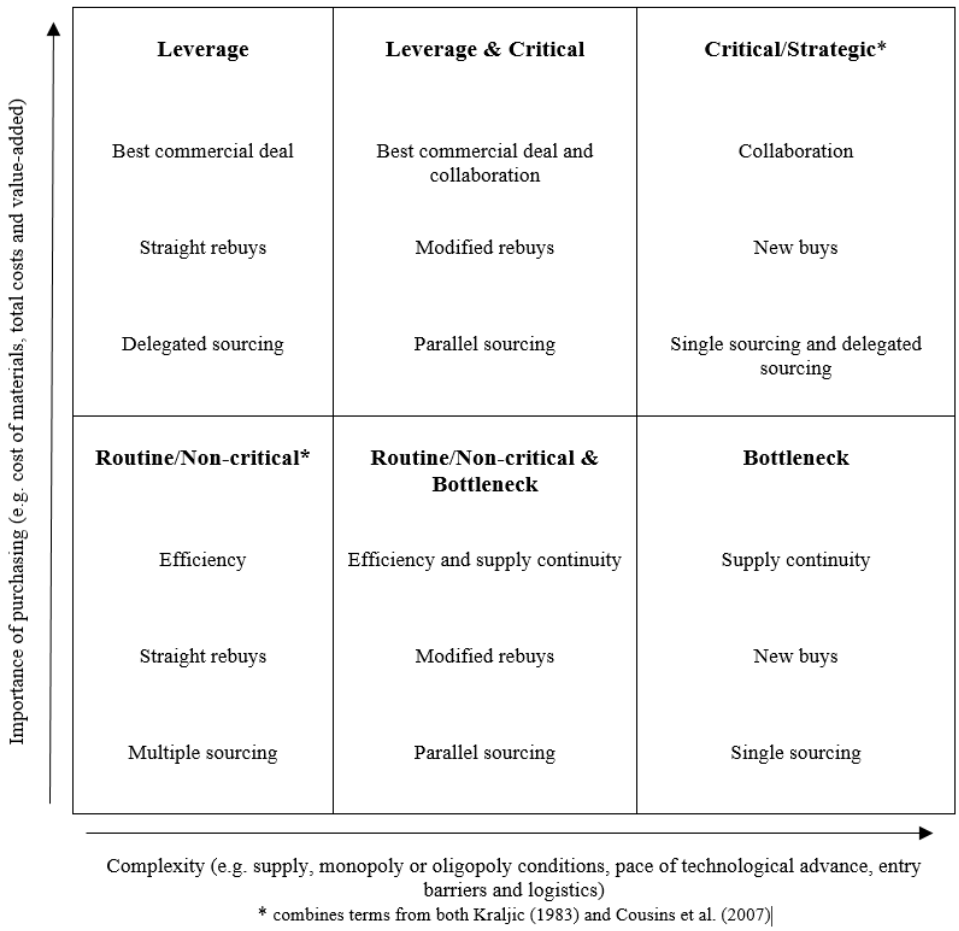

Figure 9.
The modified form of the Kraljic matrix

Faes and Matthyssen (2009) offer a perspective of how the product life cycle can be connected to purchasing strategies. This provides insights into the novelty of the purchase in the form of new-buy, modified rebuy and straight rebuy and where these kinds purchasing situations belong in the Kraljic matrix.

The theoretical contributions presented above concerning sourcing structures and new product development offer a deeper understanding of purchasing strategies. By integrating these concepts, a modified matrix is proposed (see Figure 9). This matrix

has six categories instead of four. Parallel sourcing occupies two categories in the centre as it overlaps the other four categories in the matrix. The original Kraljic matrix has a hard dividing line between leverage and strategic products. Ferreira et al. (2015) noticed that some products and services were close to the borders of another category. This is also an argument for introducing an intermediate step to have the best commercial deal and the most effective collaboration. This is in line with Rehme et al. (2005) who regarded manufacturing companies' strategies as a hybrid of the best commercial deal and the most effective collaboration (see also Bildsten et al. 2010). Faes and Matthyssen (2009) observed that products lose their novelty as they travel from the lower-right to the upper-left of the original Kraljic matrix. With the new matrix consisting of six categories, the novelty of the purchase can be described in terms of new-buy, modified rebuy and straight rebuy. This modified form of the Kraljic matrix reflects the two additional aspects of purchasing derived from Cousins et al. (2007) and Faes and Matthyssen (2009).

The matrix was tested among construction companies (see chapters on "Methodology" and "Findings and analysis").

3.9 Closing remarks

Theories help to explain the world around us. As accepted truths – until proved otherwise – they enable new insights and understandings to emerge. In the world of purchasing, theories have been developed to explain how organizations manage the purchasing process, how they deal with different purchasing situations and, among other matters, the roles of various actors. The theories that apply to purchasing in general do not, by the definition of a general theory, take account of the specific context of purchasing in construction, which is the field occupied by this research. The project-based nature of construction is a major factor in this regard. Development of these theories to reflect and, therefore, explain purchasing in construction was considered necessary, with the 'framework for purchasing situations' offered as a tentative theory for subsequent testing in a practical, i.e. construction company, setting. Further development of theory in regard to purchasing strategies for construction in general has been undertaken and is also offered as a tentative explanation of the character of supplier relationships and has likewise been tested subsequently in a practical setting.

4 Findings and analysis

This chapter presents the findings and analysis of Papers I-V. The chapter starts with an overview of the case studies and briefly what was found in each of them and how they relate to the appended papers. Thereafter, the findings of the papers are presented.

4.1 Overview of case studies

This thesis is based on a substantial amount of data gathered and analysed from four in-depth case studies (see Figure 10 for an overview). The first was a single-case study at an industrialized building company which was documented in Paper I. The study led to the conclusion that purchasing is one of the root causes of coordination issues in production. The first study was followed by a second single-case study at another industrialized building company, where the production line of finishing was investigated and kitchen installations in particular. The study was documented in Paper II, which proposes that a nearby, smaller specialist that supplies and installs the cabinets is preferable over a bulk supplier that provides just the cabinets. The third study was a multiple-case study of four industrialized building companies to show how all their purchases were made. The findings were documented in Paper III, where the companies' purchases were mapped into an adapted form of the Kraljic matrix. The study concluded that different strategies are suitable for different products in order to create value-in-production. The fourth case study was carried out among 12 construction management companies. In this study, the purchasing process as well as the strategy for different purchases were studied. The findings were that the companies to a large extent practice a 'supply and install' strategy in order to facilitate production. Moreover, purchasing decision-making is by construction professionals who are responsible for the project. Furthermore, the larger the change (novelty) from project to project, the larger is the complexity of the purchasing process. A framework of purchasing situations concerning the novelty and the different actors involved was derived from the literature and verified through the case study in Paper IV. In addition, a modified version of the Kraljic matrix was created and validated through the fourth case study with the findings presented in Paper V.

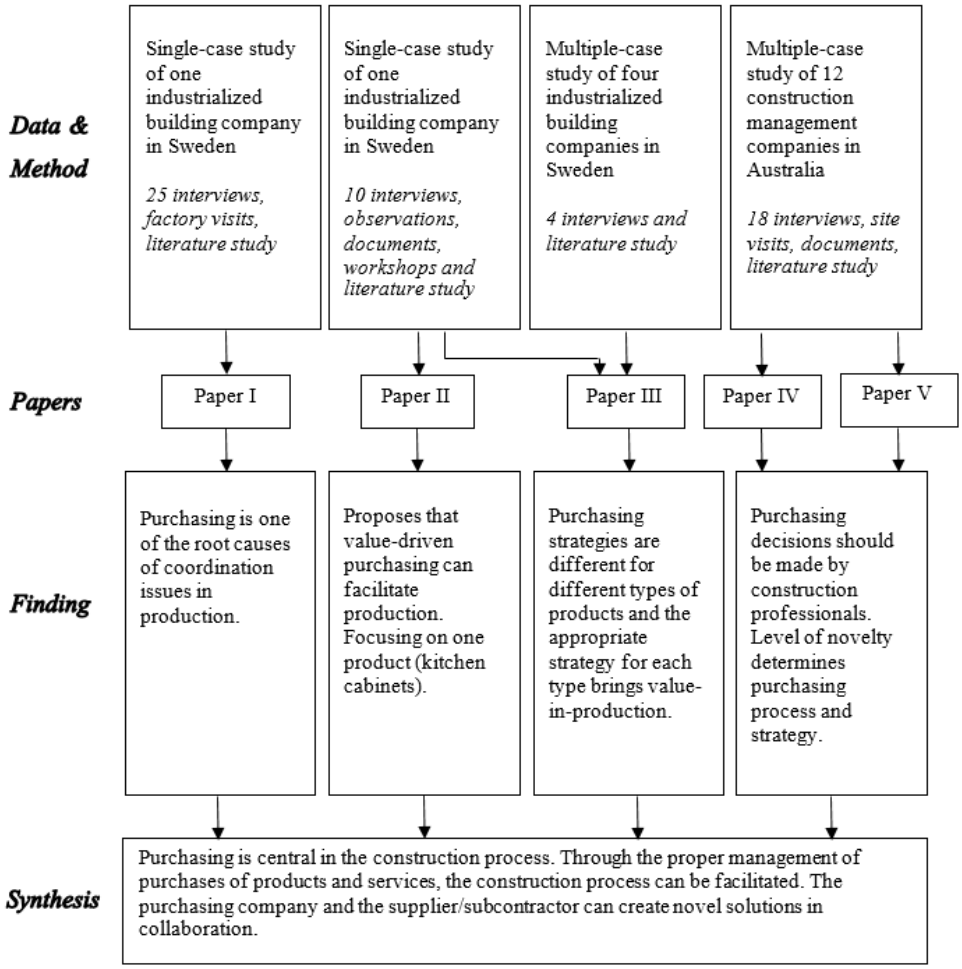

Figure 10.
Synthesis of the thesis

4.2 Findings from appended papers

The findings from the appended papers each solve a piece of the puzzle involved in answering the research questions. Below is an explanation of the contribution that each paper makes.

Findings from Paper I

A literature review in Paper I recognizes that coordination mechanisms can be connected to lean literature. A framework was created that combines six basic coordination mechanisms by Glouberman and Mintzberg (2001) with the seven wastes defined by Ohno (1988) (see Figure 11). The interdependencies in production can thereafter be connected to coordination mechanisms, different kinds of waste that, in turn, should be eliminated to create value.

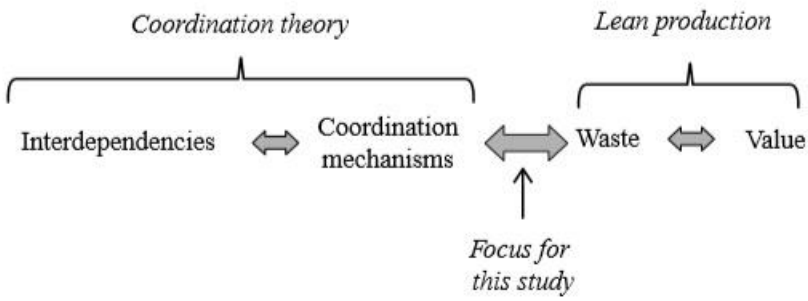

Figure 11.
Combining coordination theory with lean production

The coordination mechanisms of Glouberman and Mintzberg (2001) are: (1) Mutual adjustment, which means that two or more people adapt to each other during their work. This is typically performed in very simple work situations or in extremely complex systems that are not possible to plan or predict. (2) Direct supervision, where someone else is performing the coordination. Typically, this can be a supervisor or manager in a hierarchy of authority that issues directives for how work should be done. (3) Standardization of work, which means that the working procedures in themselves are specified. This is a prerequisite for the creation of economies of scale. In the industrialized-housing concept, standardized working routines are expected to enhance learning and utilize personnel and machines so that the non-value creating time can be reduced (Lessing et al., 2015). (4) Standardization of outputs, which means that the output from the work is standardized in order to match other activities, i.e. the interfaces between activities are standardized. (5) Standardization of skills and knowledge, which gives the opportunity for people to know exactly what to expect from each other in terms of work. This enables people to act in a more synchronized way. (6) Standardization of norms, meaning that common values and beliefs shall facilitate that people are working towards the same goals and expectations.

Lean researchers recognize that value creation can be enhanced by the elimination of waste (Fearne and Fowler, 2006; Jones et al., 1997): “The removal of waste, either within an organisation, or at the interfaces between organisations, is a way to

increase value and competitive advantage" (Barker and Naim, 2004: 52). Waste is hence defined in terms of value, which in turn is defined by customer needs/requirements and/or cost efficiency (Mossman, 2009; Barker and Naim, 2004). As Ohno (1988) defines it; "we regard only work that is needed as real work and define the rest as waste". Different types of waste are discussed in the lean production concept. Ohno (1988) identifies seven types of waste: overproduction, making defective products, unnecessary movements, waiting, unnecessary transports, excessive stock levels and unnecessary processes that should be eliminated (Womack and Jones, 1996). This original classification of different types of waste has been widely accepted, including within the lean construction concept (Mossman, 2009).

Through an explorative study of the flow from input to output in an industrialized building (see Figure 12), different kinds of waste could be identified based on identification of coordination mechanisms.

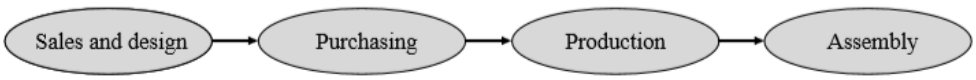

Figure 12.
Input to output in industrialized building

Much of that waste was found to be originating from purchasing decisions. Purchasing and production representatives were not always present at project meetings, which meant less possibility for mutual adjustments in the form of, e.g. information and "negotiation" in regard to solutions. Extra orders and other additional administration, such as follow up of rush orders, telephone calls to synchronize and inform the production, were common. The production had to wait for late, or suffer incorrect, deliveries that in turn caused delays to the subsequent steps in the production line. Scarce direct supervision sometimes causes guesswork in production, which occasionally resulted in errors. The delays further caused late delivery and misplacement of equipment when transporting the volumetric timber elements and equipment to the assembly site. It can be concluded that there is a need for proper coordination mechanisms between purchasing and production as well as supervision to find solutions and/or to increase standardization.

Findings from Paper II

Paper II takes up the theme of the findings from Paper I on how purchasing can add value to the production process. A literature review was undertaken to create a framework that compares market-driven purchasing with value-driven purchasing (see Table 3).

Table 3.
A comparison between market-driven and value-driven purchasing (modified from Frazier et al., 1988)

Purchasing characteristics	Market-driven purchasing	Value-driven purchasing
Time horizon of exchange	Short term	Long term
Focus of exchange	Price	Joint emphasis of core product and value-adding services
Nature of information exchanged	Limited to transaction	Close exchange of information concerning product design and production planning, as well as JIT delivery
Number of suppliers in the market	Many	Sole sourcing
Product complexity/customization	Low	High
Supplier proximity	Far or near	Near (preferably)
Transaction costs	Low	High
Level of trust	Low	High
Size of supplier compared to buyer	Large	Small
Inventory level	Large	Small/none (JIT)
Production complexity	High	Low

Table 3 shows that, in terms of facilitating production in value-driven purchasing, the focus of exchange is a joint emphasis of core product and value-adding services, close exchange of information concerning product design and production planning as well as JIT delivery, high customization, near supplier proximity, a small to zero inventory level and, last, low production complexity. Value-driven purchasing could therefore be a possible strategy for solving production complexity based on the coordination issues found in Paper I. This entails, as Table 3 also shows, that the time horizon of exchange is long, that the transaction costs are high and that there exists a high level of trust between the purchaser and supplier. Paper II argues that from a value perspective, a long-term relationship with a dedicated local, smaller supplier is a preferable choice over a short-term bulk supplier, even if the short-term supplier has lower prices. The kitchen manufacturer is taken as an example in Paper II, where kitchens were to be installed in timber volume elements. During the course of the study, the company purchased kitchens from a large supplier of standard cabinets that were transported a considerable distance. The next-door local supplier had a better opportunity to take measurements and accept adaptions in order to produce a high-quality result. By leaving the responsibility for the kitchen installations to a specialist, there could be a win-win situation by letting both companies focus on their core activities. Through value-driven purchasing, the industrialized building company can accelerate production as the production line becomes less complex when kitchens no longer have to be coordinated and assembled by it.

Findings from Paper III

Companies purchase a variety of items that require different amounts of attention to their relationships with suppliers. A literature review was carried out to determine how different purchasing strategies relate to different products and services. An adaptation of the Kraljic matrix was deduced from theory and applied to the context of industrialized housebuilding in Sweden (see Figure 13). When classifying different purchased items in construction, it is necessary to consider the project-based nature of the industry (Winch, 2006). Moreover, in industrialized building, items are delivered both to the factory and to the assembly site (Koskela, 2003). As described earlier, buyer-supplier relationships can be close or loose, where close does not necessarily mean long term (Dubois and Gadde, 2002b) and loose does not imply short term (Dyer et al., 1998). Against this background, the Kraljic matrix has been adapted by redefining the axes into a new portfolio matrix. In this new matrix, closeness of the buyer-supplier relationship (loose/close) is on one axis and length of the buyer-supplier relationship (short-term/long-term) is on the other axis.

In the adapted matrix, *leverage items* are renamed *non-project specific items*. Non-project specific items can be used across several projects and bought in large volume; thereby, industrialized builders can take advantage of their purchasing power. *Strategic items* are renamed *specialized solutions*, as this is the part of the building with the highest external asset specificity. The capabilities of these suppliers can add value that does not exist within the buyer's company. Specialized solutions can be delivered both to the factory and to the assembly site. The long-term relationship with standardized routines enables decentralized decision making that is centrally coordinated. *Bottleneck items* are renamed *supplementary items*. These are delivered to the assembly site to complete the building. In order to decrease the cost of final assembly, the key performance driver is just-in-time (JIT). Sources are typically small and medium enterprises (SMEs) (for services) and builders' merchants (BMs) (for components) with the supply in regard to the urgency of these items seen as scarce (Paper I). A high level of interaction is often needed in a close relationship; however, the length can be short as buildings are made in different locations. *Non-critical items* are renamed *project specific items* because handling might cost more than the item itself and the time horizon is short term. As these items are standardized, they require little interaction in a loose relationship. In the adapted matrix, the key performance driver is just-in-time (JIT) for production, as these items are delivered to the factory close to the time they are needed. The decision level in the adapted matrix is centralized as the client and architect are normally part of the decision making for project specific items.

	Loose	Close
Long-term	**Factory delivery** **Procurement focus:** Non-project specific items (e.g. gypsum boards) **Key performance criteria:** Cost/price and materials flow management (logistics) **Typical sources:** Established suppliers **Time horizon:** Varied, typically 12-24 months **Items purchased:** Mix of commodities and specified materials **Supply:** Abundant **Decision authority:** Decentralized	**Factory and assembly site delivery** **Procurement focus:** Specialized solutions (e.g. electrical installations) **Key performance criteria:** Co-created solutions (strategic) **Typical sources:** Established suppliers **Time horizon:** Up to 10 years or more **Items purchased:** Scarce and or high-value materials **Supply:** Natural scarcity **Decision authority:** Decentralized but centrally coordinated
Short-term	**Factory delivery** **Procurement focus:** Project specific items (e.g. kitchen cabinets *in certain cases*) **Key performance criteria:** Short-term sourcing (JIT) **Typical sources:** Multiple new and established suppliers **Time horizon:** Limited; normally 12 months or less **Items purchased:** Commodities, some specified materials **Supply:** Abundant **Decision authority:** Centralized	**Assembly site delivery** **Procurement focus:** Supplementary items (e.g. products and services for the assembly site) **Key performance criteria:** Cost management and reliable short-term sourcing (JIT) **Typical sources:** Multiple new and established suppliers **Time horizon:** Variable, depending on availability vs. short-term flexibility and trade-offs **Items purchased:** Mainly specified materials **Supply:** Production-based scarcity **Decision authority:** Decentralized but centrally coordinated

Figure 13.
Purchasing portfolio matrix for industrialized building

A select number of products and services was then inserted in the matrix for the companies A, B, C and D (see Figure 14). The portfolio matrix shows that strategies for purchased items differ between the companies. One purchasing strategy may not be right for any other company; it depends on the context of each company. All companies might not have access to the same type of supplier. Purchasing strategies also depend on the particular construction system that is used, customer demand and competences within the company. Most companies have limited resources and have to allocate them where the need is the greatest.

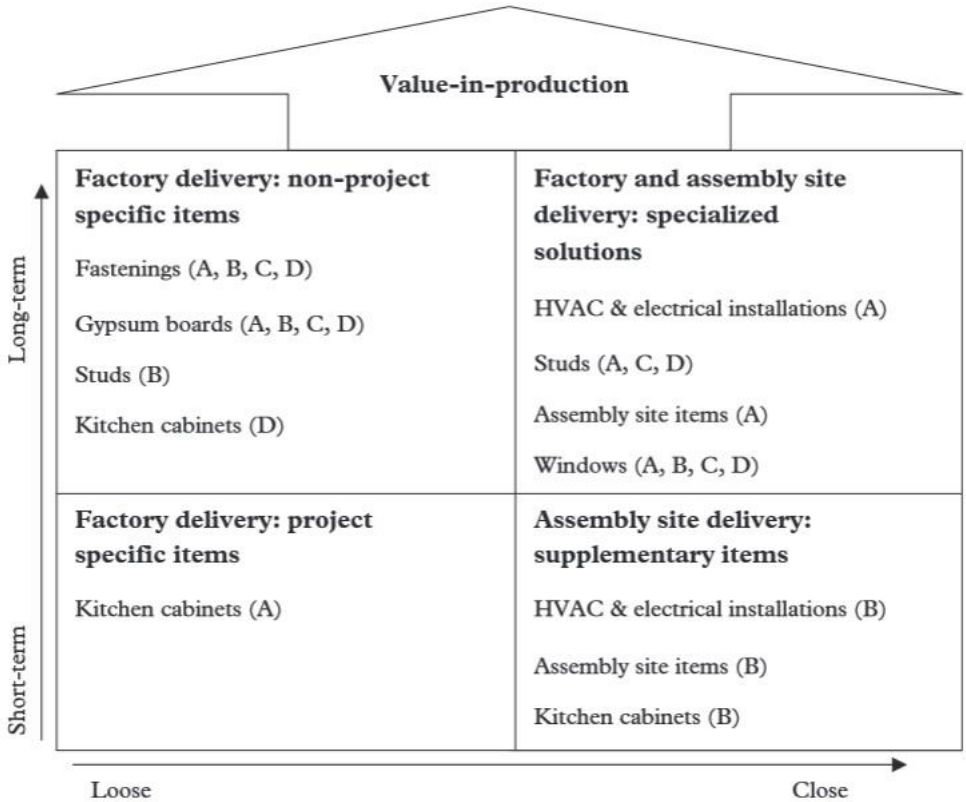

Figure 14.
Differentiated strategies of items between companies

The findings show that buyer-supplier relationships in industrialized housebuilding are principally of a long-term nature. This is motivated by the need to secure supply for production. Long-term and close relationships create possibilities for customer adaptations of products and services that fit the production system of the particular company. Longstanding routines enable secure supply and decentralized decision making. In this way, long-term relationships generate value-in-production. This does not, however, mean that all relationships are close: different items require different levels of closeness in coordination. Collaboration with suppliers of standardized items concerns mainly logistics, which indicates a loose buyer-supplier relationship. Yet, buyer-supplier relationships are long term in order to secure supply. The constant need for, and use of, the same standardized items allows industrialized housebuilders to take advantage of their purchasing power. Large amounts of products and services ordered in regular deliveries support buyer-supplier relationships that otherwise would not be possible. The general trend to create value-in-production seems to be to work upwards in the portfolio matrix towards long-term relationships. The findings are based on the practices of

industrialized housebuilders in Sweden. As such, generalization of the findings concerning buyer-supplier relationships to other contexts should be approached with caution. Even so, the portfolio matrix is generic and can be used as a tool to analyse companies in order to visualize purchasing strategies.

Findings from Paper IV

A framework portraying building construction companies' purchasing situations has been presented (see Table 2). The framework was derived from purchasing situations identified in the literature – see the chapter on "Theories on purchasing" – and tested in discussions with representatives of a select number of building construction companies. From this empirical study, it is possible to conclude that the framework is recognized by those companies as capturing their individual purchasing situations. Since it is a framework, it cannot be expected to detail every facet of purchasing in building construction; but that was not the purpose. Nonetheless, the framework provides a definition of purchasing situations found in building construction companies of various sizes in a particular region where construction activity could neither be described as insignificant nor unusual. The findings also confirm that four factors have to be addressed by the companies if purchasing is to contribute to project success: (1) classifying the purchasing situation; (2) assessing the level of complexity; (3) identifying active roles; and (4) involving the supply chain. These factors are summarized below in terms of their practical implications for the companies.

The *stages in the purchasing process* could be more efficient and effective and, therefore, add more value through greater knowledge of products and suppliers. This knowledge seems to reside close to where production is carried out, i.e. within the project team. Knowledge about suppliers and products requires long-term relationships that do not necessarily have to be formalized. In terms of the *purchasing situation* and *active roles*, i.e. *supply chain involvement*, new-buys and modified rebuys are handled by the project team, as this requires expertise on how to build in order to satisfy the needs of the client. Through decentralized purchasing, where decisions are made primarily by the project team, an environment to accommodate change can be created. Centralized purchasing, with straight rebuys, has been argued to make the purchasing process more efficient in building construction and is a common approach in manufacturing industry. It seems, however, challenging to incorporate this practice into building construction since each project is unique. Straight rebuys appear to be possible only when it comes to commodities, which are used across many projects. The decision to centralize or not therefore involves a trade-off between customization and standardization.

In order to handle *level of complexity*, it is important that the key decisions have been agreed. *Active roles* such as users, influencers, purchasers, deciders and gatekeepers, who share the common goals and risk of the purchase, need to be identified in each purchasing decision. In order to create an efficient purchasing process, it is important that the goal is clearly defined for all roles. This can be represented by decision gates in which the decider is active in signing off what has been agreed. It is important that the *decider* (typically the general manager) allows the *influencer* (typically the project team) to have an informal role in decision making as this person has knowledge of how to create value-added solutions. The designer and client are strong influencers and can enforce the use of new products and suppliers; however, such a decision cannot be influenced by the power within the company. Even so, the project team needs to determine how to build and source products. Managers should therefore be aware of the value-adding capability of the project team in their decision making.

Findings from Paper V

The project-based nature of the construction industry implies that there is a change from project to project and, therefore, from purchase to purchase. It is necessary for construction companies to understand how to manage and analyse purchasing strategies for different products and services, because of their impact on project outcomes. In manufacturing industry, the Kraljic (1983) matrix and derivatives of it are widely utilized for this purpose. The matrix was taken as the starting point for this research and modified in the light of more recent developments, particularly the integration of sourcing structures and industrial context (see the chapter on "Theories on purchasing"), before investigating companies' actual purchasing decision making. From the findings, the choice of a supplier depends on the nature of the project and availability of the particular subcontractor. The companies generally use the same supplier across projects; but sometimes switch between projects, although limit this to known suppliers. It can be concluded that the companies operate in a close relationship with subcontractors to provide something value adding. It is a strategy which, through collaboration and market forces, can accommodate change in the form of modified rebuys. Together, these offer a hybrid approach as the strategy for a majority of the purchases of the construction companies (see Figure 15). In order to achieve the best commercial deal and most effective collaboration, the companies utilize parallel sourcing for product and service packages from proven subcontractors in competition. An extension of this hybrid approach also covers products and services of low value that need to be efficiently sourced and where there has to be continuity of supply. Low-value products and services represent a significant proportion of the cost of a construction project, which makes purchasing and material management challenging. To manage

this situation, the purchase of routine/non-critical and bottleneck products and services is managed through subcontractors. The sourcing structure is delegated by the companies in order to take advantage of the (external) capabilities possessed by these subcontractors. It is beneficial for the companies to have this delegated, parallel supply structure given the variety of (comparatively) small quantities of items involved and the subcontractors' knowledge of the products. Subcontractors concentrate on the tasks that they understand best of all and are responsible for purchasing components about which they have first-hand working knowledge.

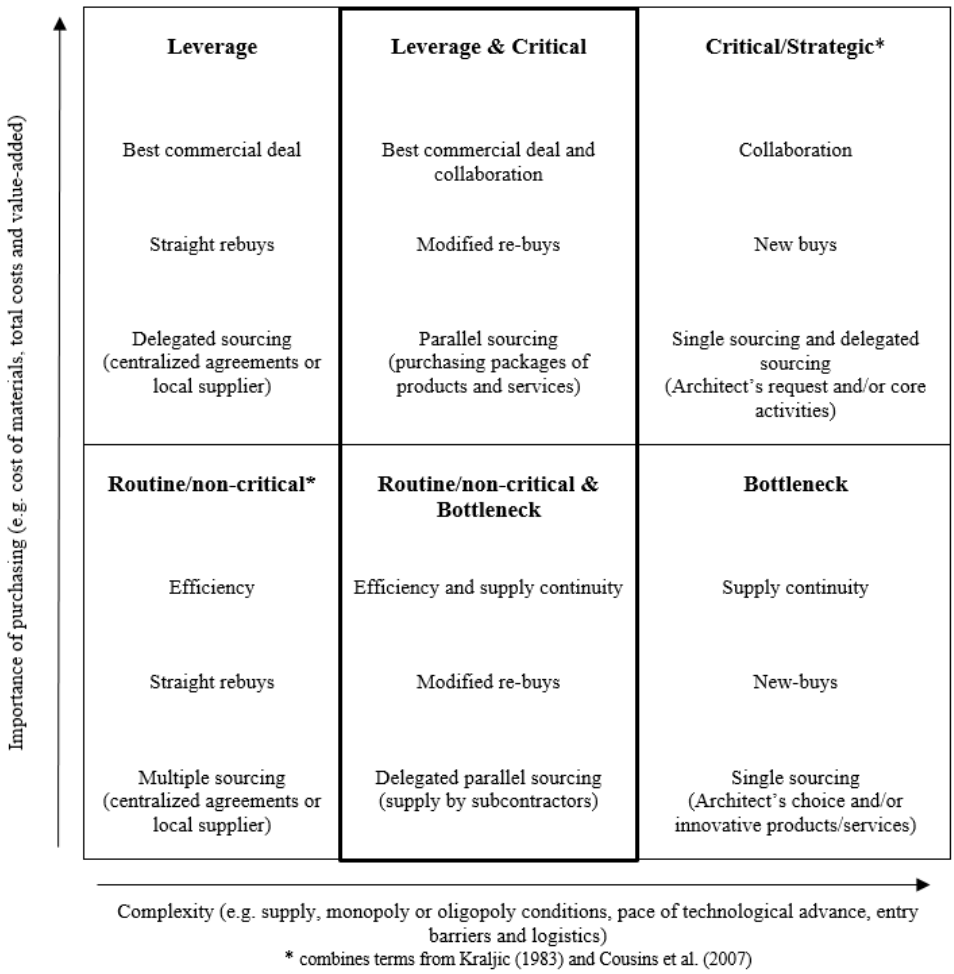

Figure 15.
The form of the Kraljic matrix in construction companies based on the findings from the case studies

4.3 Closing remarks

The five appended papers that cover the several studies in this research have explored a number of facets of purchasing in a range of construction-related contexts which include factory-based production with onsite assembly on the one hand and large-scale site-based construction on the other hand. This diversity of production/construction activity has enabled detailed analyses of each case and comparison across multiple cases to provide a richer understanding of purchasing in its practical setting. A key part of the empirical studies has been the testing of the theoretical frameworks with the case companies. Many interesting findings have emerged and these are discussed in the next chapter with their theoretical and practical implications are presented in the chapter on “Conclusions”.

5 Discussion

This chapter considers the relationship between the theoretical findings and those derived from the empirical studies, with some reflections on the interpretation of the results of the research. The chapter on "Theories of purchasing" established frameworks for purchasing that were subsequently tested in the field through case studies as presented in the last chapter on "Findings and analysis".

A better understanding of the world or a part thereof can be gained through the application of theories. Unrevealed theories can be regarded as hidden knowledge in people's experiences, since people are "tangible" and a manifestation of reality. By analysing theories and developing and testing them through discussions with experienced people, new theories can be proposed. Further testing will, however, be needed to reveal if the proposed theory can be accepted as truth.

The approach to theory development, in terms of the resultant framework of purchasing situations in building construction, has been outlined in the chapter on "Theories of purchasing" and has been tested in the field with experienced senior managers and reported in the previous chapter on "Findings and analysis". There is alignment between the theoretical framework and the views of senior managers in recognizing the former as reflecting the purchasing process as it applies to their particular purchasing situations. The framework can, therefore, be considered valid, although in the context of the case study companies only. No claim can be made as to the wider applicability of this theoretical framework here; however, others might find that it explains their purchasing situations adequately.

A framework on purchasing strategies related to purchasing situations was derived in much the same way as discussed above. This framework was developed with Kraljic's matrix as the starting point. The Kraljic matrix was modified by relating purchasing strategies to purchasing situations and the resultant tentative framework was presented in the chapter on "Theories of purchasing". The framework was then translated into observable, confirmable components/elements, i.e. topics that could be discussed with experienced senior managers. The framework can, through testing in the field, be considered valid within the context of the case companies.

In the first study for Paper I, several people conducted the interviews and observations, which might have led to some difference in understanding. This can, however, be seen as advantageous as it provides objectivity from several perspectives. The second case study, which served as input for Papers II and III, was

carried out by one person and could therefore be regarded as more subjective than the first case study as, to a large extent, it consisted of observation by one person. Nonetheless, it offered an enhanced understanding of the context as basis for further studies. In the third case study, interviews were in part conducted with a senior researcher in order to probe interviewees for a deeper understanding of the data. This was beneficial as a learning experience on how to act and ask questions during a semi-structured interview. For the case study forming the basis for Papers IV and V, the experience from the previous case studies could be used to form the interview guide and conduct the interviews. There is a risk that the character of the semi-structured interviews in a discussion form could lead the interviewee to certain answers. This was considered during the analysis stage through scrutinizing the transcripts to determine if an interviewee had been led in any way when answering the questions. On the other hand, the semi-structured form of the interviews gathered useful information from the respondents that would barely have been surfaced in structured interviews. The transcriptions of the final case study were carried out by resident Australians in order to ensure the accurate wording of the interviewees' answers. The converging results of the interviews, together with observations, site visits and documents, provided a thorough understanding that, in turn, provided credibility for this empirical study.

6 Conclusions

This chapter starts with a re-evaluation of research objectives including answers of the research questions. Second, the theoretical contributions will be presented. Third, the practical contributions will be presented and these consider how the findings can be used in industry. Last, the potential for further research is briefly discussed.

6.1 Re-evaluation of research objectives

The aim of research covered by this thesis was to describe and analyse purchasing management and its interrelation with the supplier relationships and the production process. This aim has been achieved through a synthesis of the detailed findings as presented in the chapter on “Findings and Analysis”, the chapter on “Discussions” and the appended papers.

Research questions underpinned each of the five papers and are summarized below; first, in terms of answering the research questions, then in terms of their theoretical and practical contributions. The questions were as follows:

> RQ 1: What is the relationship between purchasing and the needs of the production process?
>
> RQ 2: How can a framework assist in understanding different purchasing situations?
>
> RQ 3: How can purchasing situations be related to purchasing strategies for different products and services?

The first three appended papers, Papers I-III, are based on studies of factories, whereas the last two, Paper IV and Paper V, are based on studies of site-based construction. Factory production and site-based construction have different prerequisites for purchasing. Factory-based production is based mostly on the repetitive use of the same materials that are bought in large quantities, where the goal is to establish routines and standardize as much as possible to decrease complexity in supplier relationships, purchasing and production. Site-based construction has less room to store materials, which implies that deliveries must be scheduled to arrive just-in-time. The organization of specialist suppliers that are chosen to be the best fit for a particular project make customization possible where standardization is not as important as in factory production. Packages of products

and services can be tailor made for the project which enhances flexibility of design. Many purchases for site-based construction are, however, a reconfiguration in the form of modified rebuys.

RQ 1: What is the relationship between purchasing and the needs of the production process?

A principal finding is that purchasing should be closely involved in production in order to make the proper choices of products, services, suppliers. The findings in Paper I revealed that purchasing was critical for production as they are interdependent. If materials are not there in time or if they are the wrong materials, the work cannot proceed. Closely related to this is uncertainty on how to proceed and install the materials. The finding that purchasing has such a large impact on the organization of production provided the impetus for further study. The study for Papers IV and V revealed that one of the main priorities when choosing a supplier is timely deliveries as they can become much more expensive if the products and/or services are not delivered on time because they will delay subsequent activities, i.e. they will have a knock-on effect. It is, therefore, considered an advantage to use local suppliers as transportation is shorter and the communication of information is easier through meetings in person (as proposed in Paper II and verified in Papers IV and V). A problem with purchases from abroad is the risk of products not arriving on time and, moreover, the products might not be of the right quality or comply with local building regulations. Quality, just as delivery time, is a priority for the construction companies. The companies want to be sure that the supplier/subcontractor will deliver according to the specified quality. If there is a quality issue or if, for example, a product is wrongly installed it will lead to rework or perhaps a change of supplier/subcontractor which, in turn, will lead to delays and more costs. For this reason, the companies tend to choose locally-established suppliers that they trust rather than less expensive alternatives that might not deliver in a timely manner or to the right quality, leading to higher costs.

The construction industry has been portrayed by many researchers as price-driven in regard to the choice of suppliers. The case studies have shown that the choice of suppliers is based to a large extent on long-term relationships. The trustworthiness of suppliers plays an important part. Through long-term relationships, the project team can rely on the experiences acquired in previous purchases to overcome problems of coordination, communication and integration. The findings might encourage recognition of the industry as not so much price-driven, as tends to be quoted, but instead is one that is built on relationships, at least in those areas studied. One possible consequence of these kinds of “relational purchases” might be that purchasers (see Papers IV and V) allow their subcontractors to take a greater

responsibility for the delivery of a whole package of products and services rather than the current, wide-spread practice of separating products and services. The purchasing of integrated packages of products and services makes purchasing and production less complex for the construction companies. Specialist suppliers can enhance quality. Splitting products and services might give a better margin, but is a much riskier path. Paper IV revealed that the purchasers were familiar with the coordination issue in terms of purchasing and organization of production and, therefore, purchased products with installation services included within a single package. By delegating the responsibility of installation to a subcontractor there is less uncertainty about how to proceed, with the subcontractor left to take responsibility for controlling the supply of materials. From this perspective, subcontractors can be regarded as specialists in their respective areas and supply the materials with which they are familiar. Moreover, the senior managers interviewed in the study for Papers IV and V said they would never get involved in details and that the purchasing decisions where trusted to the project managers who had the technical expertise. This means that most purchases need technical expertise. Moreover, investigations into alternative products and services have to be made before finalizing the purchase order. Some of the companies started to formalize supplier relationships companywide to increase their purchasing power through larger purchase volumes. It is, however, difficult due to the uniqueness of each project. It is necessary to develop the most suitable solution in collaboration with the subcontractors that have expertise about how to install certain products. The fourth case study, for Papers IV and V, revealed that centralized purchasing creates difficulties as the wrong materials might be ordered and that it increases complexity in production as products and services are separated.

RQ 2: How can a framework assist in understanding different purchasing situations?

A framework was provided as a definition of purchasing situations found in building construction companies. The findings confirm that four factors have to be addressed by the companies if purchasing is to contribute to project success: (1) classifying the purchasing situation; (2) assessing the level of complexity; (3) identifying active roles; and (4) involving the supply chain. The study in Paper IV found that the project team had full authority to choose the subcontractor who, according to the project team, is the most suitable for the project. Depending on the price of the purchase there are, however, different authority levels which means that a general manager might have to sign-off a high-value purchase. It is, however, rare that the general manager does not approve a purchasing decision made by the project team. This practice of letting the project team make the purchasing decisions can be seen as a decentralized form of purchasing organization. A quote from the chairman of

one of the building construction companies was: “the responsibility of whether the subcontractor will get the job should be as close to the job site as possible because often service means it will cost you. Bad service will cost you more.” This can be interpreted as a matter of it being better to let the people with the best practical experience of production make the decision. Another reason stated by one of the project managers was: “we do so many different sorts of projects that we would not be able to use centralized procurement practices.” The project team having substantial practical experience, where each project was different, were the primary reasons for decentralized purchasing, and was a finding that resonated among the interviewees. Purchasing new products and services is especially complex (see Paper V). Most purchases are however modified rebuys (see Papers IV and V), i.e. the suppliers have been used in previous projects and the products and services are adapted to the project in hand.

RQ 3: How can purchasing situations be related to purchasing strategies for different products and services?

Project-based purchasing and the product development process provide insights into the novelty of the purchase and where exactly these kinds of product or service should be positioned in a purchasing strategy matrix for construction. A challenge in a project-based industry such as construction is that every project is unique and there is a need to know how to configure each project in terms of purchasing suitable products and services.

Figure 15 (from Paper V) shows how different purchasing situations, depending on novelty, occupy different parts of a purchasing strategy matrix for construction. Most of the supplier relationships are of a best commercial deal/cooperation character and most products and services are *modified rebuys*. The best commercial deal/cooperation supplier relationship character is a combination of *leverage* and *critical/strategic items*. The strategy for achieving the best commercial deal/cooperation is to maintain relationships and at the same time retain competition with several subcontractors and suppliers. The most suitable subcontractor or supplier is chosen according to the criteria for the particular project. This can be seen as parallel sourcing. Below in the matrix is the combination of *non/critical* and *bottleneck items*, which are of lower value than the category above. These items are sourced through the chosen subcontractors and suppliers. The items are *modified rebuys* because the items vary from project to project. The complexity in production caused by coordinating many parts as seen in Paper I can be decreased through a delegated sourcing strategy. In this way, efficiency and supply continuity can be achieved. The supply structure can, through the tiered structure in the matrix, be labelled delegated parallel sourcing.

On the left-hand side of the matrix are *leverage items* that are off-the-shelf. These are standard products, seen as *straight rebuys*, as they are purchased in standard sizes, lengths or mixes, and can also be standard services like cleaning, waste management or temporary fencing. Since these products and services are standard, they require minimal interaction during the purchase as discussed in Paper III. The standardized character of these items makes the market competitive. The strategy for these items is therefore to obtain the best commercial deal. The importance of timely delivery often involves resellers and this makes it a delegated supply structure. The purchase has low complexity as found in Paper IV and can be handled through centralized purchase agreements as Paper IV suggests, in order to benefit from economies-of-scale. The search for the best commercial deal amongst many of the companies studied was, however, often handled through decentralized purchasing, where a comparison between local subcontractors/suppliers was made by the project team. Below them in the matrix are *non-critical items*, which are of less value than the category above. An example of this item can be work clothing. Here, efficiency of the supplier relationship is important. These items are multiple sourced and can be purchased through many different local subcontractors/suppliers or through centralized purchasing agreements.

On the right-hand side in the matrix are *critical/strategic items*, which are supplier relationships of a cooperative character. The supply structure can be either single sourcing or delegated sourcing. These can be innovative products such as a façade system that is developed in close cooperation with a subcontractor or supplier in the form of a *new-buy*. They can also be core products or services like framing, which is a recurrent finding in Papers II, III, IV and V. Framing is a core activity in both factory production and site-based production. In site-based production, the companies wanted to keep their formworkers close (Paper IV and V) and in factory production they wanted to do likewise with their timber suppliers (Paper II). Framing can be seen as a core activity that is closely guarded by the construction company and can be regarded as a competitive asset in the form of an innovation. Below them in the matrix are *bottleneck items*, which are of less value than the category above. These items are single-sourced and can be specific items suggested by the architect.

6.2 Theoretical contributions

A significant part of the research was theory development, which stemmed from the basic premise that whilst general theories in purchasing existed, their applicability to a construction context and, was limited. This pointed towards the need to develop a theoretical basis for purchasing that was reflective of the project-based nature of

construction. The theoretical frameworks developed for this purpose were deduced from existing purchasing theory and tested in the construction context. Their respective contributions are discussed below.

The first theoretical framework (Paper I) is drawn on the seven wastes of lean and coordination theory. Even if not all waste can be explained and eliminated by appropriate coordination, this research shows that coordination theory provides lean researchers with a new tool for analysis of the supply chain and how waste can be eliminated.

The second theoretical framework (Paper II) is a comparison of value- and market-driven purchasing that is carried out in theory and applied to a real case study that brings alternative perspectives on purchasing in the construction industry.

The third theoretical framework (Paper III) considers the aspect of intensity and time perspective in buyer-supplier relationships based on the practices of industrialized housebuilders in Sweden. As such, generalization of the findings concerning buyer-supplier relationships to other contexts should be approached with caution. Even so, the portfolio matrix is generic and can be used as a tool to analyse companies in order to visualize purchasing strategies.

The fourth theoretical framework (Paper IV) provides a guide to describe and analyse purchasing situations in a company (see Table 2). The availability of a framework to represent different purchasing situations in building construction would be beneficial, enabling an exchange of experiences and views that might pinpoint inefficiencies and suggest improvements. How building construction companies manage purchasing decisions is not, well documented; yet, it is important to understand how companies utilize their own capabilities, as well as those of their suppliers. The framework, which was deduced from theory, was tested in construction companies. A frequent response among the interviewees was: “yes, this is exactly how it is”.

The fifth theoretical framework (Paper V) describes how each purchasing situation corresponds to a strategy (see Figure 9). The Kraljic matrix is a cornerstone within purchasing theory, but its application in project-based industries such as construction is less common. The framework here takes into account project-based characteristics as well as sourcing structures. The theoretical contributions presented concerning sourcing structures and the project-based characteristics of new product development offer a deeper understanding of purchasing strategies. The matrix was deduced from theory and refined through interviews in construction companies.

6.3 Practical contributions

It is important for construction companies to recognize that the project team possesses significant knowledge about the nature of services and products delivered by different subcontractors and suppliers. The same applies for factory-based production such as industrialized building, where the people closest to production should have a say in the choice of suppliers. Decisions that are not made in collaboration with people in production run the risk of producing lower quality, higher cost and later project delivery than might otherwise be the case.

Equally important is that all products and services do not require the same amount of interaction. There are standard products and services that could be purchased by taking advantage of economies-of-scale through centralized purchasing arrangements, while others need more hands-on experience to find the best solution.

The framework for purchasing can be used to visualize and analyse these and other purchasing situations within the company. In this way, it can become more obvious to companies which actors and roles are involved or should be involved in different stages and situations, as well as indicating the technical complexity likely to be encountered. The framework fits the companies that were studied, allowing greater detail to be added by the companies if considered necessary. By using the framework as a template, a detailed mapping of the company's purchasing organization can be achieved.

In addition, purchasing situations can be related to purchasing strategies through a modified form of the Kraljic matrix that takes into consideration the novelty of the purchase and sourcing structure, as well as the project-based nature of construction. The modification involves an intermediate classification that captures much of the relational purchasing strategies found in construction. This matrix can help in visualizing and classifying purchasing strategies within the company.

6.4 Further research

It would be interesting to investigate the supplier side and how they view their relationships with the purchasing companies. This can give an enhanced picture of the relationships between purchasers and suppliers.

Moreover, because of the increased globalisation it would be interesting to make a further study of the enablers and barriers of purchasing components from abroad. The development of components far away from the construction site can both increase and decrease complexity in a project.

Another subject of interest is the after-market service provided by suppliers in their offering to clients/construction companies. From a purchasing perspective, it would be interesting to know how purchasers consider the life-cycle perspective of components when selecting suppliers, in terms of facility management services.

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