Towards adoption of long-term highly committed interfirm relationships within the construction industry.

From project based construction process towards a more relation-based construction process within the construction industry

Msc Thesis Construction Management & Engineering

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Preface

Readers guide

This thesis is based on six major parts. This will be shown as the six chapter of this report. These are subsequently the introduction (1), in which the research that has been done will be described, followed by the theoretical part of the research (2), which leads to the framework (3) that is tested in the following chapters of empirical research (4). Al this information combined will result in the chapter of the systhesis (7) which will end in the chapter of the conclusion and recommendations (8).

By exeption of the introduction chapter, this thesis is especially written for people who have experiences in; the working field of the construction industry, researcher in field of business administration, civil engineering, or construction management.

Within each chapter there will be a brief introduction of the content of the chapter. Each chapter will have a three layered structure which includes; paragraph (1), sub-paragraph (2) and within these sub paragraph themes (3) can be found.

References can be found at the end of the thesis. The references are cited by the oxford style reference system, which means that within the text only year and author are shown, and that full information about the references used can be found at the end of the thesis. This also includes the appendices.

Acknowledgements

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My graduation project also forms the end of my study in delft. My student time would not have been so great without the people that surrounded me in all those years. I am grateful to all of them, but I want to thank some in special Judith and Andries, for their general support and the many meetings for advice and motivation and all the meals we have had for the creation of the thesis. Thank you. Also I would like to thank Ingeborg and Tom, for their general focus and advice on the structure of my thesis and especially for the motivational surroundings you have given me to write my thesis. I also want to thank my parents for their support during my study at the TU delft, without them this all would not be possible. Thank you for all the support during these sometimes struggling times. I want to thank my close friends for listen to all my stories about supply chain integration all the time and also the given feedback about my thought and ideas about the structure of the construction industry. Thank you all for your support.

Executive Summary

Executive Summary (English)

Over the last few years, media in the Netherlands frequently reported the presence of inefficiencies in the Dutch construction industry, often referred to as '"Waste" - some indicated this waste to amount to over 6 billion Euros annually. Add the construction fraud in 2001 and the financial crises of 2009 it deems obvious that there is a growing necessity for the construction industry to look for new ways to organize the industry, structure process, improve production and change cultures.
One of the possibilities to reduce waste in the construction industry might be the application of supply chain management, and specifically supply chain partnerships. The objective of this study is to identify possible constraints for adoption of supply chain partnerships within the Dutch construction industry. A literature study is performed to identify the actions that are essential to be taken to enable long term highly committed interfirm relationships. Results of this literature study are applied on empirical data concerning the economical structure of the Dutch civil engineering sector and empirical data retrieved from interview within and outside of GMB B.V.

Theory

Supply chain management
The theoretical basis of supply chain management theory is derived from the Toyota production system, which introduced a new view on the manufacturing industry besides the mass production theory founded by Ford. This resulted in the lean thinking philosophy focusing on the search for perfection and value creation, in order to increase the performance of the production process within the manufacturing industry. Simultaneously, it also created a theoretical foundation within a broader perspective, including the organizational and economical perspective.
This lead to the scientific belief that there is an opportunity in organizing the supply chain differently, in order to increase the overall performance of construction and by doing so becoming more competitive within an industry: supply chain management. The major precondition for supply chain management to be effective is that a sector needs to have the possibility to create long term collaborative relationships within sourcing clusters, beside once-off obligated legal transactional exchange relationships. This long-term collaborative relationships or supply chain partnerships, is the most integrated interfirm supply chain relationships.

Preconditions supply chain management in construction industry
Now moving to construction industry, theory shows that this industry has unique characteristics with respect to the supply chain: I) different delivering points within the production process II) on-site and one-of-kind geographical bound production III) dominant and influential role of the principal in the process. These characteristics however do not hamper the possible adoption of supply chain partnerships in the construction industry.
Construction supply networks and the possibilities for supply chain partnerships are influenced on three different levels: Transfirm, Interfirm and Intrafirm. Innovation and knowledge increases on all three levels by implementing supply chain partnerships. For the construction industry, it requires changes and adoptions on all three levels to realize the benefits of supply chain management.
On the transfirm level the procurement policy for public agencies should abandon the tendency of "playing the market" with a lowest lump sum exchange. Also on this level, there is a need for a platform outside the supply networks, which enables capturing of the lessons learned and technologies created within the supply constellations.
On interfirm level, all organizations within the prospective supply constellation need to be aware that the

adoption of supply chain partnerships will improve their competitive positions. This requires all organizations to move away from the current strategy of maximizing profit within their own share of the project, towards a situation where the total benefits of the supply constellations are optimized.
On intrafirm level the organizations must give insight in the key performance indicators driving their own performance, and lessons learned needs to be shared within the entire organization.
When all the preconditions at the various levels as described above are fullfilled, theory shows that all layers in the construction industry should benefit. Though the benefits are obvious, the theory and application of supply chain partnership is complex in nature. Theory indicates seven pillars that need to be fulfilled in order to be beneficial in comparison towards other transactional relationships. Within these pillars, social and cultural aspects have significant influence on supply chain partnerships. Essentially, this implies that supply chain partnerships can only be effective and beneficial when the industry as a whole will change their ways of competing within the market, making a step change from traditional competitions between firms towards collective competition between constellations. Empirical research into perceived constrains that hamper fulfillement of these preconditions show;

Empirical research

Percularities Dutch civil engineering sector (demand side market)
The preconditions that were found in literature were subsequently tested on a dataset of current procurement and economical lay-out of the Dutch civil engineering sector. Findings are that currently the demand side mainly selects contractors for civil works based on the lowest price in a make-to-order decoupling point. Furthermore, it shows an influential role of third parties on the decoupling point in the construction process used by the demand side to transfer project and risks towards the supply side.
Perceived constrains: Case study Comwonen – Dura Vermeer (supply side market)
The case study by Comwonen – Dura Vermeer shows that althought the attempt to integrate the supply chain is profound, the current implementation is a top down which results in a tier in the supply chain with locked in buyers, where the supply chain goal is soley based on price reduction throught the supply chain instead of maximizing value for money. In doing so, the goal of the supply chain is soley based stabilizing market share and turnover instead of maximizing value for money.
Perceived constrains: Case study GMB (supply side market)
The case study done with GMB B.V. confirms both these findings. The make-to-order decoupling drives project specific supply chains: even with design-to-order decoupling point the supply side is still found to act as a project specific supply network. The data also indicates the presence of dominant demanding parties in each discipline of the engineering sector. This results in a low quantity of discipline specific projects in which supply chain partnerships over multiple projects are difficult adapted or maintain.

Conclusions

Theory clearly demonstrates the value of supply chain partnerships, but not all preconditions required to implement this in the civil engineering industry are currently met. Therefore, based on induction of case studies no long term committed interfirm relationships can be found in the Dutch civil engineering industry based on this explorative research, and further actions are required to realize the benefits indicated by theory.
The dominance of make-to-order decoupling point, the hampering current role of engineering consultancy firms in the construction process, the geographical specificity of projects and the dominance of a small number of demanding parties holding a large amount of the total capacity of demand per discipline, are the significant constraints perceived, hampering fulfilling of the preconditions required for the step change towards project unbounded long term highly committed interfirm relationships in the Dutch civil engineering industry.

Recommendations

Further actions are required to overcome the currently perceived constraints found. Above all, public agencies should move towards concept-to-order and design-to-order decoupling points to enable realization of the opportunity and innovative power that exists in the civil engineering industry. Furthermore, they should leave out the rigid time constrain of projects, in tender procedures or/and final delivering date of projects, in order to create space for a trade-off between time and price in a project, instead of being solely based on price. This will give the space needed in the industry for possible adaption of supply chain partnerships.

Management Samenvatting (Dutch)

De laatste jaren zijn er diverse artikelen verschenen in het nieuws over de inefficientie die aanwezig is de huidige de bouwindustrie van Nederland. De “faalkosten” zoals deze inefficientie veelal wordt genoemd, is geschat op een 6 miljard euro per jaar. Samen met de opspraak van de bouwfraude van 2001 en de financiele crisis van 2009 is het duidelijk geworden dat er een steeds groter groeiende noodzaak is om te kijken naar vernieuwende manieren om de industrie te organiseren, de processen te structuren, productie te verbeteren en culturen te veranderen.
Een van de manieren om faalkosten in de bouwindustrie te reduceren kan gevonden worden in de toepassing van supply chain management en dan in het specifiek supply chain partnerships.
Het doel van dit onderzoek is dan ook om mogelijke belemmeringen voor toepassing van supply chain partnerships in de Nederlandse bouw te identificeren.
Allereerst is er een literatuur studie uitgevoerd om de acties te identificeren die noodzakelijk zijn voor de toepassing van toegewijde lange termijn relaties tussen organisaties, de zogenoemde supply chain partnerships. De resultaten van deze literatuur studie zullen worden getoetst met emperische gegevens van de economische structuur van de Nederlandse civiele techniek sector. Tevens zal dit getoetst worden op emperische data verkregen via interviews binnen en buiten GMB B.V.

Theorie

Supply chain management

De theoretische basis van supply chain management komt voort uit het productie system van Toyota, welke een nieuwe visie introduceerde als aanvulling op de reeds bestaande visie van massa-productie geintroduceerd door Ford. De visie evolueerde naar de denkwijze van Lean thinking, waarbij de zoektocht naar perfectie en waarde creatie centraal staan, om zo de performance van het productieproces te verbeteren. Tevens gaf dit de theoretische basis voor een breder perspectief waarin ook de organisatorische en economische aspecten worden meegenomen.
Dit theoretische kader heeft geleid tot een mogelijkheid om de aanbodsketen anders te organizeren, zodoende dat de performance van de gehele keten wordt verbeterd en zodoende de organisaties in de keten en betere competatieve positie krijgen in de industrie: supply chain management. De belangrijkste voorwaarde om supply chain management effectief toe te passen is de mogelijkheid om binnen een setor lange termijn samenwerkingen te creëren binnen een aanbods cluster, naast de jurisdische eenmalige traditionele uitwisseling relatie. Deze lange termijn samenwerking, of te wel supply chain partnerships, is binnen een aanbodsketen de meeste geintegreerde samenwerkingsvorm.

Voorwaarden van supply chain management binnen de bouw

Kijkend naar de bouwindustrie is in de theorie te vinden dat deze industrie unieke karaktereigenschappen heeft ten opzichte van de productieindustrie: I) er zijn verschillende klantontkoppelingspunten in het productieproces II) op het werk en eenmalige geografische productie III) de dominante en invloedrijke rol van de opdrachtgever in het productieproces. Ondanks deze karaktereigenschappen zou volgens de theorie de mogelijke toepassing van supply chain partnerships in de bouwindustrie niet verhinderd worden.
Het aanbodsnetwerk in de bouw en de mogelijkheid voor supply chain partnerships worden beinvloed op drie verschillende lagen: Transfirm, interfirm en intrafirm. Innovatie en kennis zal op alle levels toenemen wanneer supply chain partnerships worden toegepast. Voor de bouw geldt dat er op alle drie de lagen veranderingen moeten plaatsvinden alvorens men de voordelen van supply chain partnerships kan behalen.
Op de transfirm laag zullen de publieke organisaties de neiging tot “het bespelen van de markt door middel” van aanbesteding op vaste laagste prijs moeten verlaten. Ook zal men in deze laag een platform moeten creeren welke onafhankelijk van het aanbodsnetwerk in staat is om de kennis vanuit dit netwerk op te slaan en innovatie te stimuleren.

Op de interfirm laag zullen alle organisaties in het virtuele aanbodsbedrijf de noodzaak voor toepassing van supply chain partnerships moeten erkennen, om zo hun competatieve positie in de industrie te verbeteren. Hierbij moeten alle organisaties af stappen van de huidige strategie waarbij men de winst per project per organisatie probeert te maximaliseren naar een situatie waarbij de alle organisaties de totale winst van het virtuele aanbodsbedrijf probeert te maximaliseren.
Op de intrafirm laag zullen de organisaties inzicht moeten krijgen en geven over hun belangrijkste bedrijfsindicatoren en zal men binnen de organisaties van het virtuele aanbodsbedrijf kennis van voorgaande projecten moeten delen met de gehele organisatie.
Als aan al deze voorwaarden worden voldaan binnen alle lagen, laat de theorie zien dat alle lagen voordelen zullen behalen van de toepassing van supply chain partnerships.
Ondanks dat de te behalen voordelen voor de hand liggen, is de theorie over de implementatie van supply chain partnerhips in een organisatie complex. De theorie geeft aan dat er 7 pilaren zijn waaraan men moet voldoen om implementatie van supply chain partnerships succesvol te laten verlopen. In essentie geeft dit aan dat supply chain partnerships alleen effectief en voordelig kunnen zijn, wanneer de manier van competitie in de gehele industrie veranderd, van traditionele competitie tussen organisaties naar collectieve competitie tussen aanbodsketens. Emperisch onderzoek naar de vermeende knelpunten die de waarmaken van de voorwaarden tegen houden, zijn als volgt;

Emperische onderzoek

Eigenaardigheden Nederlandse civiele industrie
De voorwaarden welke zijn gevonden in de literatuur zijn achtereenvolgens getest op een dataset van de huidige aanbestedings en economische gegevens in de Nederlandse civiele techniek industrie. Onderzoek toont aan dat in de huidige markt de vraagzijde hoofdzakelijk gebruik maakt van selectie van de aanbodzijde door middel van laagste prijs in een make-to-order klantontkoppelingspunt. Verder is te zien dat de derde partijen een grote invloed hebben bij de vragende partijen op de plek van het klantontkoppelingspunt waarbij project en risico worden overgedragen.
Vermeende belemmeringen: Case Studie Comwonen – Dura Vermeer
De case studie bij Comwonen – Dura Vermeer toont aan dat, ondanks dat de poging om de aanbodsketen te integreren noemenswaardig is, de huidige implementatie van boven naar beneden is gericht, wat resulteert in een streng van ingesloten onderaannemingen, waarbij het doel van de gehele keten alleen is gericht op het verlagen van de prijzen in plaats van het optimaliseren van waarde voor geld. Door deze aanpak is het doel van de keten alleen het vastleggen van orderprotefieulle and omzet in plaats van het optimaliseren van waarde voor geld.
Vermeende belemmeringen: Case studie GMB
De case study gedaan bij GMB B.V. ondersteunt deze eerste bevindingen. De make-to-order ontkoppelingspunt zorgt voor project specifieke aanbodsketens: Zelf bij een design-to-order ontkoppelingspunt zal de aanbodszijde nog steeds bestaan uit een project specifieke netwerk. Data laat ook zien dat in de huidige markt er per discipline speciefieke dominante vragende partijen zijn. Dit zorgt voor een laag aantal projecten per specifieke discipline waardoor supply chain partnerships over meerdere projecten moeilijk zijn toe te passen en te onderhouden.

Conclusie

Theorie laat duidelijk de voorwaarde van supply chain partnerships zien, maar in de huidige praktijk wordt nog niet aan alle noodzakelijke voorwaarden voor toepassing in de civiele techniek voldaan. Vanuit inductie van het emperisch onderzoek is te concluderen dat er geen lange termijn samenwerkingen tussen organisaties in de Nederlandse civiele techniek sector te vinden zijn en dat er extra actie noodzakelijk om de theoretisch voordelen te behalen.

Een aantal significatie belemmeringen worden gezien, welke nu nog de transititie naar project ongebonden lange termijn samenwerkingen binnen organisaties in de nederlandese civiele techniek sector tegenhouden. Dit zijn; de dominantie van make-to-order ontkoppelingspunt, de tegenwerkende rol van consultancy bureaus in et bouwproces, de geografische specificiteit van projecten en de dominantie van een klein aantal vragende partijen welke een grote hoeveelheid van de totale vraagcapaciteit per discipline hebben.

Aanbevelingen

Er zijn extra acties nodig om de gesignaleerde belemmeringen te overkomen. Maar nog belangrijker is het dat de publieke organisaties zich zouden moeten bewegen naar concept-to-order en design-to-order ontkoppelingspunten om innovatieve kracht in de civiele techniek te activeren. Tevens zou men het rigide tijdselement, in tenderprocedure alsmede opleveringsdatum moeten verlaten, om ruimte te creeren voor een trade-off tussen tijd en prijs in een project, in plaats van alleen op laagste prijs. Dit zal noodzakelijke ruimte geven in de civiele techniek voor mogelijke toepassing van supply chain partnerships

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1 Introduction

1.1 Introduction

In the current construction industry there are several issues at hand. Some of these issues results in problems within the construction industry. Social reports and scientific research notice that currently there is still a discrepancy between the demand and supply chain. For example this can be seen in the national enquiry into the construction fraud. Due to this intervention into the working of the market in the construction industry, there became a renewed demand for other ways of organizing the supply chain within the construction industry then used in the previous 30 years. A lot of organizations are still searching for this new way of approaching.

Even so there are a lot of models concerning the way of managing the supply chain of an industry, not even especially the construction industry. Currently it is accepted that Supply Chain management is a new approach of doing business within the manufacturing industry. Looking at companies like Dell, Toyota, Caterpillar, Wal Markt they have reached a high level of performance in organizing, planning and controlling the supply chain in a whole, while they have to face customers who become more sophisticated and demand lower cost, better quality and increased project variety. With all these companies we can see that there is a strong focus on the relationships with the different organizations within their supply chains.

Viewing the construction industry and especially the civil engineering industry we can see that the current industry is predominantly a demand driven process and that design is often disconnected from production, even though there is shifting focus on integrated contracts where design and production are combined as one. Also the heavy price fighting mechanics currently used in the transfer from demand to supply side (Mochtar and Arditi 2001) prevent the full use of innovative capacity of the construction industry. Furthermore the construction industry is been criticized of lack of standardization, adversarial behavior and lack of supply chain integration. Currently we can see that within the construction industry they recognize the importance of supply chain management in order to improve the performance of projects. (O'Brien, Formoso et al. 2009); (Johansen, Glimmerveen et al. 2002).We can also see that within the demand side (for instance RWS) there is a tendency to give the supply side more freedom for influence in the design of the projects procured. The focus within the building process will be shifted further towards the initiative phase of the projects. The general idea from the public parties is that by giving more freedom to the market the competition and diversity of concepts will grow and in doing so giving more value for money. With this new approach they also lower their own organization and development costs, by laying more task and risks in the hands of the private companies. This forward shift also gives the opportunity to change the industry from a demand-driven process towards a supply-driven process within the industry. Combined with the implementations of supply chain integration and long term relationships it would be possible to create supply chain specific concepts to put into the market.

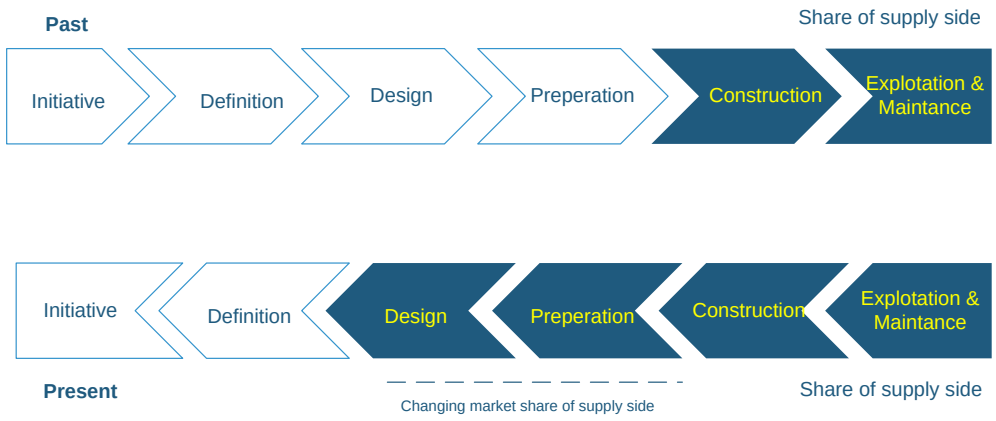


Figure 1.1: tendency of agencies procurement within construction industry

1.2 Sense of urgency

In construction projects and the supply chain it is difficult to guarantee the quality and the reliability to the customer as well as inside the companies. We can still see this in current news header in the newspapers in the Netherlands. For example headers stated that billion of Euros are still wasted within the industry (see header below).

> ***Vermijdbare fouten kosten bouw miljarden***
>
> *Rotterdam - Vermijdbare fouten kosten de bouw al jaren miljarden euro's.*
>
> *Vorig jaar lagen de zogenoemde faalkosten naar schatting op 11,4 procent van de omzet. Het gaat dan in totaal om een bedrag van zo'n 6,2 miljard euro. In 2001 lagen die kosten nog op 7,7 procent van de omzet. Dat blijft uit cijfers van onderzoeksbureau USP.*
>
> *Dat het percentage oploopt, hoeft niet te betekenen dat de daadwerkelijke kosten ook zijn opgelopen. Het kan ook zijn dat de bouw zich er bewuster van is geworden en er kritischer naar kijkt. Meer aandacht voor de uitvoerbaarheid van een project in de ontwerpfase wordt het meest genoemd als manier om de kosten terug te dringen. Maar een betere communicatie is ook een belangrijk aandachtspunt.*
>
> *Publicatie datum: 09-03-2011 18:45 (Bron: ANP)*

Together with the even more dynamic and demanding customers there is a demand within the construction industry for processes to become more efficient, reliable and stable. Together with the fact that the current pricing mechanisms in the civil engineering industry are still mostly depended on lowest price (Mochtar and Arditi 2001) and the freedom for the a supply chain to distinguish themselves from other supply chains is lowered to only cost leaderships instead of the focus on products hence differentiation. Therefore the full potential of the innovative capacity has not been reached and the competition is more focused on survival and maintaining the current market share, then increasing margins profits (Skitmore and Smyth 2007). Even so the profit margins are already under pressure due to the fact that there is a great variability in the efficiency and productivity within projects and within the supply chain resulting in low profit margins within the whole supply chain. This could also be seen within the accuracy of the cost-estimations versus the actual cost within the projects undertaken. Even so the performances of the organizations within the supply chain are not always known and the learning effect of past performance has yet not been fully incorporated within the supply chain. On the order hand we can see that even though the organizations within the supply chain do not have actual information about their performances, long term relations exist within the construction industry, but are not tied to activities and organizations in a formal way.

Still even if information about performance of suppliers exists, is it still not used to select and manage the suppliers in a supply chain tier. Also the three peculiarities (Vrijhoef and Koskela 2005) in the construction industry have influence on the efficiency of the suppliers and predictability of the projects, but even so the construction industry is in need for a new way to manage the supply chain in order to reduce cost levels and being able to react on more dynamic, variable and demanding environment.

A scientific new approach on the production issues of projects within the construction industry are given within the science of lean construction and then especially within the lean production theories. But to implement these production theories, research also shows that, in order to be successful, it should be supported by a highly organized governance structure in there supply chain (O'Brien, Formoso et al. 2009). So not only the production thinking should be sufficient, but especially the political, social, moral and industrial relations within the industry are the driving issues that contextualizes the different complex adaptive system concepts. With this complex adaptive system concept, the problems occurring from fragmentation within the industry should be decreased by creating long-term inter firm relations and shared business strategies between multiple firms in the construction industry (Vrijhoef and Tong 2004). In doing so the competition between companies may shift towards competition between supply chains in a constellation. Furthermore with this integrated approach

the administrative and juridical papers and procedures should well be reduced, and therefore reduce the transaction cost within projects and within companies and organizations.

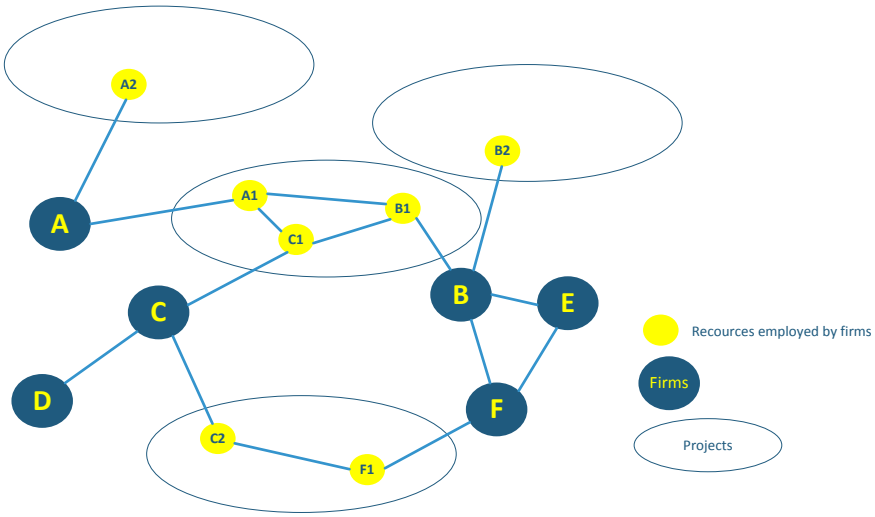


Figure 1.2: Network relationships within construction industry (Dubois and Gadde 2000)

(Dubois and Gadde 2000) concur with these effects, and signal a contradiction in the way the supply networks in the construction currently works. It is concluded there are two conflicting networks. One is the permanent network, which is characterized by long-term recurrent exchange of products and services among a limited number of firms. However these relationships still seem not tied to activities or resources of the organizations. The other network is the temporary network, where co-ordination is substantial. However, there is little benefit gained from shared learning as long as relationships are confined to the duration of the individual project. In order to solve this problem customized products developed by the supply chain could improve both efficiency and innovation for all actors. Firstly to reduces adjustments on the site. Secondly this will stimulated development of differentiated offerings by the supply side and help change the industry to a more supply-oriented industry.

1.3 Research questions and objective

After the theoretical problems indicated within the scientific research together with the general opinion of the construction industry the question arises about the reason and possibilities of long term commitments within this highly fragmentized industry and within the organizations in the construction industry in order to improve the performance of the industry as a whole. This question is the base of research that will be conducted and can be formulated as follows:

What are the preconditions for organizations in the construction industry to integrate their supply chain through adoption of supply chain partnerships, and identify perceived constrains by the construction industry for not fulfilling the preconditions for supply chain partnerships?

This question has two different components. First is the question 'What are the preconditions for organizations in the construction industry to integrated their supply chain through the adoption of supply chain partnerships'. This part of the research objective will be answered by the empirical research done. The second component is to define supply chain partnerships, supply chain integration and the construction industry in order to come to a stable and robust hypothesis which then can be tested with the empirical research, as stated before. This can be seen in the research- or sub questions that are formulated:

Research question 1

Where does the concept of supply chain partnerships derive from, what is the philosophy and characteristics of supply chain partnerships and which preconditions have to be met?

Research question 2

How do the peculiarities of the construction industry affect the concept and characteristics of supply chain partnership and under which construction specific preconditions could this be beneficial?

Research question 3

What are the perceived constraints within the construction industry for not fulfilling the construction specific preconditions?

From these three questions the main focus for the first two questions will be on theoretical research conducted while the third question is mainly focused on the empirical part of the research conducted. From these research questions we can derived the following research objective:

'To identify possible constraints for adoption of supply chain partnerships within the construction industry.'

This implies more specifically that developments, shifts and trends within the construction industry and their activities such as the forward shift within the supply chain will be indentified. In addition to this, in order to conclude what the critical implementation issues for adoption of supply chain partnerships are, the status of the Dutch construction industry will be explored and described. These two parts of the objective results in a two part empirical case study research, namely I) a data analysis of the Dutch construction industry and II) case study within the supply chain of the Dutch construction industry.

1.4 Scope of research

The research into the supply chain of an industry is very broad and complex. Therefore there is a necessity to give clear boundaries where in between this research will be focused. As seen in the research objective this research will only focus on supply side of the construction industry. Due to the case study that will be conducted the research will be focused on the Dutch construction industry only. Moreover this is due to the fact that GMB, the company where the case comes from, is currently focusing on growth within the Dutch market and not yet focusing on foreign markets. Although the focus will be on the Dutch market this doesn't mean that there isn't any room for examples or cases within other countries on the issues of supply chain integration. Furthermore the scope of this research will be done from perspective of a focal organization within the supply side of the market, in the current practice the general contractor, hence GMB. From this perspective the research questions will be researched and answered. From this focal organization the possible constraints for adoption of supply chain partnerships within the supply side and with the demand side will be researched. Furthermore the industry where GMB works in is the civil engineering industry. While the theoretical explorative research will look at theory from the construction industry and their sub industries, the case study that will be done will focus on the sub industry of civil engineering and the constraints found will be specific for this sub industry of the construction sector.

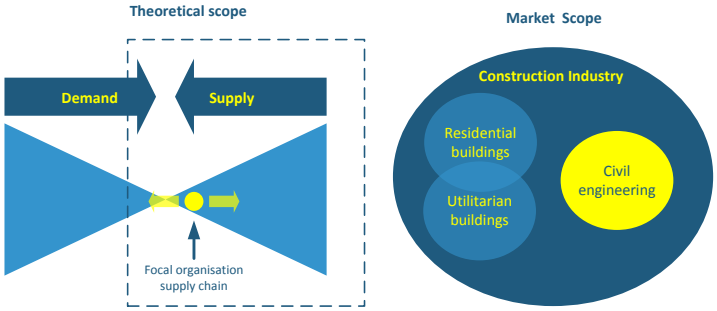


Figure 1.3: Scope of research

1.5 Research methodology

The above given research objective and problems have resulted in research questions that will be answered with scientific research. In order to answer the questions raised a research design has to be made. This research design is based on the insight of research design and methodology given by Baarde & De Goede (1999) and (Yin 1994). To come to a constructive research design an exploration on supply chain management theories within construction has been done. The research design is based on the research questions and research objective stated in the previous paragraphs. This orientation phase of the research will be seen as part I of the research. Part II will be theoretical research. With these theoretical research propositions of the supply chain partnerships within the construction industry can be generated, in order to come to a valid hypothesis which can be found in part III. This will lead to a conceptual framework. Expectations and questions are turned into the conceptual framework in order to test the hypothesis by means of empirical research. Due to the "connection" and "differences" research question as well as research in which certain expectations between concept and variables exist, explorative empirical research is well suited as research design (Baarde & De Goede 1999).The explorative empirical research will be done by a case study. The type of case study that is chosen will be elaborated in depth within chapter 4 of this report. The testing aspect of this research will lie in the examination of theories and possibilities described by scientific literature and the descriptive side in the supply chain view on supply chain management. The hypothesis is generated to examine by means of empirical research is this hypothesis is valid or not. After this confrontation between empirical and theoretical research part IV will be the conclusion and recommendations from the research question answered. The aggregation on base of this research will be in the form of testing the propositions, hypothesis and predictions at the hand of a theoretical framework, in order to indentify the critical implementation issues, hence constraints on adoption of supply chain partnerships in practice of the construction industry. The theoretical framework will contain the following aspects; theoretical actions for adoption of supply chain partnerships and benefits of this adoption (Figure 1.4). Within the Part II (Figure 1.5) of the report the explorative theoretical research will signals actions and benefits that will be researched within the empirical case study to find the constraints for implementing and adoption of the actions in order to reap the benefits. The theoretical framework that will be constructed in paragraph 4.6 will be the aggregation of the propositions, hypothesis, and predictions based on the explorative theoretical research done.

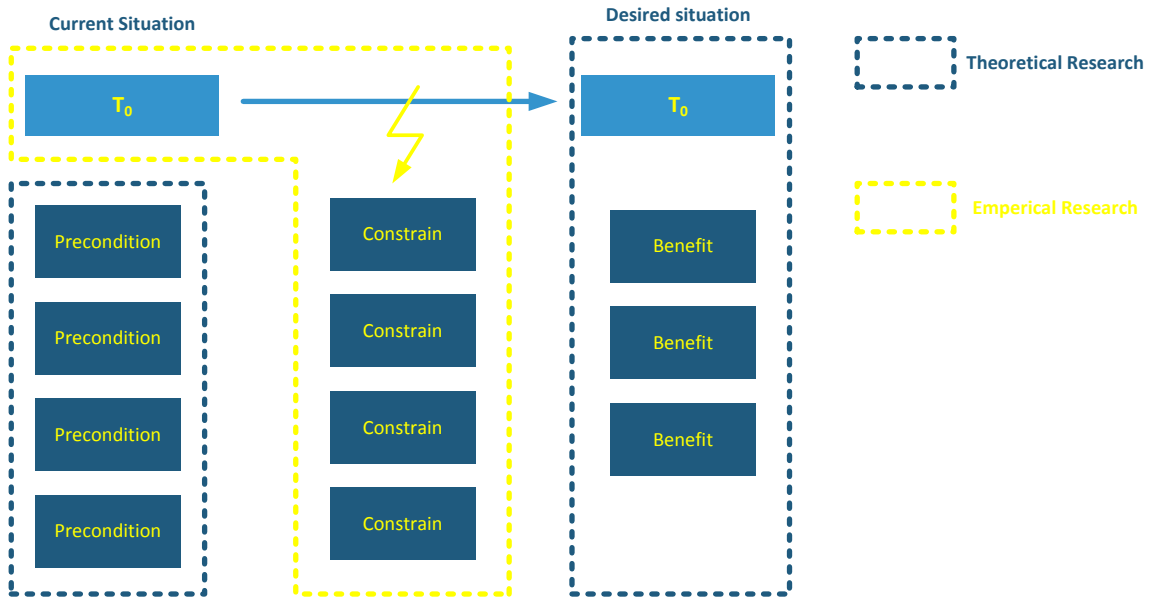


Figure 1.4: Aspects of theoretical research framework

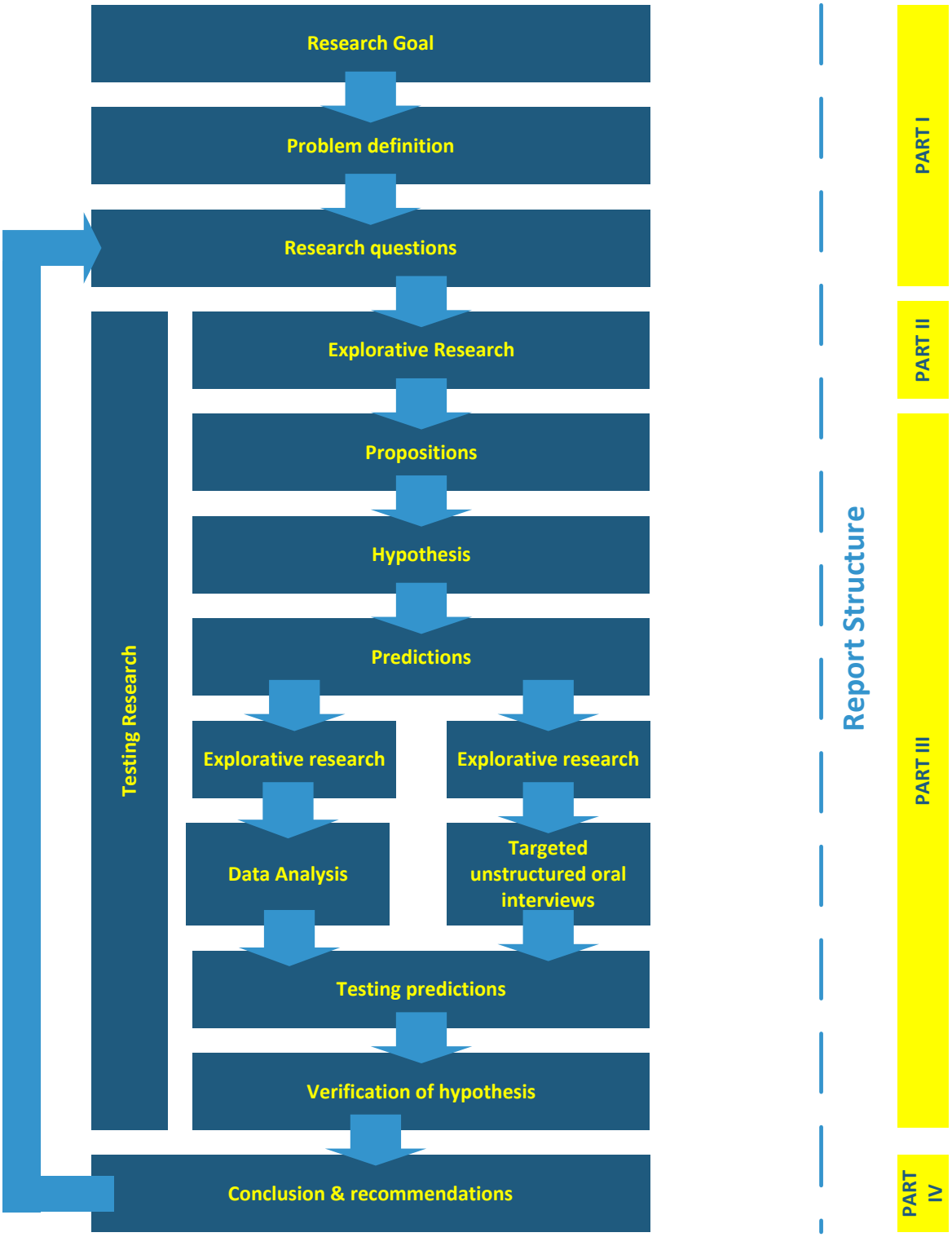


Figure 1.5: Research methodology structure

1.6 GMB B.V.

GMB is professional family-based business, founded in 1963, with activities in the areas of water energy and soil, which resulted in 2008 in a turnover of 127 million Euros. The focus of the organization lays on the incorporation of the total water supply chain. The activities of GMB are divided in the clusters Civil (infrastructure and concrete & industrial construction), Water technology, Sewer technology, Sludge technology, Installing techniques, water, and treatment facilities. The intensive collaboration between the clusters insures the multidisciplinary approach within projects. GMB is active in the whole supply chain from design towards production. As a reliable partner GMB is active for different organization including; Rijkswaterstaat, provinces, municipalities and industries. GMB is focused on providing strong services on which clients can rely on in order to fully control the project according to the client's wishes and interest.

Still GMB is looking for new ways to organize their supply chain and control the outputs of the project delivering. This research will give insight in new ways of organizing the supply chain in which GMB is operating, and there gives an outline of a possible business strategy for GMB. Furthermore this research will give insight into the current situation of the supply chain within GMB and possible implementations options for GMB to change their organization towards the formulated possible new strategy. From the perspective of GMB the research goal can be defined as; find a new business strategy for GMB and give solutions to come to this new business strategy. This can also be found in the research questions given in the previous paragraph.

Within the research perspective GMB will provide means for retrieving data of their supply chain and gives insight into the way the current supply side is operating. One of the ways for retrieving this data, as shown within the research methodology, is by in depth oral interviews. GMB will provide relevant contact persons in order to acquire data for this research. GMB is chosen for this research for the following reason;

1. That operate within the Dutch construction industry
2. They have a business focus on civil engineering related projects
3. They are looking for possible new business strategies

1.7 Report Structure

To give the reader better insight in the way this report has been formulated within this paragraph we will give the outline of the structure of the report. First of all the report consist of four parts as shown in Figure 1.5. The structure of the report itself is that each chapter will consist of numerous paragraphs. Each paragraph and chapter will begin with a brief introduction and will be closed by a short conclusion.

The first part will comprehend the introduction of the research that is done. In this introduction the sense of urgency to conduct this research will be given. Furthermore the research methodology and research objective will be explained together with a brief description of the organization that helps provide the empirical data for the case study done.

The second part of the report will consist of the theoretical explorative research. This second part is structured by two chapters. Chapter 2 give an overview scientific research on supply chain partnerships and supply chain integration in order to come to a clear answer on the first research question. Chapter 3 will give insight in the second part of the theoretical explorative research done. This chapter will provide scientific research into supply chain partnerships within the construction industry and the possible benefits for the construction industry.

The third part of the report has two elements that will be included. First of all it will include the theoretical framework and hypothesis that will be test by the empirical research. This can be found in chapter 4. Secondly the findings of the empirical research conducted can be found within chapter 5 and chapter 6. In chapter 7 will we find the synthesis which included confrontation between empirical data and the scientific framework that has been tested.

Finally the fourth part we concluded the findings of the research done and will give recommendations on the further research within the field of supply chain partnerships within the construction industry. This can be found in chapter 8.

2 Supply chain management theory

2.1 Introduction

As described in Chapter 1, there is an increasingly demand, in the understanding of terms of concepts of chains, cluster, networks within different industries. Supply chain management for an individual organization is a more emerging research field within the construction management discipline. In order to come to a description about the current theories in construction industry on supply chain management, this chapter first will give the mainstream management supply chain literature.

Chapter 2 is organized on a historical timeline of champions of their specific research field, in order to come to a clear definition of mainstream supply chain management and the theory of an integrated supply chain. The timeline of these champions is given in the following figure;

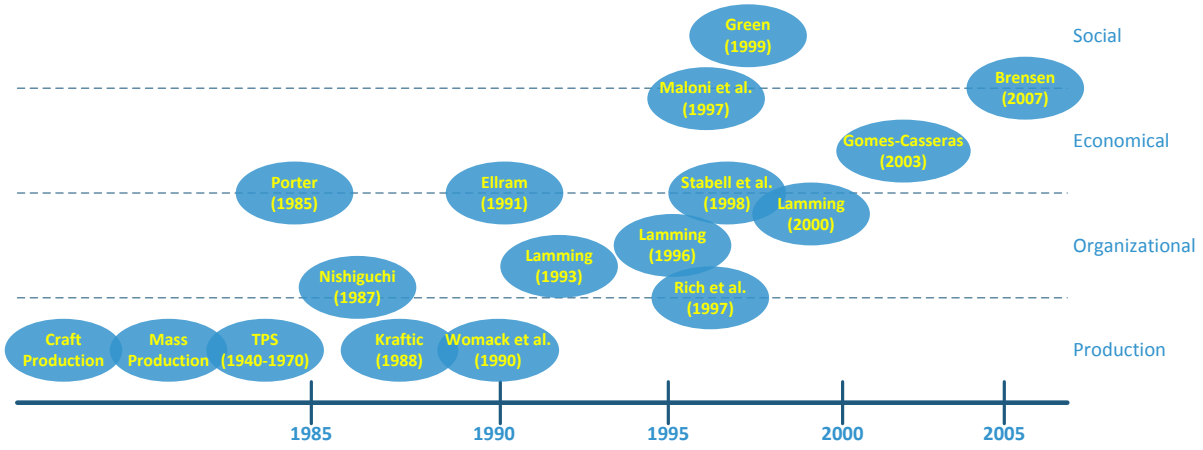


Figure 2.1: Historical scientific research timeline (aggregation of London and Kenley 2001; Vrijhoef and De Ridder 2007)

While the champions have their own perspective, to influences the research into supply chain management, the different perspectives can be categorized in 4 theoretical perspectives; social, economic, organizational and production theories. The four perspectives are represented in the following figure;

Figure 2.2: four perspectives of supply chain management (adapted from Vrijhoef and De Ridder 2007))

This chapter will explain how the production theories from early day's craftsmanship towards the lean thinking principles will have their influence on supply chain management. The production perspective can been seen as basic impulse in historic view for supply chain management, and therefore will be elaborated more in-depth, due to the critical nature of these production theories for understanding current supply chain theory.

At the end of each paragraph within this chapter, an explanation will be given on the perspectives in which the described theory is founded. In the first paragraph the production theory will be explained with the emphasis on craftsmanship, mass production and lean production. The second paragraph will elaborated on value chain

and lean supply and the third will be focused on supply chain management and integration. The fourth paragraph deals in more detail with the most integrated way of SCM, namely partnerships. The chapter will and with a conclusion in paragraph 5.

2.2 Origin of production theories

2.2.1 Introduction

Within this paragraph the origin of production theories within manufacturing businesses will be explored in order to give more insight into the current theories. We will start with craft production from the early days towards the current theories within the manufacturing industry and the philosophy behind these theories.

2.2.2 Craft production

Until World War 1, the manufacturing process has been characterized by disintegration in which the manufacturing supply chains were very fragmented. In many occasions an independent machine shop owner had contracted their machine for specific parts or components, whereas the workers within the assembler's plant were independent subcontractors. This was a normal situation during the industrial era of craft production. Womack et al. (1991) records that particularly within Europe the principle of craft production is well spread. Craft production can be characterized with low productivity, long cycle times, and high flexibility of production systems, small production volumes and variability within performance of the production. The major business objectives in this period are exclusiveness of products and ultimate customization in order to achieve ultimate customer satisfaction. As stated before, the craft production can be described as extremely decentralized organizations with assemblers tendering most of the design and engineering work as well as parts manufacturing to small and independent subcontractors and suppliers (Womack, Jones et al. 1991; Lamming 1993). Because of his nature, craft production has to deal with the following problems, including difficulties to make identical products due to the fact that there is a lack of standard design systems, and many of the different subcontractors in the supply chain have different production methods. As a result of the craft production, parts were often differing from their initial specifications, and fitting problems occurred while the part of each product was individually and collectively unique. This led to an excessive amount of rework, long lead times of assembly and parts manufacturing, long delivery times of end products and costly production and unreliability of products (quality, functionality, durability). In conclusion craft production is based upon the notion that manufacturers of complex products required skilled labor within a collaborative environment, supported by a system of apprentice-journeyman-master organization in order to fulfill the needs of the customers.

2.2.3 Mass production

After World War I, when the craft production had encountered problems it could not surmount, Henry Ford and General Motors' Alfred Sloan moved car manufacturing from centuries of craft production into the age of mass production. With this change they moved from disintegration within the supply chain towards a vertical integration within the supply chain, were there is a situation where adjoining stages of the assembly process are incorporated and controlled in one hierarchical system by the main company in the production process, in this case the assembler. These changes into mass production are represented by an inflexible and rigid production system characterized by a narrow range of standard products, high productivity, large production volumes, intolerance of disruptions and many buffers, to assure smooth production. The smallest design changes were avoided, and standard designs were kept as long as possible, due to the rigid production system. The only real innovation in the product design was driven by simplicity (Womack, Jones et al. 1991; Lamming 1993). The reduction of complexity of the products and production meant a simpler assembly and a higher speed and reliability of processes. In doing so, there was a need for another way of looking at the manufacturing, supply and production technologies including standardization and interchangeability of easily

fitting parts. Due to the simplification of the products and production, there was no need any more for craftsmanship or skilled labor. Lamming (1993) signals with this “deskilling” of the workforce, the work condition grew to become boring and dispiriting, while taking away the responsibility, authority and possibility from workers to control their own work. The process of “deskilling” of labor applied equally to the subcontractors and suppliers of these mass manufacturers. The basic principle of the integration policy in mass production is congregation of component supplies which eventually leads to internalization of all supplies under the direct control of the mass producer (Lamming 1993). In Ford’s case, this was primarily because of dissatisfaction with subcontractors, and apparent inability of suppliers to match Ford’s tremendous process innovations and quality expectations. Womack et al. (1991) record that Ford pursued vertical integration partly because he had perfected mass production techniques much faster and earlier than his suppliers and subcontractors. Another reason was the idea that he could achieve substantial cost savings only by doing everything himself. While Ford kept to the rigid control within the supply chain and the vertical integration within their chain, GM overtook Ford while it adopted a less centralized organization, however, with a strong central policy making. GM’s policy of vertical integration was a less rigid copy of the policy of total integration within the Ford concern, where GM look more to outside suppliers, and in doing so adopted a wider variety of product models. Therefore the principal benefit of vertical integration and mass production merely involve enhancement of internal efficiency, by improved reliability, synchronization of assembly and supply and high productivity. Looking at the negative aspects of the mass production it includes, demoralization of the workforce also within upstream parts of the supply chain including subcontractors and suppliers and inadequate or inability to respond to external changes and market demands.

2.2.4 Lean production

After World War II Eiji Toyoda and Taiichi Ohno at the Toyota Motor Company wanted to change the current mass production system for the Japanese market situation and introduced a new production system, the Toyota Production System (TPS) (Ohno, 1987). They became pioneers for the concept of a new and more efficient production method which was later called *lean production* by James Womack, Daniel Jones and Daniel Roos. The term ‘lean’ was actually first coined to describe this system by Krafcik (1988). Lean production is often considered as a Japanese reaction to mass production system, introduced by Ford and Sloan.

In 1985, Womack, Jones, Roos and others at the Massachusetts Institute of Technology (MIT) formed the International Motor Vehicle Program (IMVP) and engaged in a five-year, five-million dollar research project directed at identifying production factors leading to success in the global automobile manufacturing industry (Womack, Jones et al. 1991). In 1991 they wrote a book about their research and introduced a new phrase, lean manufacturing. The term "lean" was used because Japanese business methods used less human effort, capital investment, floor space, materials, and time in all aspects of operations. In relevance to the rigid vertical integration of the supply chain of the mass production, within the lean production the Japanese manufacturers like Toyota were the first to formulate a strategy of vertical quasi integration, and establish long term relationships with their suppliers, while considering them as independent partners. While in the mass production the vertically internalized supply divisions became passive, inattentive and non innovative because of the lack of the market pressure, were the customers got more demanding and sophisticated, the lean productions style of Toyota was more based on long term agreements. (Framework rule market situation)In these strategically relationships that were formed the common strategic objective became customer responsiveness. The objectives of the lean production theory were described by Womack et al. (2003) in the principals of lean thinking.

2.2.5 Lean thinking

Step of lean thinking

Lean thinking is based on a strategy to specify *value* and to line up the value-creating activities along a *value stream*. This value stream needs to *flow* smoothly in order to meet the demands of the consumers (*pull).* And

all of this needs to be done perfectly. This is a summary of the five principles of lean thinking. The strategy of lean thinking is based on minimization or preferably elimination of *wastes*, in order to produce as much value as possible for the *consumer*. In order to think lean, four steps need to be performed. These four principles interact with each other in a virtuous circle. And this circle represents *perfection*. Value can always flow faster; the pull of the consumers can always become more accurate. In order to start this process, this value needs to be determined. The followings steps of lean thinking, as shown in Figure 2.3 are crucial for a deeper understanding of the process implied by lean production.

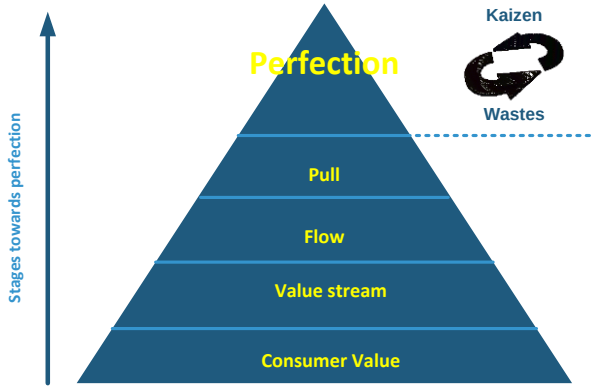


Figure 2.3: Lean thinking principles (Womack and Jones 2003)

Specifying the *value* is the critical starting point of lean thinking. Value needs to be defined by the customer in terms of a specific product which meets the customer's needs at a specific price at a specific time. But the producer is the one that creates value. So therefore the producer has to define value accurately through a dialogue with the customers. In order to correctly specify the value of a product, it is important to understand who the costumer is. Without knowing who the customer is, it is impossible to determine the value. There are two types of customers: the next costumer and the final costumer. The next costumer is next step in the production process and the end consumer is the one that uses the product. Therefore value has to be evaluated throughout the supply chain from the perspective of the customers within the chain as well as the end consumer of the product.

The next step in lean thinking is to identify the entire *value stream*. In most cases three types of activities will occur along the value stream: value adding activities, unavoidable non-value adding activities – like inspecting to ensure quality – and avoidable non-value activities. In order to make a process lean, it is important to line up the value adding activities and minimize the unavoidable non value activities. The avoidable non-value activities need to be eliminated. The value stream can be specified as the set of all actions that needs to be performed to bring a product on to the market. It needs to pass three critical management tasks (Womack and Jones 2003):

1. the *problem solving task* running from concept through detailed design and engineering to production launch.
2. the *information management task* running from order-taking through detailed scheduling to delivery
3. the *physical transformation task* proceeding from raw materials to a finished product in the hands of the costumer.

Identifying the value stream almost always exposes a lot of non value adding activities which need to be eliminated. The effort of integrating individual processes up a down the value stream, and joining the three critical tasks efficiently, requires an inter corporate networking model, in which the network of the value stream is viewed as a "lean enterprise" with his own mission, culture and communication mechanism (Womack and Jones 2003). The lean enterprise can be viewed as a group of legally separate but operationally synchronized companies within the value stream, with the sole purpose to constantly analyzing the value stream in order to provide the highest value to the end consumer.

After the value has been specified and the value stream is identified it is time for the next step. The third step in lean thinking is making the value adding activities *flow*. This is one of the hardest and longest steps in lean thinking. In order to make the process flow it is important to focus on the product and its needs, rather than the organization or the equipment. Usually this means that the work of functions, departments and firms need to be redefined and aligned. In this way they can make a positive contribution to value creation and speak to the real needs of employees at every point along the stream. So then it is actually in their interest to make value flow.

After completion of step three, lean production can make any product in any combination, so that shifting demand can be accommodated immediately. This resulted in the fact that sales forecast are not needed anymore. A company can simply make the product that consumers actually need in a manner of speaking. The consumer *pulls* the product out of the company, instead of the company pushing the product, often unwanted, towards the consumer (see Figure 2.4).

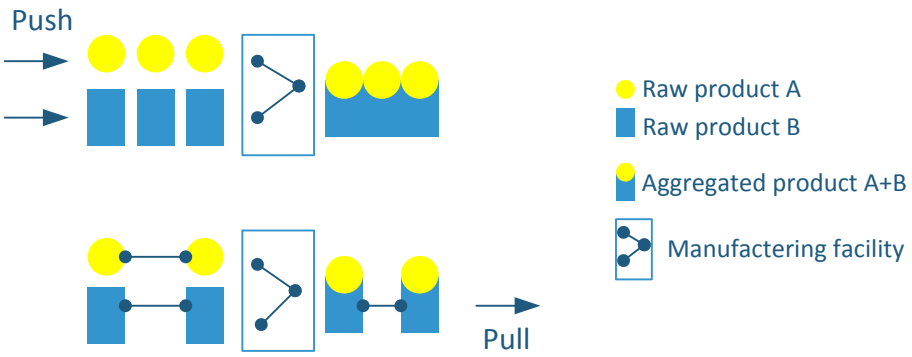


Figure 2.4: Representation of push/pull principle

This can be done with the concept of *Just-In-Time*. JIT is based on products being delivered exactly on time. This reduces the stocks of materials and inventories while speeding up the process of ordering and delivering within the supply chain. Implementation of JIT requires a very reliable production without errors and a good relation with suppliers, in order to make the activities flow and reduce waste. While problems become visible within the supply chain, it becomes necessary to solve them in order to keep the production process running. This kind of forced confrontation with problems in the production line together with the analysis of the root of the problem that caused the production to halt resulted in a progressively more streamlined and smother production process eventually leading to a production where there is virtually no inventory needed.

After the implementation of the first four steps of lean thinking, one final step remains. Actually there is no end of the first four steps. It is a loop of constant improving and adjusting the activities in order to make the production process become even leaner. This is the fifth principle: *perfection*. An important spur in perfection is transparency. If everyone (subcontractors, suppliers, employees) can see everything, it is easier to discover better ways to create value.

Kaizen

While perfection, as been mentioned above is the ultimate goal of lean thinking, kaizen is the way to come there. One phrase that is often heard at Toyota is: *"It's how we work, how we do our job every day… each time a bit better*". The phrase reflects on Toyota's commitment to '*kaizen'*. (Kaizen is the Japanese word that in current English literature can be best described as continuous improvement) Kaizen is a Japanese concept which aims at continuous quality improvement by taking small practical steps (Morgan and Liker 2006). This quality approach is done on three levels: management, teams and individuals.

The management has to improve the system and the procedures. Teams aim for improvement of the procedures and the establishment of the standards of the organization. Individuals can try to improve the

workplace. Kaizen places process-measured thinking versus result-measured thinking. Process-measured thinking appreciates qualities of employees such as commitment, enthusiasm and diligence. Companies have to measure their process-measured criteria as well as result-measured criteria (Dean, 2000). In kaizen there are three important conceptions. *Policy deployment* is the policy aimed on introducing Kaizen. *Cross functional management* raises the attention for business aspects such as quality, costs and reliability besides design, production and sales. And *quality function deployment* (QFD) centralizes the consumer in the quality care thinking. These three conceptions are the base for kaizen. One of most important things of Kaizen is the participation of all the employees. From the top-down and from the bottom-up everybody has to participate in Kaizen. There are ten Kaizen rules which can be applied to lean thinking;

	Rule	Explanation
1.	**Standards**	work with and according to regulation
2.	**Treasures**	consider problems as possibilities for improvement
3.	**Go to *gemba***	get the information where it happens
4.	**Take the facts**	
5.	**5 W's and 1 H:**	Who, Why, When, Where, What and How
6.	**PDCA**	Control cycle; Plan, Do, Check, Act
7.	**3 x Mu**	avoid wastes (*muda*), control out of controls (*mura*), manage strains (*muri)*
8.	**5 x S**	seiri, seiton, seiso, seiketsu, shitsuke: tidy up your workspace
9.	**Discipline**	do what has been promised
10.	**Do it**	work according to these commandments

Table 2.1: ten kaizen rules (Morgan and Liker 2006)

The principle for kaizen eventually transformed to total quality management (TQM). TQM aims, just like kaizen, to diffuse quality control to all levels of the production process (within management, teams and individuals) in order to assure continuous quality monitoring and correction of quality defects within the production process. Together with the introduction of improvement programs to correct the places in the production process that have reoccurring quality defects, this results in proactive quality programs which are achieved by ongoing research, process innovation and product development.

Wastes

While Kaizen is applied to achieve perfection, the type of waste under number 7 needs a better clarification. The ultimate goal for lean thinking is perfection. Perfection can be defined as elimination of all kinds of wastes. So in order to create the ultimate value for the customer, the assembler needs to reduce al wastes within his production process, in order to gain competitive position within the market. Toyota defined three types of wastes in lean: *muda* or nonvalue-added work, *mura* or unevenness and *muri* or overburden (Morgan and Liker 2006). The first type Muda is the best known 'M'. It is a Japanese term for activity that is wasteful and doesn't add value. Any activity that lengthen lead time and add an extra cost to the product the costumer is unwilling to pay, is considered muda. The following seven kinds of muda are targeted in TPS:

Muda		*Explanation*
1.	**Overproduction**	Production ahead of demand
2.	**Transportation**	Moving products that are not actually required to perform the processing
3.	**Waiting**	Waiting for the next step in the production process to take over
4.	**Inventory**	all components, work-in-progress and finished product not being processed
5.	**Motion**	people or equipment moving or walking more than is required to perform the processing
6.	**Over processing**	due to poor tool or product design creating activity
7.	**Defects**	the effort involved in inspecting for and fixing defects

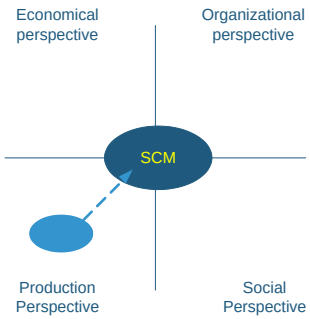
Table 2.2. Seven types of Muda (Morgan and Liker 2006)

The second type Mura is the Japanese term for unevenness. In a normal production situation the workflow is uneven. If there are uneven production levels in an organization, this results in inventory of another type of muda. This can be avoided with JIT. The third type Muri is a Japanese term for overburden or unreasonableness. Some consider muri to be the opposite of muda. Muri pushes a machine, a process or a person beyond natural limits. Overburdening people can lead to sloppy work resulting in quality problems and

potential safety risks. Overburdening a machine can cause a breakdown or defects. This can be avoided through standardized work.

2.2.6 Main strategic goal of lean thinking

As stated before the goal to achieve perfection while having zero waste is based on the strategy that the end consumer is the most decisive market factor within the production supply chain. The ultimate goal of the lean thinking principles is to create the highest customer satisfaction within production and manufacturing, while achieve zero waste, hence the ultimate value adding for the end consumer. In order to meet with the expectation of the consumer, it's important to reduce the cycle times and production cost of the manufacturing process, while keeping the process adjustable to the demands of the customer.



The theory in perspective

Concluding the craft, mass and lean production theories are still based within the production perspective, but the lean production theory gives the incentive for research to look beyond intrafirm production perspective towards a broader founded perspective.

2.2.7 Findings

So while we started with craftsmanship in the early days the Toyota production theory gave a new view and concept on the manufacturing industry. This eventually resulted in the lean thinking philosophy in which the search for perfection and value creation are the focus point of the philosophy to increase the performance of the production process within the manufacturing industry.

2.3 Lean supply and value chain

2.3.1 Introduction

Within this paragraph we will take the step towards a broader view on the production philosophy of lean thinking towards a theory that comprehends a broader perspective beyond the narrows of production alone.

2.3.2 Lean Supply

Like the above explained in paragraph 2.2 as within the theory of lean production, within lean supply, the entire flow from raw materials to the consumer is considered as an integrated whole, wherein the boundaries and interfaces (between organizations, companies, suppliers and assembler) are thus seen as artificial within the supply chain. In other words the interfaces are seen as a result of the economic arrangements of assets governed by many other factors (e.g. labor skills, geographical location of raw materials etc.) instead of being created as natural transformation stages in the development or addition of value also shown in Figure 2.5 (Lamming 1996)

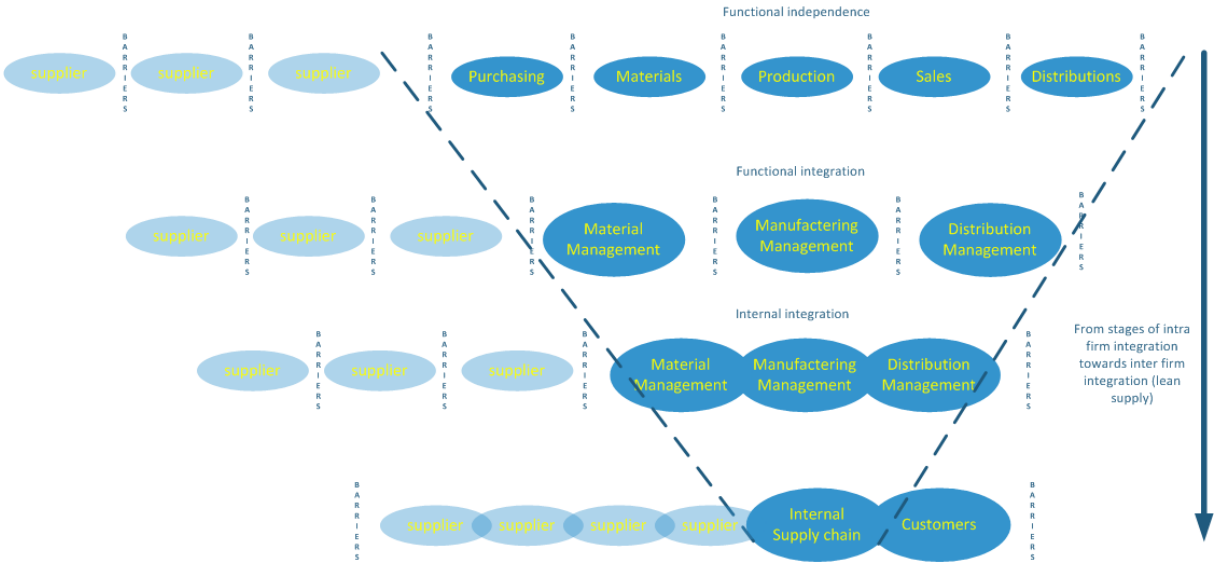


Figure 2.5: Stages from intra firm integration towards interfirm integration (adapted from (Lamming 1996))

In consideration towards the principle of lean production, within lean supply the effects of costs associated with less than perfect execution of a sub process are not limited to the location of the execution. So while, with lean production the relationship within the vertical supply chain between assembler and suppliers, can be categorized as a traditional position of “senior-junior” attitude, within lean supply the traditional positions of assembler and supplier, which tend to obscure the central quest for removal of waste, are not recognized. In other words the process chasers from the assembler, that are chasing delayed expedited deliveries traditional late by the supplier, are not only to cost of the assembler, but also towards the delayed suppliers and even towards the suppliers that does not warrant expedition with delivery. So not only the waste occurs at the assembly the whole supply chain has his effect on it, and therefore the power relationship between should shift towards a more collaborative nature. This collaboration between the assembler and supplier works both ways:

1. The suppliers are given more freedom and involvement in the operations and processes of the assembler, in order to ensure that, in the long term, the suppliers indentify the costs to them of dealing with progress chasers to manage the deliveries. In this way, the lean suppliers will ensure that their added value is transferred to the end consumer in the most efficient way, thus ensuring their survival.

2. The pressure placed on the assembler by the more sophisticated and demanding end (consumer) market and therefore influencing the need to reduce production costs within the supply chain, are logically passed on to the suppliers, due to the fact that any departure from perfect execution within the supplier's operation, are not only for concern of the supplier, but also to concern to the assembler confronted by the consumer.

In conclusion lean supply gives the relationship between assembler and suppliers a more collaborative nature in comparison to lean construction the relationship is more hierarchical. In order to fulfill the premises given by the lean supply theory it is necessary for assembler and suppliers to become aware of the concept explained above and realization of "being in the same boat" with their neighbors within their supply chain, and in doing so create a operating attitude that recognizes the cost associated with any departure from perfect execution of the tasks necessary to provide long term customer satisfaction. This awareness of "mutual destiny" leads to the need for a more sophisticated procurement strategies beyond the traditional purchasing strategy towards a more collaborative client supplier relationship across the supply chain.

Lamming (1996)also implies that in order create the "inter-firm" kaizen (stated under lean thinking) within the supply chain, which is an essential part of the lean supply theory, to create "open book negotiation" within the assembler-suppliers relationship, due to the fact that lean supply does not recognize the artificial boundaries in the flow of supply invented for the convenience of commercial arrangements. This results in the implication that in order to come to vertical collaboration based on the lean supply theory, the assembler needs to share their process information, including cost data, to their suppliers within their supply chain. The reasoning goes that the assembler has benefit from the supplier development in order to become more competitive. The suppliers on the other hand will not give their process information, without the premises of better competitive positions. These premises can be given when the strong assembler can create improvements that are not specific limited to products or services, but instead more in the areas of "employee development" or "housekeeping" and even general business management.

The theory in perspective

The production theories, as stated in the previous paragraph, are still based on a hierarchical structure of the supply chain, in which the assembler has the ultimate power leverage over the suppliers and does not look beyond the borders of their intrafirm process, and still maintains barriers and accordingly the interfirm relationships within the supply chain. Different research investigates the possibility for different relationships within the supply chain, then was custom within the production theories, with Lamming as one of the champions with the theory of lean supply. With this new look, the importance of selection of parties grew and the way of procurement became increasingly influential to the strategic behavior of firms and supply chains. So in conclusion the theory of lean supply goes beyond merely the production perspective and includes the organizational aspect and a "quasi firm".

2.3.3 Value Chain

Porter is champion in the field of the strategy and competitive positions of firms, and is well known and has had great influence on the research into supply chains and supply chain management. Porter defines three different generic strategies in which firms can obtain their competitive advantages.

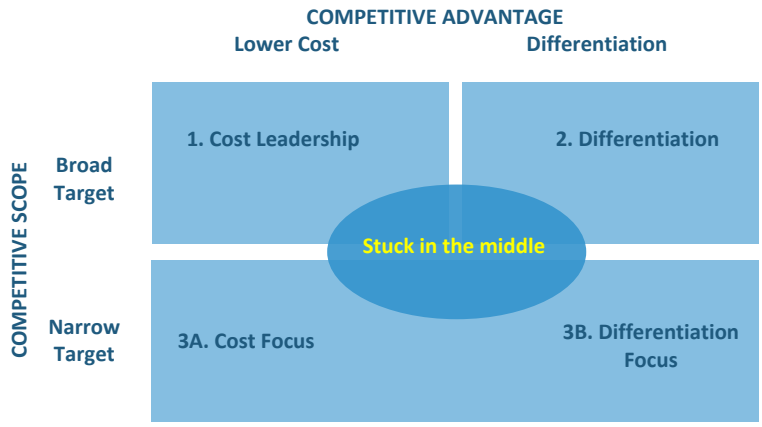


Figure 2.6: Generic strategies for firms (Porter 1980)

The value chain is also a concept introduces by (Porter 1980) as a systematic way to unravel and examine all activities a firm performs and how the interact with each other. Porter describes a firm as a collection of activities that are performed in order to create value for the firm. With this concept a firm is divided into strategically relevant activities in order to create a better insight into the behavior of costs and the potential differentiation sources of the firm, to gain a better competitive position. A representation of the value chain can be seen in Figure 2.7.

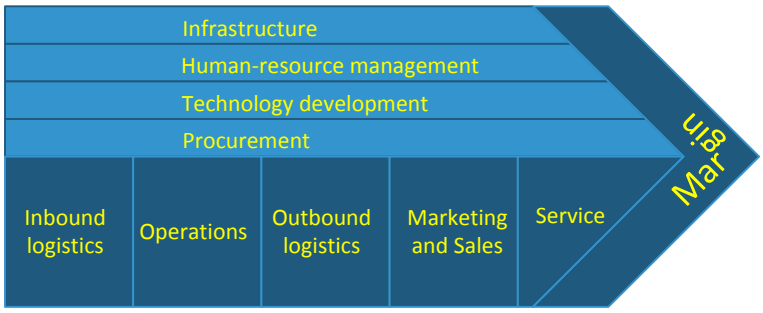


Figure 2.7: Value chain (Porter 1980)

According the concept the firm is categorized into two main activities; the primary activities and support activities. The primary activities are focused on the production and the transfer from seller to buyer. The support activities consist of all supporting activities to the primary activities.

The firm's value chain is often part of a larger stream of activities, including multiple series of supplying and buying firms, which include transfers from each other purchasing inputs as well as delivering outputs. This results into interdependencies between multiple firms and their value chain. This interdependence advocates considering the integral performance of a collective system than rather the performance of separated individual value chains, hence the value system shown in Figure 2.8.

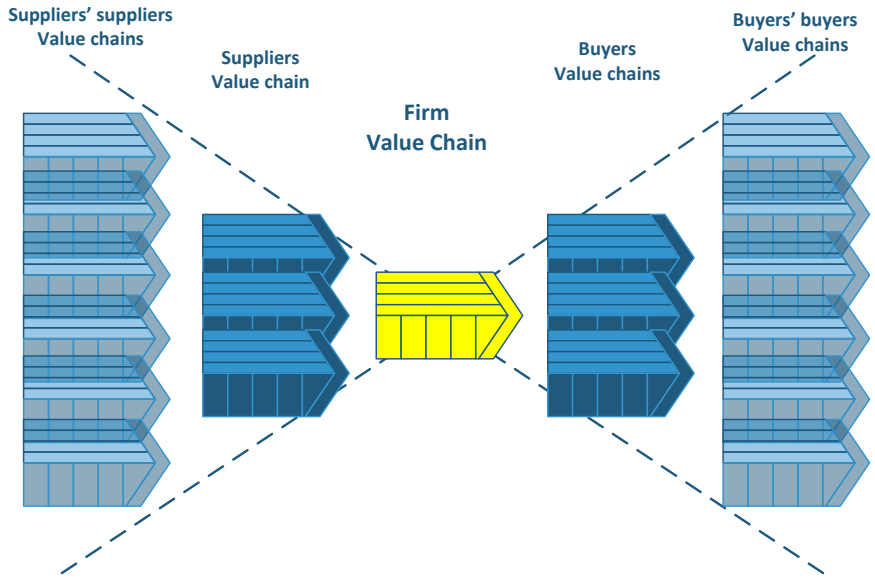


Figure 2.8: Value system according to Porter

In this value system, the performance of the value chain and the activities within the value chain are highly interrelated by the linkages within the value system, and therefore highly dependent on the optimization and co-ordination of those linkages. Mutual benefits can be gained from joint optimizations of activities and linkages, in order to create performance improvements, hence competitive advantages.

The concept of the value chain has since been challenged by Charles Stabell and Oystein Fjeldstadt (1998) who stated that the value chain is actually a very poor model of many businesses, and its use can lead to dangerous mistakes at the strategic level. They suggest that there are three different mechanisms through which businesses create value: the value chain, the value shop and the value network. They also argue that the proportion of businesses that fit the chain model is declining rapidly. Value shops (such as consultancies, builders, and primary healthcare organizations) create value by applying resources to solve individual problems. Their activities seldom follow a linear sequence and are often iterative in nature. Value networks (which include many telecommunications, banking and insurance companies) create value by selling customers to each other. Their value creation shows significant network effects, which is not the same thing as the 'economies of scale' pursued by value chains. Figure 2.9 shows the three different mechanisms for business to create value for the customer, according to Stabell and Fjeldstad (1998)

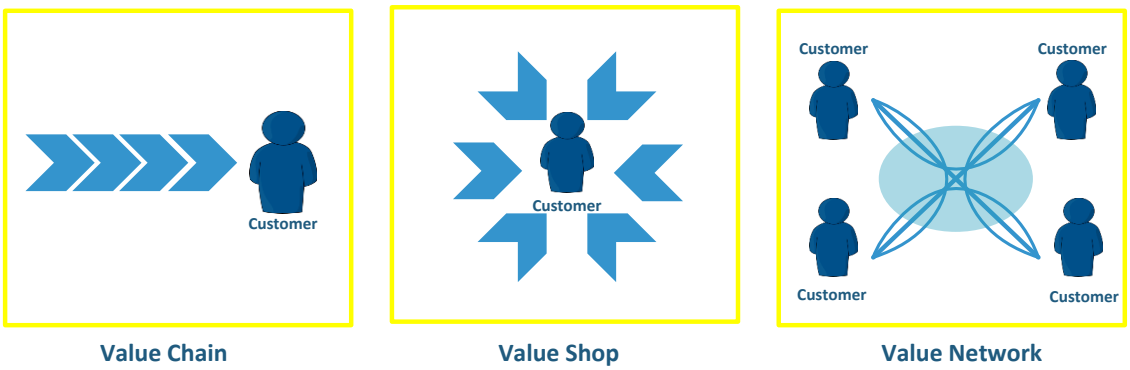
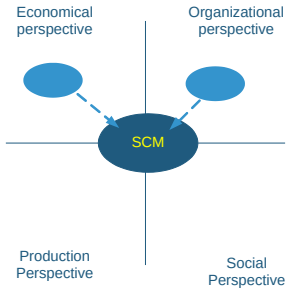


Figure 2.9: Mechanism for business to create value (representation of (Stabell and Fjeldstad 1998))



The theory in perspective

Porter described his theories of value chain based on the economic perspective with reflects on the organization perspective within firms and within value systems. The value chain theory is therefore the interlink between the organizational and economical perspective.

2.3.4 Linkages between value stream, lean supply, value chain, value system

Looking at the concepts as stated before, the concept of the value stream of Womack (1991) resembles Porter's value system to a large extent. The differences between the two concepts is that within the value system the relationships between suppliers and buyers are linked while with the concept of value stream the relationships are more integrated into the individual process up and down the value stream. Lean supply, on the other hand, is focused on supplier procurement, coordination and development is supported through allied business partners and strategic collaborative partnerships to enable lean production, hence value stream, to take place (Lamming and Cox 1995). This perspective is in contrast with porter's value system, which is the accepted view, that control of suppliers, is key to lean supply chain. Lamming (2000) suggested that achieving lean supply is a complex matter because of the nature of competition in markets, as the suppliers are involved simultaneously in several other chains. Jealous guarding of expertise cannot be maintained in the lean enterprise as it requires trust between firms.

The concept of value stream and lean supply are based on the principles of lean thinking. Though these principles are well spread, the dogma and rhetoric are questioned in relation to the narrowly defined instrumental rationalist approach currently undertaken within the lean movement (Green 1999). Green (1999)aimed at literature that provided evidence of the human cost of lean methods in Japanese industry, based on the personal account of the life as an assembly-line worker inside the Toyota plant, written by Kamata in 1982. Green argued that 'while the lean rhetoric of flexibility, quality and teamwork is persuasive, critical observers claim that translates in practice to control, exploitation and surveillance'. Green gives the signals that there is an important social perspective missing within the lean movement, and there according theories. This is why the premises of *lean thinking* still debated among research, like the theory of Porter, also in concern with the applicability beyond the manufacturing and production industries as implicated by Womack and Jones.

2.3.5 Findings

As shown the principles that followed from the philosophy of lean thinking within the perspective of production also promises to be beneficial within a broader perspective, including the organizational and economical perspective. Furthermore this indicates that there is room for a new way of organizing the supply chain in order to increase the performance of construction and become economically more competitive within an industry.

2.4 Supply Chain Management

2.4.1 Introduction

The previous paragraph has given the beneficial promises for adoption of the lean philosophy for firms form different perspectives. In order to apply this philosophy and make it beneficial a new management style for organizations is needed in which they integrated their supply chain to reap the fruits of labor from a productional and economical perspective. Within this paragraph the new supply chain management approach is research in order to find transactional relations between firms that can occur within supply chain management.

2.4.2 Organizational economic perspective

Ellram (1991) took an industrial organizational perspective, by defining the supply chain management approach different from traditional perspectives in two respects. First, supply chain management has a broader goal, namely managing inventory and relationships to achieve a high level of customer service rather than accomplishment of specific marketing objectives. Second, the supply chain management approach attempts to manage both upstream and downstream activity within the supply chain, while the marketing channels tended to focus on downstream activity in accordance with the theory of Porter. Ellram signals that there are three ways for a firm to maintain a competitive position within a market.

1. Vertical integration[1], on an intrafirm level, by means of acquisition, to control chain efficiency through ownership
2. Obligation contracting, which is an ongoing co-operative with other chain members, bound by legal agreements
3. Supply chain management, an integrative approach to using information to manage inventory throughout the channel from supply to end user, bound by supply chain commitment and acceptance of mutual dependencies.

Ellram represents supply chain management as a network of firms interacting to deliver a product of service to the end customer, linking flow from raw material supply to final delivery. This is also in line with the view of Stabell on value shops, instead of the value chain. A categorized of the three competitive positions based of different types of competitive relationship that firms can undertake, together with the level of vertical integration are shown in Figure 2.10.

[1] Definition of vertical integration by ellram; the combination within a firm of functions that can be/usually are carried out by separate firms.

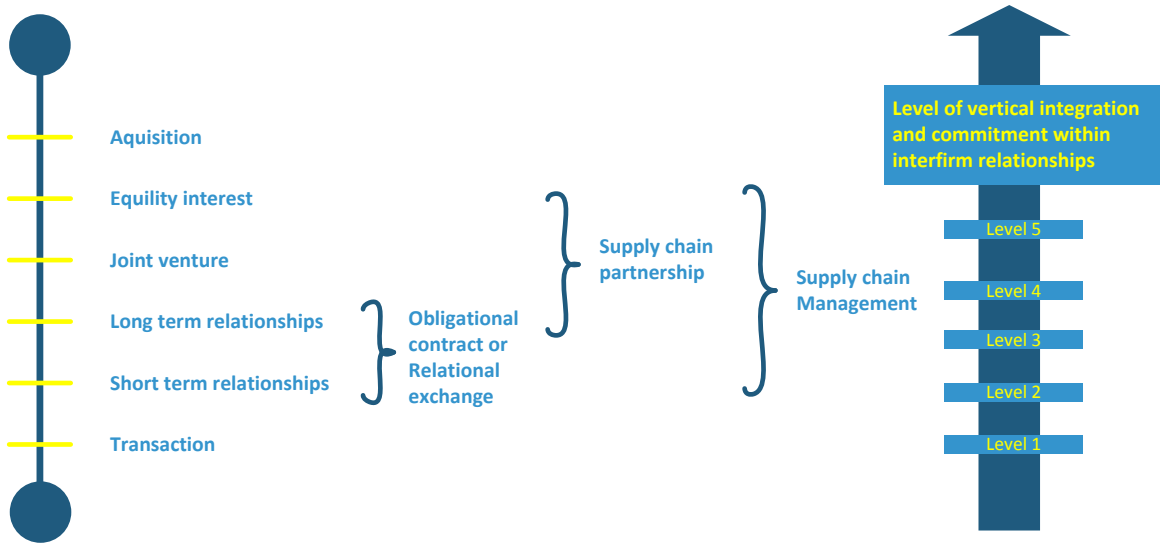


Figure 2.10: Types of competitive relationship and competitive strategic positions (adapted from (Ellram 1991)

The reasons for vertical integration

In an industrial organization perspective Ellram signals that there are three broad reasons for vertical integration; control, communication and cost. A firm may choose vertical integration within their supply chain network to improve control over the way it brings its product to the market. Vertical integration may also help a firm to avoid the externalities that can occur when it is branded goods while handled by supply chain partners who are not part of the firm. The premise of Ellram (1991) for vertically integrated firms is that they should enjoy excellent communications because trading partners are directly linked to the internal communication of the firm. In addition, common ownership should also improve the cost structure by creating economies of scale, integration opportunities, and reducing transaction cost. Concluding internalizing operations through vertical integration increases control of their value added activities within the supply chain. Also seen in table are the disadvantages of vertical integration. The major disadvantage of vertical integration, diseconomies, may occur if the firm internalizes more operations than it is managerially, structurally or technically capable of handling. Also vertical integration may increase the firm's risk through concentration of assets and possible loss of focus and managerial failure within vertical integration.

Advantages	Disadvantages
Control	*Limiting competition*
Uncertainty reduction of Costs, Quality of supply, Quantity of supply	More difficult for non-integrated firms to enter business
	Weaken non-integrated competitors
Convergent expectations	Inability of vertical integration to replicate market incentives
Reduced probability of opportunism	
Reduced probability of externalities	Less awareness of market issues
Dependence on monopoly suppliers	Size preserving tendency
Protect important proprietary/competitive knowledge	Internal information distortion
Ease of conflict resolution	*Diseconomies*
Easier to enforce/monitor internal compliance	Balancing scale economies
More readily available rewards internally	Volume requirements vary by process
Communication	Firm has insufficient volume to achieve scale
Improved co-ordination of processes	Inability of management to control large organization effectively
Greater goal congruence	
Cost	Limits on span of control
Economies of scale through avoidance of intermediaries	Increased inefficiency
Procurement	Increased difficulty in communication
Sales promotion	Large size of firm
Distribution	All communication cost born internally

Process integration	*Risk*
Technical or physical integration	Asset concentration
Improved asset utilization	Exit barriers
Avoid switching/transaction costs	Perpetuate obsolete processes
	Exaggerate synergies

Table 2.3: advantages and disadvantages of vertical integration (Ellram 1991)

Legally bound supply chain relationships

Ellram also signals that obligated contracts (needed to maintain short and long term relationships bound by legal agreements) fits best when transactions are recurrent, and assets needed for production are highly specialized, yet not limited to one use. Firms must recognize the hazards of opportunism within this contracting, while maintaining flexibility in the contracts, firms should not allow flexibility in areas where the potential for opportunism is high. The following summary has been made for obligated contracts used.

advantages	disadvantages
Cost reduction	***Control/Dependence***
• Reduced production costs	• Loss of incentive to be competitive due to dependence
• Reduced transactions costs	• Trust may prolong relationship of unequal benefits
• Better information/reduced uncertainty	• Increased risk if opportunistic due to dependence
• Routinise transactions	• Difficult to manage multiple relationships/complex governance
Risk reduction	• Difficult to build all contingencies into relationship
• Sharing of assets	• Difficult to evaluate due to multi-dimensionality
• Lower break-even costs	• Real or perceived loss of control over operations
• Sharing of information both formally and informally	• Informal relationships may be difficult to control
• Volume commitments	• Heavily dependent on individuals involved; limited transferability
• Increased flexibility versus vertical integration	***Cost***
• Future orientation with joint planning	• Outside firms receive profit on value-added that firm would retain if activities are performed internally
• Trust	• Duplication of efforts may increase total cost
• Interdependence	
• Sharing of risks and rewards of relationship	

Table 2.4: Advantages and disadvantages of obligated contracting supply chain relationships (Ellram 1991)

Commitment based supply chain relationships

As previous described in this paragraph, Ellram signals that there is more than only obligating contracts or vertical integration within her definition of supply chain management. The main thrust to use supply chain management, according to Ellram, is 'simply a different way of competing in the market' that falls between transactional-type relationships and acquisition, and assumes a variety of economic organizational forms.

This main thrust was based on the implications given by Williamson's transaction cost economic theory (TCE) (Williamson 1979). TCE is an economic theory derived to develop strategies for a firm and is concerned with how the boundary of a firm is governed by the attempt to reduce the cost of transacting with other firms. This principle is based on the recognition that transaction do not occur within friction and that costs arise from the interaction between and within firms as transaction cost. So when transaction costs are low, firms will resolve transaction by contracting and legal bounded relationships, while when internalization will prevail for high transaction costs. Situations within the market structure that are conducive to supply chain management and TCE theory included;

1. Recurrent transactions requiring moderately specialized assets
2. Recurrent transactions requiring highly specialized assets
3. Operations under moderately high to high uncertainty

The theory in perspective

The definition of Ellram given in her theory is the foundation for supply chain management from a, as stated before, organizational and economical perspective. Furthermore this theory gave the scientific validation for collaborative partnerships, within this organizational economical perspective.

2.4.3 interlocked suppliers and cluster sourcing

The urge to broaden the scope of the lean model of supply chain integration draws from the works of Hines (1994) and Nishiguchi (1994). Although they are both advocates of the lean supply system theory, their research gives descriptions of the historical, organizational and economical structures of the Japanese system

of supply across the automotive and electronics industries. Within this research both researcher give a 'richer' picture of lean production and supply chains than within the studies of supply chains at that moment.

They signal that in the traditional way, suppliers are categorized and organized into either specialized subcontractors or standardized suppliers, based upon the degree of complexity of the supplied item. It is within the specialized subcontractors that the pyramidal Japanese subcontracting system also known as the concept of clustered control lies. This system has traditionally been described as a pyramid with an individual assembler corporation at the top and successive tiers of highly specialized subcontractors, along the supply chain, increasing in numbers and decreasing in organizational size at each stage. This is also known as the Alps structure of supply chains, a series of overlapping pyramids resembling mountain alps across an industry (Nishiguchi 1994). Although this implies a closed system within the supply chain in reality first tier suppliers supply too many assemblers across the industry.

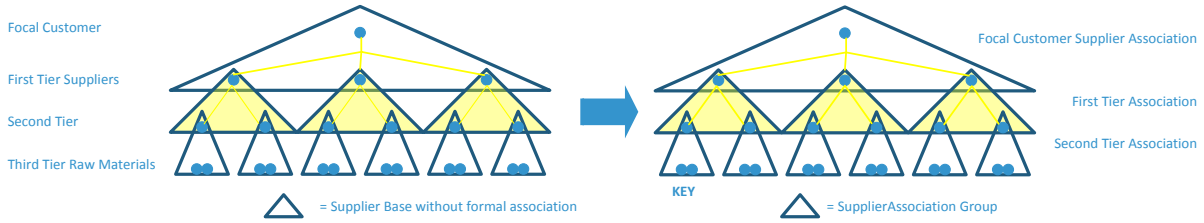


Figure 2.11: Sourcing networks (alps) (Nishiguchi 1994) and industry supply chain sourcing mao (Rich and Hines 1997)

Rich et al. (1997) enlarged the industry specific view to look at the wider economy, rather than a closed rigid system. In this wider perspective the system is moving more towards a system of interlocking supplier. This means that although a firm may be within one supply chain within one industry, the firms may potentially operate within different tiers within other industries. The signal that not only the alps structure of the supply chain was at the heart of the competitiveness of Japanese companies, but that also the suppliers association or Kyoryiku Kai, was core to this competitiveness. The definition for suppliers association is given by Hines (1994) as follows; a mutually benefiting group of a company's most important subcontractors, brought together on a regular basis for the purpose of co-ordination and co-operation as well as to assist all the members to benefit from the type of development associated with large Japanese assemblers: such as kaizen, just in time, kanban, U-cell production and the achievement of zero defects (Hines 1994). Rich et al. (1997) propose an enriched supply chain map than Nishiguchi by stating the power of the supplier associations to the successfulness of the Japanese production companies as shown in Figure 2.11.

But within this supply chain map, they described, accordingly with the theory of Ellram, the potential benefits of supply chain relationships that go beyond transactional supply chain relationships towards collaborative relationships within the supply chain. Rich and Hines (1997) described this as follows;

'The deliberate strategy to align and integrate the external productive resources, and the strategies of suppliers through the development of collaborative relationships, explicitly recognizes the dependency between the organization and its sub-contracting network.' The benefits, by recognizing these explicit interfirm dependencies and the need for collaborative relationships, rather than the adversarial behavior within this tiered supply chain approach, are summarized by Rich and Hines (1997) in the following table.

Benefits of collaborative relationships
1. A tiered supply structure with heavy reliance on small firms
2. A small number of direct suppliers, but within a competitive dual sourcing environment
3. High degrees of asset specificity among suppliers, and risk sharing between customer and supplier alike
4. A maximum buy strategy by each company within the semi permanent supplier network, but a maximum make strategy within these trusted networks
5. A high degree of bilateral design, employing the skills and knowledge of both customer and supplier alike
6. A high degree of supplier innovation in both new products and processes

7.	Close, long term relations between network members, involving a high level of trust, openness and profit sharing.
8.	The use of rigorous supplier grading systems increasingly giving way to supplier self certification.
9.	A high level of supplier coordination by the customer company at each level of the tiered supply structure.
10.	A significant effort made by customer at each of these levels to develop their suppliers.

Table 2.5: Benefits of collaborative relationships (Rich and Hines 1997)

The theory in perspective

As stated above, the description given by Nichiguchi, was still based on the production perspective, while the theory given by Hines et al. combined Nichiguchi's view with a more economical organizational perspective and signals the benefits of collaborative relationships within cluster sourcing or as it may also be known as network sourcing with suppliers associations within these clusters.

2.4.4 Findings

For supply chain management to be effective, an industry needs to have the possibility to create long term collaborative relationships within sourcing clusters, beside once-off obligated legal transactional exchange relationships. This long-term collaborative relationships hence supply chain partnerships, is the most integrated interfirm supply chain relationship, before acquisitions.

2.5 Supply Chain Partnerships

2.5.1 Introduction

As shown in the previous paragraph the most integrated transactional relationship within a supply chain, is the interfirm long term collaborative relationship, hence supply chain partnerships. This type of transactional relationships is needed to fulfill the beneficial aspects within a firm or organization. Within this paragraph research is done on the characteristic of these supply chain partnerships and the effects on the industrial lay-out.

2.5.2 Supply chain partnerships

Ellram signals that beside obligating contracts are a part of supply chain management, the other part of supply chain management is the establishment and maintenance of a supply chain relationships develop through increasing levels of commitment and integration. Supply chain management must be beneficial for all partners by reduced risk and reduced uncertainty through common objectives and information exchange. Because of the interdependent nature of a supply chain, supply chain management must exhibit attitudes and behavior indicative of common interests and collaboration among supply chain partners. The supply chain relationship based on commitment is later defined by Maloni et al. (1997) as supply chain partnership. This is also in line with the theory of Rich and Hines (1997)

The definition of supply chain partnership will be elaborated in more depth. Also termed a strategic alliance, a *supply chain partnership* is a relationship formed between two independent entities in supply channels to achieve specific objectives and benefits (Ellram 1991; Maloni and Benton 1997). By reducing the supplier base and invest in less tangible benefits such as supplier relations, the manufacturers will be able to take advantages of the partnership with their suppliers. With this approach the assembler should leave the conventional completely discrete engagements and move towards the idea of relationalism between firms, breaking down the interfirm barriers as described by lean supply (Lamming 1993) and shown in Table 2.6.

Contractual	Discrete Orientation	Relational Orientation
Duration	One time	Long term
Communication	Very little, just enough for transaction	Complex, two way sharing
Transferability (switch parties)	Completely transferable	Extremely difficult to transfer

Management support	Low	Extensive, sincere
Attitude	Solely profit-focus	Open, trusting, cooperative
Visibility	Low	High
Planning and Goals	Individual, short-term	Joint, long term
Benefits and Risk	Individual	Shared mutual
Problem solving	Power driven	Mutual, judicious

Table 2.6: discrete versus relational business strategies (Maloni and Benton 1997)

Initial efforts to create supply chain partnerships within contemporary manufacturing, began with the inclusion of suppliers in cross functional sourcing teams in order to improve supply chain effectiveness. Supply alliances, hence *supply chain partnerships*, extend well beyond this notion to an even more relational level of exchanges in which partners create intensive, interdependent relationship from which both the suppliers as well as the manufacturer benefits. Table 2.7 shows the traditional versus partnership supply chain strategies.

Traditional supply relationships	Supply chain partnerships
Price emphasis for supplier selection	Multiple criteria for supplier selection
Short-term contracts for suppliers	Long-term alliances with suppliers
Bid evaluation	Intensive evaluation of supplier value added
Large supplier base	Few suppliers
Proprietary information	Shared information
Power driven:	Mutual:
• *problem solving*	• *problem solving*
• *improvement*	• *improvement*
• *success sharing*	• *success sharing*

Table 2.7: Traditional supply relationships versus supply chain partnerships (Benton and Maloni 2005)

Maloni et al, categorized the benefits for such a supply chain partnership, based on the economical organizational perspective of Ellram, combined with production perspective, including the proposed competitive positions from Porter (cost leadership, product differentiation, and market segment focusing), together with the social production perspective of continuous quality improvement. The suggested benefits of supply chain partnerships in summarized in Table 2.8.

Benefits of supply chain partnerships	
Uncertainty for buyers	*Cost savings*
• cost	• economies of scale
• quantity discounts	• ordering, production and transportation
• high quality	• administrative switching
• improved timing	• process integration
Uncertainty for suppliers	• technical or physical integration improved asset utilization
• market	*Joint products and process development*
• understanding of customer needs	*Improved communication*
Uncertainty for both	*Shared risk and rewards*
• convergent expectation and goals	
• reduced effects from externalities	
• reduced opportunism	

Table 2.8: Potential benefits of suppliers partnership (Maloni and Benton 1997)

It appears that the biggest potential pitfall of supply chain management relationships is the occurrence of opportunism. The best way to avoid opportunism is careful selection of partners, and sharing of risks and benefits. Long-term commitment to the supply chain is critical. Without long-term commitment and benefits for the partners, a supply chain partnership might lose its incentives and mutuality (Ellram 1991; Maloni and Benton 1997; Rich and Hines 1997; Benton and Maloni 2005; Bresnen 2007). The next paragraph will give an in depth description for the adoption of supply chain partnerships and the critical factors for supply chain partnerships.

2.5.3 Adoption and success factors of supply chain partnerships

In order to create this kind of partnerships Maloni indicates that a major issues remains. The issue indicated to come to a closer relationship with the suppliers the firms must reduced the number of suppliers. Within the production and manufacturing supply chain management research Harland (1996) signals that there is a strong trend in many companies towards reducing the total numbers of suppliers as well as concentrating more on developing the relationships with the remaining ones (Harland 1996). During the last decades multiple sourcing has been replaced by other forms of purchasing strategies (Gadde and Håkansson 1994), which increases the importance of supply relationships (Harland 1996). Today companies are moving towards single or dual sourcing (Harland, 1996). This realization for a smaller supplier base is also the first steps towards the adoption of supply chain partnerships according to Maloni et al. (1997). The next steps within the adoption can be seen in Table 2.9. In the next table we find the critical success factors in the phases of adoption towards supply chain partnerships (Table 2.10);

Supplier partnership adoptions steps
1. Establish strategic need for partnership
2. Develop partner criteria, evaluate suppliers, and select partner
3. Formally establish partnership
4. Maintain, refine expand partnership (possible reduction or dissolvement)

Table 2.9: Supplier partnerships adoption steps (Maloni and Benton 1997)

Critical success factors in phases of suppliers partnership adoption	
Throughout	*Partnership establishment phase*
• top management support	• perception and needs analysis
• communication	• intense interaction
• central coordination	• documentation
Initial strategic analysis phase	*Maintenance phase*
• social and attitudinal barriers	• trust
• procedural and structural barriers	• goodwill
Supplier evaluation and selection phase	• flexibility
• total cost and profit benefit	• conflict management skills
• cultural compatibility	• social exchange
• financial stability	• boundary personnel
• partner capabilities	• performance measurement
• management compatibility	
• location	

Table 2.10: Critical success factors of suppliers partnerships adoption (Bresnen 2007)

Bresnen (2007) signals that there are seven pillars of partnership within the more social perspective of partnerships from an intrafirm point of view in project based organizations. The pillars and their influences on the organization are given in the following table (project based specific pillars are given in dark blue);

Pillars of partnerships	
• The need for long term vision, also in relation to partnering	***Strategy***
• the need to generate commitment	
• the need to maintain continuity	
• the need to rationalize (i.e. standardize) processes	
• the need to concentrate improvement efforts	
• the need to give freedom to individuals and encourage them to live with ambiguity	
• the need to understand who the client is and effectively make the case for partnering	
• the need for a careful and intense selection process	***Membership***
• a balance between single sourcing and being 'locked in' to the relationship	
• structuring membership and workload to encourage repeat business	
• being 'open'	
• creating certainty for clients	
• selecting project core teams (including 'clusters')	
• developing partnering skills (e.g. training in process analysis, problem-solving)	
• reviewing membership	
• alternative funding arrangements (e.g. via PFI)	***Equility***
• sharing savings and other benefits fairly	
• maintaining commitment to long term development of the relationship	
• agreeing ownership of innovations	
• looking after key people	
• project incentives based on realistic costs, prices and fair distribution	
• open book accounts	
• benchmarks for demonstrating 'value for money'	
• developing trust	***Integration***
• continuity and building long term cooperation	
• integration (both external and internal) at various levels (strategic, tactical, operational, interpersonal, cultural matching)	
• getting rid of internal conflict (internal partnering needed)	
• joint IT strategies	
• supporting/rewarding integrating behavior	
• competence of people	
• the need for simple, robust and widely-understood benchmarks	***Benchmark***
• to generate quick wins	
• agreeing how to measure improvements and what improvements to measure	
• use both objective and subjective measures	
• benchmark project and firm performance	
• involve workers	
• overcome resistance to value engineering	
• the need for establishing standards and procedures that embody best practice based on process engineering	***Project Processes***
• process improvement based on process standardization	***Feedback***
• robust systems of feedback, based on measurable targets (CSFs and KPIs);	
• walking the job	
• final workshop	
• telling senior management	

Table 2.11: Pillars of partnerships (Bresnen 2007)

Brensen (2007) also gives the paradox accordingly and the social deadly sins within project based organizations as shown in Table 2.12. In depth elaborations of project specific aspects within supply chain partnerships will be given within the next chapter.

Pillar	Paradoxial effect	Deadly sin
Strategy	Wishful thinking about strategy and behavior	Sloth
Membership	Fostering of relationships built on exclusivity	Lust
Equity	Encouraging exploitation and opportunism	Avarice
Integration	Reinforcing a desire for control	Glutony
Benchmarks	Setting of inappropriate targets	Envy
Processes	Over-engineering of processes	Wrath
Feedback	Failing to capture knowledge and learning	Pride

Table 2.12: Paradoxial effects of partnership pillars

2.5.4 Success factor: strategy for collective competition

Within the overall success factor of strategy of supply chain partnerships (Maloni and Benton 1997; Bresnen and Marshall 2000; Benton and Maloni 2005; Bresnen 2007), Gomes-Casseres (2003) stipulates the emerging need for understanding supply chain constellations within supply chain management and supply chain partnerships. Gomes-Casseres, like Ellram (1991), Lamming (1993; 1995; 1996) signals that there is a specific need for interfirm long term relationships to create competitive advantages, by the recognition of Penrose (1995) that the traditional definition of the firm might be problematic. He states that for an analysis of economic power there is no doubt that the industrial firm is not the most relevant unit; indeed individual men as well as corporations may extend their economic power by extending their ownership interests, and an attempt to define the firm according to power groupings would produce too amorphous a concept to handle.

Gomes-Casseres gives within his definition of alliance, in accordance with Maloni et al, that an alliance is more strategic of nature and more relational based than the stand-alone transaction based alliance, in accordance with Ellram. Moreover Gomes-Casseres gives a clear definition of constellations within the context of alliances aka a supply chain partnership which is formulated as follows; An alliance is any governance structure to manage an incomplete contract between separate firms and in which each partner has limited control. These structures may be more or less formal; it is the degree of incompleteness that determines whether we are dealing with an alliance, not whether or not there is a stand-alone structure to govern the relationship(Gomes-Casseres 2003). The definition given for constellation is as follows; A constellation is a set of firms linked together through such alliances and that competes in a particular competitive domain; the constellation may compete against other constellations, or against single firms (Gomes-Casseres 2003). While the definition of constellation given by Gomes-Casseres (2003) is more restrictive in relation with the concepts of strategic networks, supply chain networks, supply systems (Porter 1980; Rich and Hines 1997), the importance of Gomes-Casseres research is, the implication that there is a competitive advantages for interfirm partnerships, hence a constellation within a particular domain, and moreover the advantages of collective competition by constellations. The competition between firm-constellation only means that the firm has more required capabilities in-house than do the members of the constellations or as view in the perspective of Ellram (1991), the firm is more vertical integrated through ownership. Gomes-Casseres categorized the new constellation competition versus the traditional firm as follows (Table 2.13):

	Traditional competition	Collective competition
Competitive units	Firms	Constellations
Industry structure	Oligopoly of firms	Oligopoly of constellations
Source of differentiation	Firm-based advantage	Group-based advantage
Valuable resources	Controlled by the firm	Assembled by constellation
Governance of resources	Corporate structure	Constellation structure
Source of profit	Rent in the value chain	Rent in the constellation

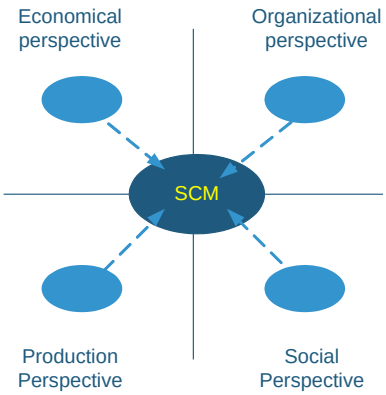
Table 2.13: traditional versus collective competition (Gomes-Casseres 2003)

In conclusion with supply chain partnerships, the competitive position as a firm will not only be differ from the current practice, but firm needs to broaden their strategy scope by being aware and include the competitive position of the constellation, hence their supply chain of supply network (Lamming 1996; Rich and Hines 1997). In consideration this is in line with the research done by Alter et al. (1993), that suggest that close-knit inter-organizational networks produce superior economic performance and quality, than the large vertical integrated ownership based firms.

2.5.5 Findings

As shown within this paragraph supply chain partnership is complex in nature and has seven pillars that need to be fulfilled in order to be beneficial in comparison towards other transactional relationships. Within these pillars we see that the social perspective has great influences on supply chain partnerships, together with cultural aspect within the industry. This results the fact that supply chain partnerships are really effective and beneficial when the industry as a whole will change their ways of competing within the market. This implies the cultural changes from traditional competitions between firms towards collective competition between constellations.

2.6 Conclusion



As defined in the in the preface of this chapter there are different perspective from a business point of view to look at supply chain partnerships. While a major impulse was the production perspective from the car-industry, the other perspectives within the current scientific research show that the different perspective are aggregated towards one solid concept of supply chain partnerships;

While supply chain management is “just another way to compete within a market, the most integrated way in doing so is by supply chain partnerships, which should be adopted from a intrafirm perspective within the top-management of the all the organizations within the supply network, while have a strategic goal in mind, that fosters long-term relationships, hence have a long term business strategy which included supply chain partnerships.

3 Preconditions of supply chain partnership in construction

3.1 Introduction

While there are different perspectives for looking at supply chain management and the kind of relations that are in place within industries supply network, supply chain partnerships and supply chain constellations give another strategy for business and organizations.

As concluded in the previous chapter it has been shown that long term partnership, defined as supply chain partnerships can have a beneficial effect on competitive position of firms engaging in this type of relationships within the supply network. In the next chapter will give the findings of the exploration within the current theories for the possibility of adoption of supply chain partnerships within the construction industry. This research is done due to the peculiarities that make the construction industry different in comparison towards the manufacturing industry. Secondly beneficial effect of the supply chain partnerships within construction will be explored. In paragraph 2 the peculiarities of the construction industry in comparison towards the manufacturing industry will be elaborated. Paragraph 3 will give the impact of these peculiarities on the concept of supply chain partnerships and possible benefits of adoption of supply chain partnerships within the construction industry. Paragraph 4 elaborates a best practice of the current Dutch construction industry. This case is the first attempt for adoption of supply chain partnership within the construction industry. Furthermore the researcher himself has cooperated on this first attempt to implement supply chain partnerships. Findings of this case will likely to be published within scientific research. This chapter will be closed with a conclusion, which results in a research framework that will be elaborated in chapter 4.

3.2 Construction Industry

3.2.1 Introduction

While in chapter 2 the premise for beneficial attributes of the implementation of long term supply chain partnerships are given for the manufacturing industry, the application of these theories in the construction industry differ. Within this paragraph a description is given on how the construction industry works and the peculiarities are within the construction industry.

3.2.2 Construction industry

Process and product within construction

Fernández-Solís (2008) indicated the principal difference in high abstraction between the construction industry and the manufacturing industry. The construction industry can be seen as an industry where the process of change is leading over the end result while in manufacturing it's the other way around. So in other words, while in manufacturing the products are leading over the process for this creation, in construction the process of creation leads to the end result hence the product (Figure 3.1).

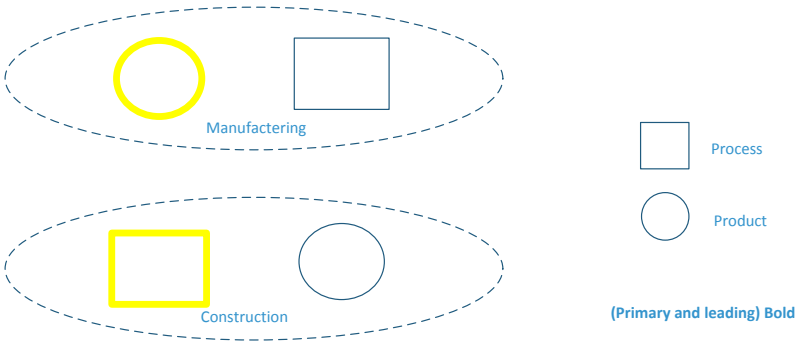


Figure 3.1: Process and product in manufacturing and construction (Fernández-Solís 2008)

The first recollection of this view on the activity of creating a building is Aristotle, who wrote 'Human beings become builders by building'. The essence of the activities undertaken is environmental change: where there was nothing, now there is a building or work, through the process of construction. While this is the case for all transformations, it can be argued that construction has a real product in the form of projects undertaken (Figure 3.2).

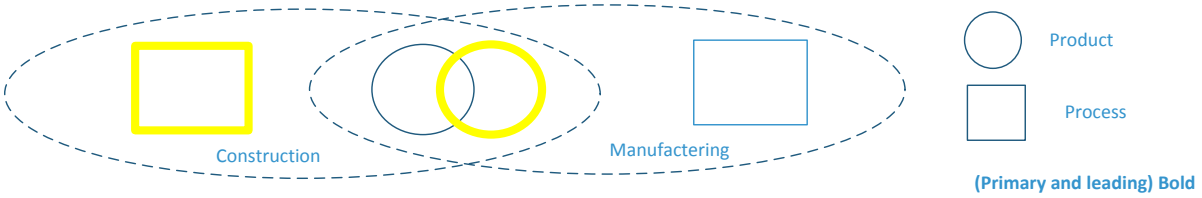


Figure 3.2: Construction process and product (Fernández-Solís 2008)

Dubois et al. (2002) signals that, in contrast to the manufacturing industry, that the construction industry is a loosely coupled system of actors, in which, as described above, the process as the primary competence and the project as the enabling characteristic. This view is in line with the schematic representation of the demand and supply side within the construction industry given by Vrijhoef et al. (2007).

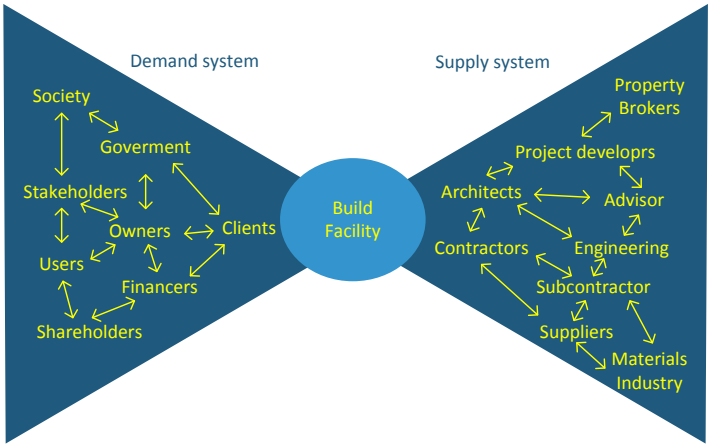


Figure 3.3: Lay-out of construction industry (Vrijhoef and De Ridder 2007)

This representation indicates the build facility as the transaction place for demand and supply. To clarify this transaction place, the build facility is the result of the construction process in which a temporarily project based network interacts with the long-term reoccurring exchange based network (Dubois and Gadde 2002; Fernández-Solís 2008). In conclusion one of the major different between the construction and manufacturing industry can be found in the contemporary project based character of the construction industry in which the process is the dominant factor.

Products of Construction

Within the term construction industry many different and heterogenic projects (products) can be identified. A categorization of the construction industry is given by EIB[2], who divides the industry into two major sub-industries:

1. The industry that delivers projects within the residential and utilitarian buildings (office and industrial buildings).
2. The civil engineering industry in which the projects that are delivered have physical transformed soil, waterways or physical infrastructures within the environmental context, outside the residential and

[2] dutch economical institute for construction industry

utilitarian buildings. Furthermore a civil work does not have a direct beneficiary in the form of an organization and or persons. Projects within the civil engineering include;

- infrastructural works (highways, secondary roads, railways, subways, bridges, tunnels, railway stations)
- water barriers (embankments, storm surge barriers, locks)
- water quality works (like sewage, water purification plants etc)

It needs to be noted that while industrial building projects are placed together with residential and office buildings, this category can also could be placed within the civil engineering industry. For example the water purification plant can also be considered as an industrial building for the water agencies.

3.2.3 Construction Process

While the construction industry, as stated before, has the characteristics of contemporarily project based industries that can been seen as the product, it has some peculiarities (Vrijhoef and Koskela 2005) in which the process of construction takes places, what makes the construction industry unique of character in comparison with other industries. These peculiarities have a decisive impact in the current practice within the supply side, looking at the construction process from a social organizational economical production perspective. Furthermore it has a decisive impact within the way that the demand and supply side encounter each other in the market of the construction industry.

Different delivering points within production process

Within all industries different delivering points can be found. Based on the logic that before production can start, you will need to have an virtual solution for a problem, hence followed a design process, Gosling et al. (2009) categorized the different positions within the production processes in which the demand and supply side find each other for their transaction of tasks risks and materials or products. There are multiple supply chain configuration indentified, depended on the position of the decoupling point. These positions given by Figure 3. are based on the different positions within industries.

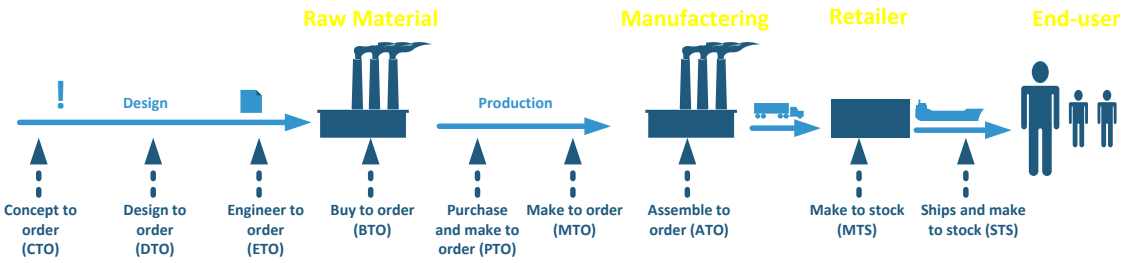


Figure 3.4: Decoupling point locations within industries and supply chain (aggregation of Vrijhoef and De Ridder 2007; Gosling and Naim 2009; O'Brien, Formoso et al. 2009))

Within the construction industry the design and production phase are often disconnected. Furthermore information and material flows are contradictory to each other. The construction industry is categorized by Gosling et al. (2009) as an engineer to order supply chain. In this case the decoupling point, where demand and supply find each other within the market, is located within the design phase of the product. Upstream from the decoupling point all products are produced to forecast while downstream from the decoupling point all products are pulled by the end-user. This encapsulates the different decoupling locations given by O'brien et al. (2009)for the construction industry, although the definitions given by each differ. Gosling et al. (2009) signals that there are four different kinds of definitions given for engineer-to-order supply chains, which are;

1. ETO supply chains have customized production dimensions with the decoupling point located at the design stage.

2. ETO supply chains offer customized products where existing designs are modified to order

3. ETO supply chains offer customized products where completely new designs are developed to order. Within the theory given by O'brien et al (2009) this will be defined at design-to-order (DTO)

4. ETO supply chains operate in a project environment with project specific demands/one of a kind. Within the theory given by O'brien et al (2009) this will be defined as concept-to-order (CTO)

These decoupling points based within the construction process and its effect on flows of information and material are within Figure 3.5. Moreover the positions and formation of the supply side is given.

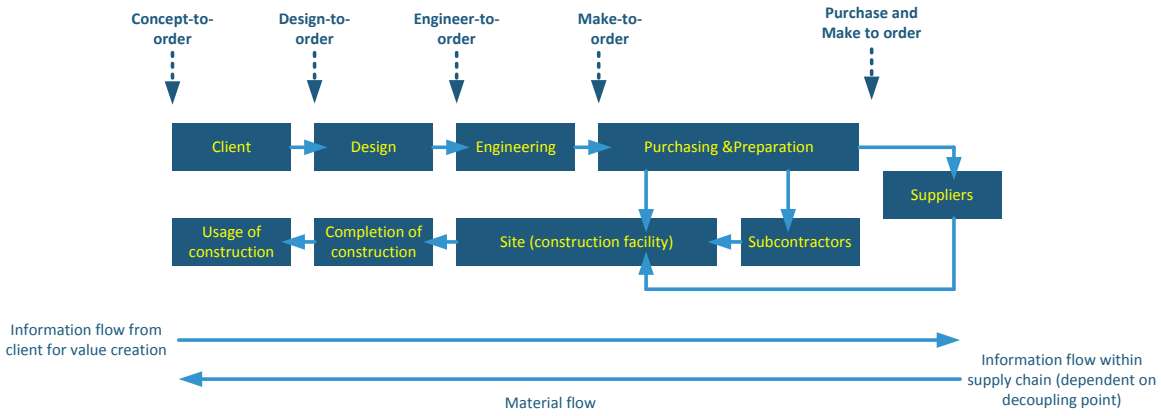


Figure 3.5: different locations of the client order decoupling point within the construction supply chain (aggregation of Vrijhoef 1998; O'Brien, Formoso et al. 2009)

Looking at these different decoupling position within the construction process, a strategy to gain competitive advantages within the different decoupling positions, can been created by supply chain structures through modularity also known as the 'forwards shift' seen in the residential and commercial sector of the construction industry, it must be researched if this model is also valid within the civil engineering industry (Gosling and Naim 2009). This forward shift towards CTO can be seen as a creation of the downstream supply side to create a strategic buffer against the variability and influences of the client in demand (Fernández-Solís 2008). Furthermore this shift could resolve the various problems within the production that occur within the construction process, due to the fact that design is often disconnected from production, by the contradictionary flow of information and material (Vrijhoef 1998; Dietrich, Eskerod et al. 2010). So the forward shift within the construction process is also driven by the need for the supply chain to control information and material flow without transaction from client towards suppliers and backwards.

One of a kind - on site production

Most of the production in construction in one-of and done on the building facility hence the construction site. Due to the transformational nature of construction, mostly very few materials and products that are needed for the transformation yet available on site. Therefore a contemporary factory on site is created, in which the product hence product will be created. Due to this geographical boundary the logistics in construction are converging, in which mainly all subcontractors and suppliers within this project supply chain are directly involved in the production on-site. This result in the need for coordination of spatial workstations on the construction site due to the scarcity of space available (Winch 2002). Furthermore due to the geographical constrain and the transformational nature of construction, production on site normally takes places in an open environment in which nature effects have free play.

Role of principal

Construction projects are dominated, as stated above, by to-order decoupling points in which the demand and supply side find each other for transactions and therefore the products are pulled out of the supply chain. While this is in line with the basic manufacturing theory of lean production as described in chapter II, the end-

customer is at the start as well as the end of the entire construction process, and gives the initiative to start this process as well as being the end customer of the product hence project. This places the end-customer in a dominated role and need for responsiveness within the project supply chain. This dominant role results in a demand driven industry in which products are rarely “launched” or “marketed” in comparison to other industries. This also result in the fact that most products are not standard, and process are not repetitive, and often cause high levels of waste (Vrijhoef and Koskela 2000). Furthermore the role of the client and their impact on the upstream and downstream supply side is described as follows:

‘Clients are in a key position of influence in the selection of the project procurement approach. They must recognize this and use partnering to help achieve and efficient and successful project. Many clients have limited in-house expertise in construction management and are heavily reliant on bought-in expertise, i.e. consultants. Consultants are less positive about partnering than clients and contractors; they perceive a loss of control (Black, Akintoye et al. 2000)

Impact of the peculiarities

Due to these peculiarities the construction industry is complex of nature. As stated above the construction industry is based on the process of transformation, which indicates that within the industry it is not merely about the exchange of products, hence projects, but also about the exchange of services, knowledge, competences and other capabilities. Furthermore the exchange within the construction industry is hampered, by the role of the client and end-user. Looking at the purchasing strategies of clients, they have to comply within the boundaries given in the legal system. Aspects that influence the strategic choices of client and supply chain are bounded by the ability to transfer risk and liability through the supply chain. This is, as described by statuary by the environmental pressure on transfirm level, which embodies the legal system, state procurement policies, construction regulations, labour market regulations and zoning regulations (Winch 2002; O'Brien, Formoso et al. 2009). Looking at the current construction industry practices the following contractual positions within the Dutch legal system can be defined (Figure 3.6).

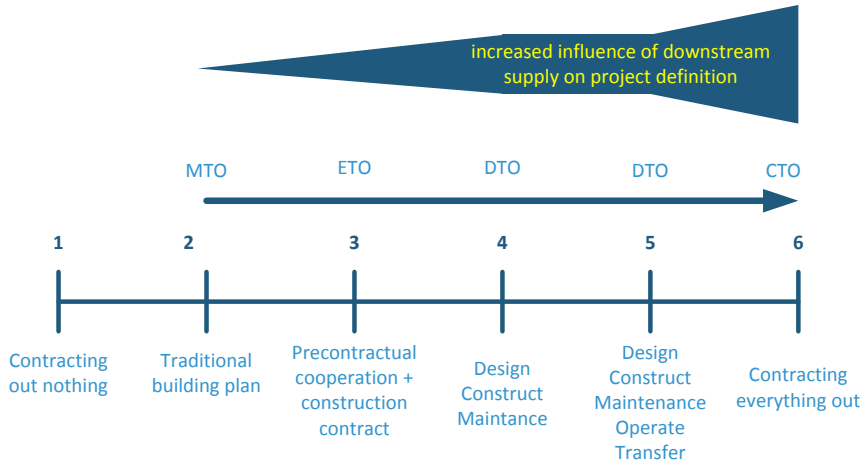


Figure 3.6: Forward shift in construction, effects on project, contract, decoupling point. (adapted from De Ridder, 2004)

Within these legal boundaries the client decoupling point shifts through the building process forward which has resulted in the different contracts that are used by clients to participate in an exchanges within the construction market. The possible contract chosen for the exchange by the client is influences by; 1) Transfirm environmental pressure (Winch 2002; O'Brien, Formoso et al. 2009), 2) Capex Opex decision (O'Brien, Formoso et al. 2009) and the 3) Make or buy decision by the client. The choice “make or buy” can also be described as the choice of the client for outsourcing or in-house production. In-house production is justified when resources are commonly needed and offer enough economies of scale. If this is not the case the client is better off with the decision to buy. By contrast the client has more difficulties to find a downstream supply chain that is

willing to produce resources if there are few other clients who need the same resources (Williamson 1979). When the client choice to buy it has the disadvantages the client or upstream supply chain are reduced in the power to react to undesired situations, influences the production pace and methods and the client should be aware of these undesired situations and effects (Tate, Dooley et al. 2011). The concept is shown in the following picture (Figure 3.7).

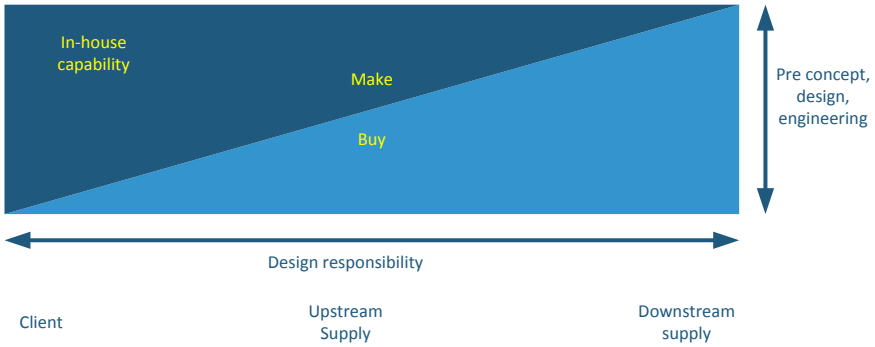


Figure 3.7: Outsourcing decisions for client (adapted from Twigg 1998)

While with the forward shift not only the demand uncertainty will be reduced for the downstream supply side, the downstream supply side also gains more influences on the project itself, which let them to reduce the risk of variation within demand (Naim et al., 1999). Still the tension between process and project as well as material flow versus information flow, remains as peculiarities within the downstream supply network. Due to these interdependency and causality the problems that occur, will flow more than ones downstream through the supply chain, which results in last minute and ad-hock adjustments on the construction site.

A representation of the effect of the role of client and the specificity of the product on the construction industry in comparison towards the manufacturing industry is given in the following representation (Figure 3.8).

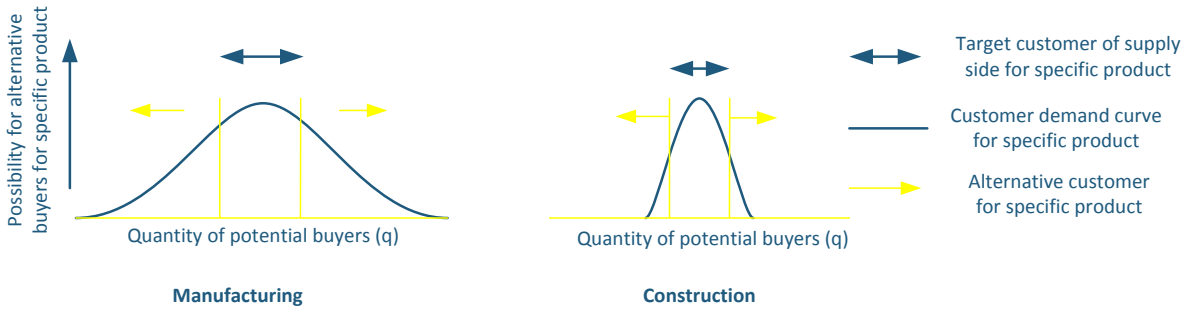


Figure 3.8: Impact of the peculiarity 'specific product' on demand and supply in construction

Due to the specificity of the product demanded by the customer it is difficult for the supply side to transfer this specific product towards order alternative customers within the market, or even impossible to the geographical constraint of the product offered by the supply side. The above described peculiarities also have their effect on the economical behavior of the supply network. Major influences on this economical behavior are as stated before the project nature of construction industry and in particular the geographical constrain within projects. Due to the facts that much of the current production process within construction require on-site assembling or creation, resources needed (material, people, supporting infrastructure etc.) for the transformation are needed within the build facility, hence are also bound by these geographical constraints. Furthermore the civil engineering market has a tendency to act as monosopy, which results in loses in revenues for the supply side, due to the price inelasticity of 1 (Carstens and van Nouhuys 2006).

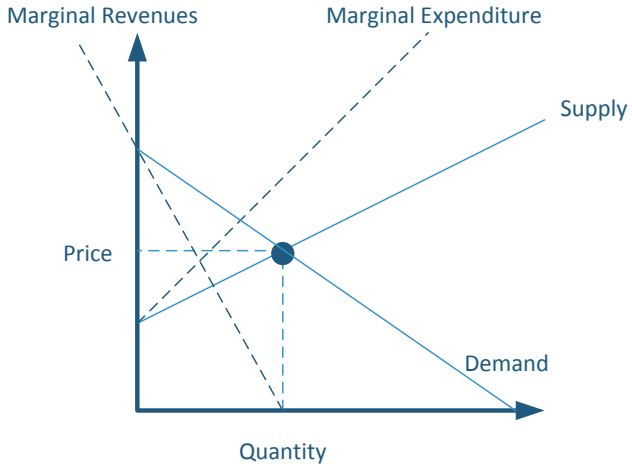


Figure 3.9: Effects of monopsony on demand and supply curves (Carstens and van Nouhuys 2006)

3.2.4 Findings

Summarizing the paragraph of the characteristics of the construction industry the following enumeration can be made;

1. Construction is process dominated, while maintain close ties to the product, seen in construction as projects
2. The projects within the construction industry can be defined as heterogenic and can be categorized in 2 major sub-markets; residential buildings and civil works
3. There are three peculiarities within construction industry; I) different delivering points within the production process II) on-site and one-of-kind geographical bound production III) dominate and influential role of the principal.
4. Due to the peculiarities within the construction industry, the economical behavior within the supply network, organizational lay-out and production process is complex of nature.

So while the characteristics of construction industry are described, these characteristics have their impact on the way the industry perceives the concept of supply chain partnerships, but theory shows that these peculiarities does not hamper possible adoption of supply chain partnerships. The next chapter will shows possible benefits of the adoption of supply chain partnerships within construction.

3.3 Construction Supply Chain Partnerships

3.3.1 Introduction

In paragraph 3.2 the specific nature of the construction industry versus the manufacturing industry is elaborated in more depth. While the construction has some economical, organizational, production related peculiarities, in this paragraph the effect of these peculiarities on the way the downstream supply network and the construction industry are arranged. Furthermore this paragraph will elaborated on the possibilities for supply chain partnerships in construction for improving their innovative capacities and in doing so creating competitive advantages in supply constellations.

3.3.2 Partnership in construction industry

The current layout of the downstream supply side and the effect of the project based peculiarity is described in more dept by Dubios et al. (2002). It signals a contradiction in the current way the supply network is organized. It points out that there are two conflicting networks. One is the permanent network, which is characterized by

long-term recurrent exchange of products and services among a limited number of firms. However these relationships still seem not tied to activities or resources of the organizations. The other network is the temporary network, where co-ordination is substantial (Figure 3.10).

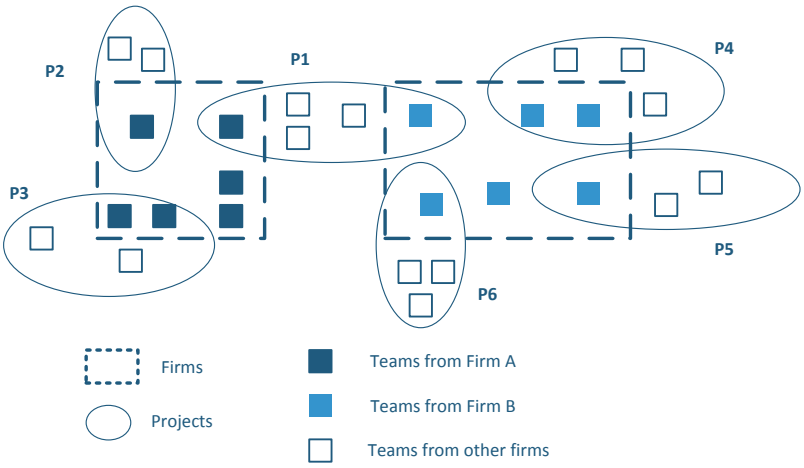


Figure 3.10: Relationships within construction industry (Gadde and Dubois 2010)

Still there is little benefit gained from shared learning as long as relationships are confined to the duration of the individual project. In order to solve this problem customized products and services could improve both efficiency and innovation for all actor categories. Firstly to reduces adjustments on the site and secondly this will stimulated development of differentiated offerings. This perspective implies the need for interorganizational view on project delivering within the supply network. Different layers within the supply side network can be distinguish that influences the construction industry, current performance and innovation, and the way relationships between parties are formed, namely (O'Brien, Formoso et al. 2009; Gadde and Dubois 2010);

1. the project level (operational and temporarily network) which is connected to the intrafirm level,
2. the multi project level (strategic and permanent network) which result in the interfirm level
3. the industry (all Dutch construction projects)(policy) level transfirm

With this different levels within the construction industry two kind of partnership within construction can been distinguished. In order to give a clearer picture the different definition of partnering alliances and strategic partnership or strategic partnerships need to be explained.

Partnering

Partnering can be defined as followed;

‘‘Partnering involves two or more organizations working together to improve performance through agreeing mutual objectives, deriving a way of resolving any disputes and committing themselves to continuous improvement, measuring progress and sharing the gains’’(Egan 1998).

This interpretation leaves room for the partnering within a project or within a broader and more strategic nature, which is not bounded by the boundaries of a specific project. The definition implies intend for continuous improvement. In order for continuous improvement to take effect, it is necessary for the relationships to have a long-term strategy, which is not project bounded, and induces high-involvement, hence the supply chain partnership[3] within construction (Black, Akintoye et al. 2000; Saad, Jones et al. 2002; Bresnen 2007; De Ridder and Vrijhoef 2007; Gadde and Dubois 2010). This is a different kind of partnerships, then when the premise for collaborative attitude and continues improvement are made for a specific project, hence

[3] Definition given in chapter II

improvement of competitive advantages for temporarily project for specific short term broader penetration of the market, also defined as precontractual cooperation (De Ridder, 2004) or partnership alliances.

Longevity

The supply chain partnership with this longevity and high involvement, gives premise of benefits for the competitive positions of firms within the supply chain. The benefits can *by symbol* as two sides of the same coin. Not only are there the benefits, which are focused on the reduction of waste within the production process to improve the efficiency of daily operation, but also the benefits in product development, hence project improvement, and continuous improvement, as well as innovation (Lamming 1993; Håkansson and Snehota 1995; Black, Akintoye et al. 2000). Looking at the supply chain partnerships in construction there are some crucial features necessary to benefits from this kind of integration within the supply network. The features found crucial are longevity, adaptations, dependency, interaction, atmosphere and mutual orientation (Gadde and Dubois 2010).

Longevity is needed for business transactions to be reoccurring regularly over a longer period of time. The main reason for longevity within these partnerships is adaptations. This is the need for both parties involved in the partnerships to make improvements to their joint performance. Adaptations not only improve performance but also create interdependencies between parties. Adaption and interdependencies evolves from the interaction between the parties. While this interaction is a continuous process, within the longevity of the partnerships, it is possible to distinguish different episodes within the interaction for the improvement of these interactions (Figure 3.11).

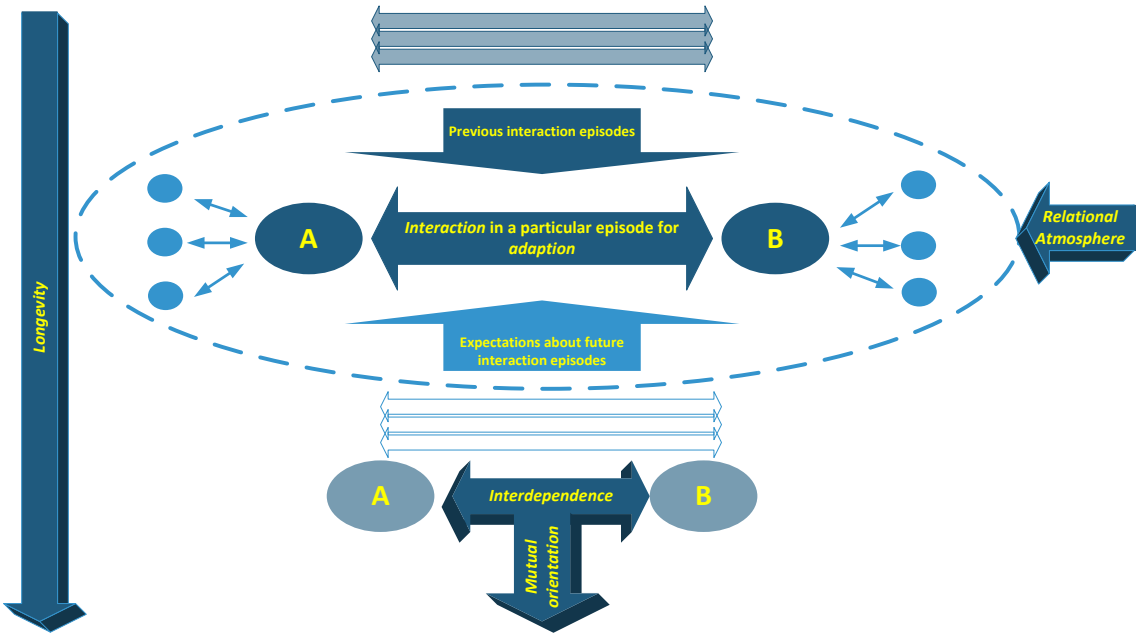


Figure 3.11: crucial features of supply chain partnership on interaction (adapted from Gadde and Dubois 2010)

This interaction takes place within the relationship atmosphere between the two parties. The atmosphere is balanced on the mixture of collaboration and confrontation. This is a balance between two parties to resolve conflicting interest with the collaborative features.

Mutual orientation

These tension and conflict are also known as the paradox of conflict and tension in a buyer supplier exchange (Cox 2004) (Figure 3.12). Due to the longevity of these interactions and the effort to improve the joint performance this creates interdependencies between parties which result in a mutual interfirm market orientation which is not bounded by projects.

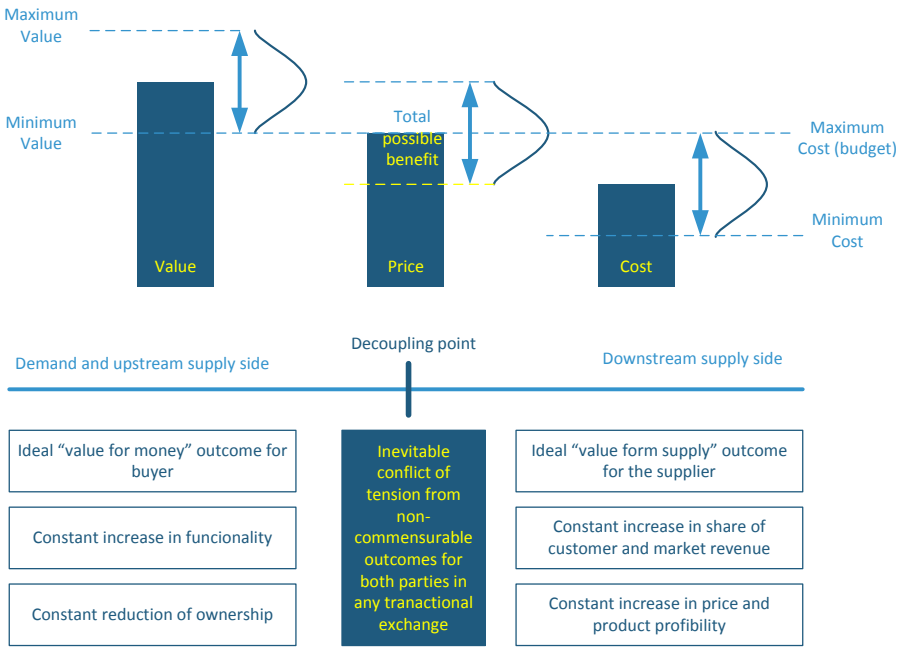


Figure 3.12: conflict and tension within demand and supply side in an exchange (adapted from Cox 2007; De Ridder and Vrijhoef 2007)

In the light of these crucial features of partnership we can see the following effects of the peculiarities within the construction industry on these features. While the longevity is necessary for the partnerships to be successful, it shows that within the construction industry, due to the one-of kind of nature and the specificity of the different project, often no long term relationship can be established. This is also shown in the way many contractors have organized their businesses. Generally the contractors have implemented a decentralized organizational structure, which often result in sub-optimalization for the organization as a whole or even for the supply chain, by the tendency of seeing the good of the project rather than the organization. This results in the fact that the businesses of the downstream supply chain are to a high extent organized for maximum profit in single projects (Frödell and Josephson 2009). This business strategy creates a huge amount of pressure on the inevitable conflict within an exchange, by wanting to create the biggest "piece of the cake" of a one-off project, instead of creating a larger cake, hence bigger total benefit. Due to this project optimization strategy the downstream supply side in construction normally tries to avoid dependence on specific business partner within the supply chain in order to create a competitive market within these suppliers base for reduction of prices in the market and to avoid the risk of dependency of on technical solution or transaction. So while parties within the supply network are interdependence for the technical project delivering, the current relationships between organizations within the supply base can be characterized as low involvement or arms length distance (Frödell and Josephson 2009; Gadde and Dubois 2010). This adversarial behavior towards dependency on specific partners hampers the possibility for continues improvement and adaption with for example TQM (Black, Akintoye et al. 2000).

While the conflict in exchange presented by Cox is inevitable, the need for change towards a joint strategy for the upstream supply side and demanding parties as well as the downstream supply side is needed to create better benefits within the construction industry, while it remains an outsourcing market based exchange on projects (Figure 3.13).

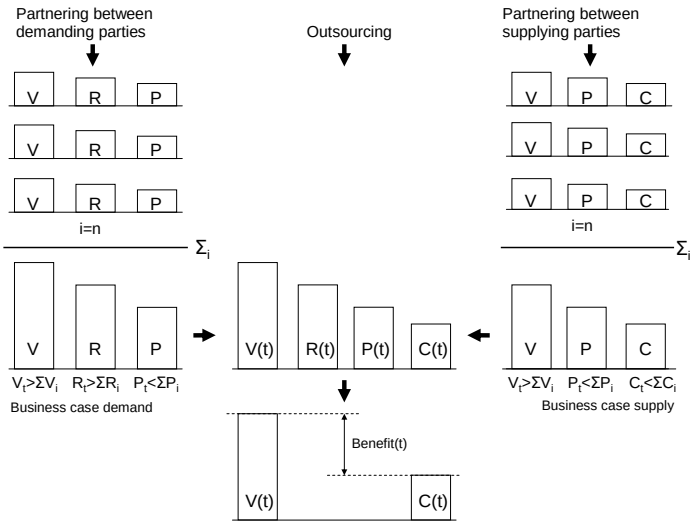


Figure 3.13: Integrated partnering within market based exchange (De Ridder and Vrijhoef 2007)

The result of the short-term project based strategy has its effects on the relational atmosphere where the power and influences of inter-organizational are expressed (Bresnen 2007). The reluctance towards adaption and dependence between business partners not only hampers the adaption but also severely constrains the possibility of mutual orientation of parties involved. A major drawback of this mutual orientation that is perceived within the market is that its stops companies to take advantages of the price competition and the more favorable deals from alternative suppliers (Bresnen and Marshall 2000), which results in the inevitable conflict within the exchange, as shown above. This approach towards the market can be seen within the demanding as well as the supplying parties and can be described as favorable approach of "playing the market" (Gadde and Dubois 2010). Furthermore within this relational atmosphere it is questionable if the buying party is the dominated party, hence has power and influences within the market. From the perspective of demanding party, it could be questionable whether the supplying side is interested in the engaging of long term relations and mutual orientation, if the impact of the contractor on the business of the supplier is relatively small (Frödell and Josephson 2009).

Summarizing the differences between a supply chain partnership and a typical relationship in construction follows in the table below:

Relationship dimension	High involvement relationships (supply chain partnerships)	Construction relationships
Longevity	Continuous business exchange over time with loyal partners	Business over a long time featured by irregularity and low loyalty
Adaptations	Mutual adaptations among firms provide benefits for improving their joint performance	Few adaptations among firms in the permanent network – requiring substantial adjustments at the site
Dependence	Technical complexity handled through arrangements leading to organizational dependencies	Technical complexity handled through standardized parts. Firms avoid organizational dependence
Interaction	Intense interaction among firms. Previous episodes impact on the outcome of a current episode, as do expectations about the future	Limited interaction among firms, intense interaction at the sites to adjust to particular project contexts. No impact of expectations concerning the future
Atmosphere	Collaborative elements balance potential confrontation related to contradictory business interest	Interaction patterns do not foster collaborative elements which makes adversarial conditions dominating
Mutual orientation	Evolves through the continuity of interaction episodes and successive adaptations leading to strengthened interdependences and relationship development	Cannot evolve since adaptations are avoided, intermittent interaction at sites leads to limited transfer of experience among projects over time. Business

	exchange is 'market based'

Table 3.1: features of high involvement relationships and typical relationships in construction (Gadde and Dubois 2010)

The typical relationships in construction together with the decentralized organization where the profit is maximized on projects and the adversarial behavior towards partners within the supply chain, does not foster the favorable conditions for innovation and learning capabilities of organizations. This behavior has also a direct relation towards the way the tendering and procurement within the industry takes places. Due to the temporally short term focus of the one-of-kind projects the tendering result to be very competitive and price driven, also in relation to the way the procurement is realized and the influences and risks given to the downstream supply side. In conclusion it shown that to reap the fruit of labor of the potential benefits of supply chain partnering the focus should be reorientated beyond the narrow project focus and current contracting formulas towards more enhanced collaboration and potential opportunities for the extension of scope of interaction within the market and supply network (Gadde and Dubois 2010).

3.3.3 Innovation stimulation and knowledge capturing through supply chain partnerships in Construction industry

One of the major of the possible benefits of supply chain partnerships within the construction industry is that with these supply chain partnerships the possibilities for knowledge transfers between projects but within the same supply constellations can be created. The knowledge transfer across multiple projects will reduce the adjustments on-site within the particular projects, hence it will reduce the waste within a project, and in this way the downstream supply side is enabled to generate more value for supply. Furthermore result show that a degree of trust and dependence in interorganizational relationships, hence supply chain partnerships, moderate the negative effects of unforeseen critical incidents (Dietrich, Eskerod et al. 2010).

Looking at the current imperative within the construction industry the organization should be changed towards increased centralization and reduced competitive bidding, in order to fully benefit the potential of knowledge transfers and knowledge capturing. It is necessary to bear in mind that while these supply chain partnerships could create potential benefits, there is a cost associated with the development of supply chain partnerships for the organization involved. Due to this cost of partnerships it is not always necessary, desirable or feasible to adopt these relationships (Bresnen and Marshall 2000). This signals the need for supplier network based on a portfolio in which there are different types of relationships rather than relying on the single relationship type that is based on playing the market and the corresponding adversarial behavior. This is also in line with the with the different exchanges mechanism given in the theories of Ellram (1991) as described in chapter II. This implies the need for strategic differentiation (Porter and Millar 1985) with regard to the level of involvement with business partners within the supply network. In regard this differentiation in relationships is perceived as constrained by the contractor's view that the only way to make profit within a project is by generating low prices from the supply base within the project (Frödell and Josephson 2009).

3.3.4 Interdependencies between layers within the supply network on innovation and supply chain partnership in construction.

Project partnering and strategic partnering

As stated before there are different layers within the supply side network, that can be distinguish who influences the construction industry, current performance and innovation, and the way relationships between parties are formed; the intrafirm, interfirm and transfirm layer (O'Brien, Formoso et al. 2009). These layers are intertwined which each other on the perspective of knowledge capturing and innovation in supply chain partnership within the construction industry. It is indentified that the network of single-project actors is shaped by the long term business network that effects, and in turn, is itself affected by the projects in which actors participate (Dietrich, Eskerod et al. 2010). While the construction industry has its peculiarities with the project based products, these peculiarities can inhibit learning from projects and therefore, prevents the efficiency in

the project based operations. Together with the decentralized business organization within the construction industry this can lead the situation where “the left hand not only doesn’t know what the right hand is doing, but also may not even know there is a right hand” (Gadde and Dubois 2010). Dietrich (2010) shows that the capability for business to capture knowledge is depended on the quality of the collaboration within the project, which on his turn is influenced by different relationship aspect between the parties involved in the project (Figure 3.14).

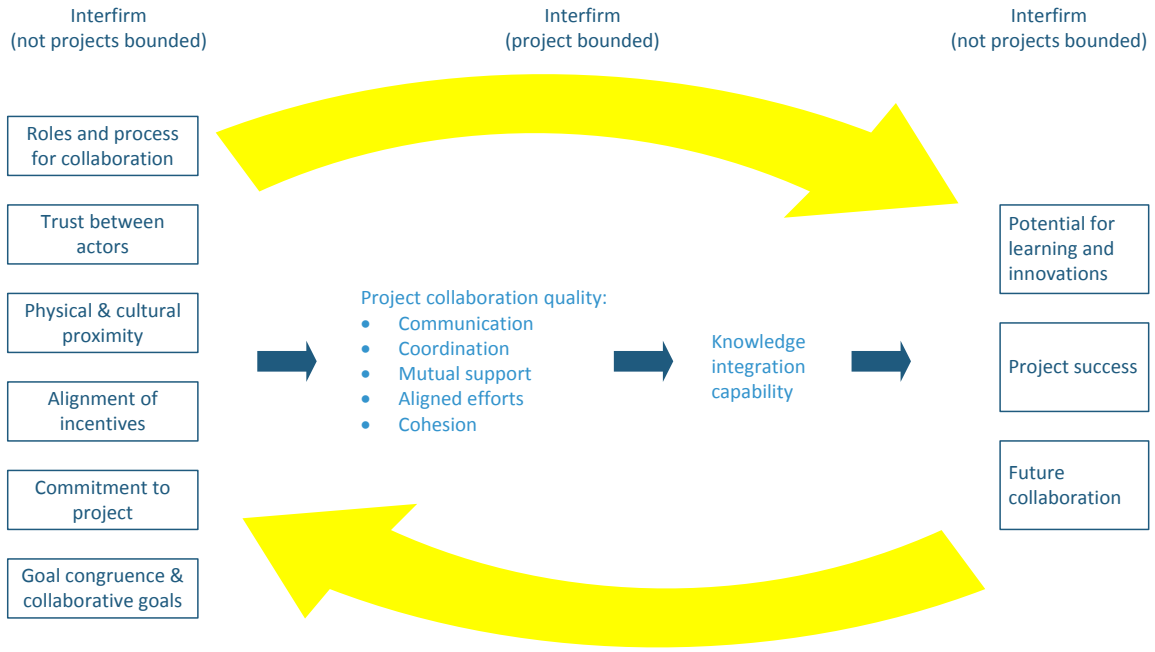


Figure 3.14: Interdependencies between project bounded innovation and supply chain partnerships (adapted from Dietrich, Eskerod et al. 2010)

Strategic partnering and environmental pressure

While the above theory shows the interdependencies between project level and company level on innovation, the interdependencies between the three different levels as defined within this paragraph and the need for supply chain partnerships within construction to create better innovation and knowledge sharing, will be established. Wu (2008) shows a framework of the interdependencies of knowledge creation between the intrafirm, interfirm and transfirm levels (Figure 3.15). Furthermore within these three levels there are different requisitions given by Shoayan. This shows that through the implementation of supply chain partnerships within construction will increase the innovation and knowledge sharing within the supply network and in doing so impacts the innovation within intrafirm and transfirm level, and in their turn, influences the knowledge creation on company and project level, and improve the creation of value within the network (Maqsood, Finegan et al. 2003). This should be facilitated, as shown in the figure, by an information technology platform which is interlinked between the business and projects within the supply network (Lönngren, Rosenkranz et al. 2010). Not only will this information technology platform enable the capturing of knowledge, it will also improve the performance of business (El-Mashaleh, O'Brien et al. 2006). Furthermore on project level this means that the information technology platform that is used on interorganizational level could be used to increase the performance of a project, hence on the project level, due to the better integration of people, process and available information systems (Bhargav, Koskela et al. 2008).

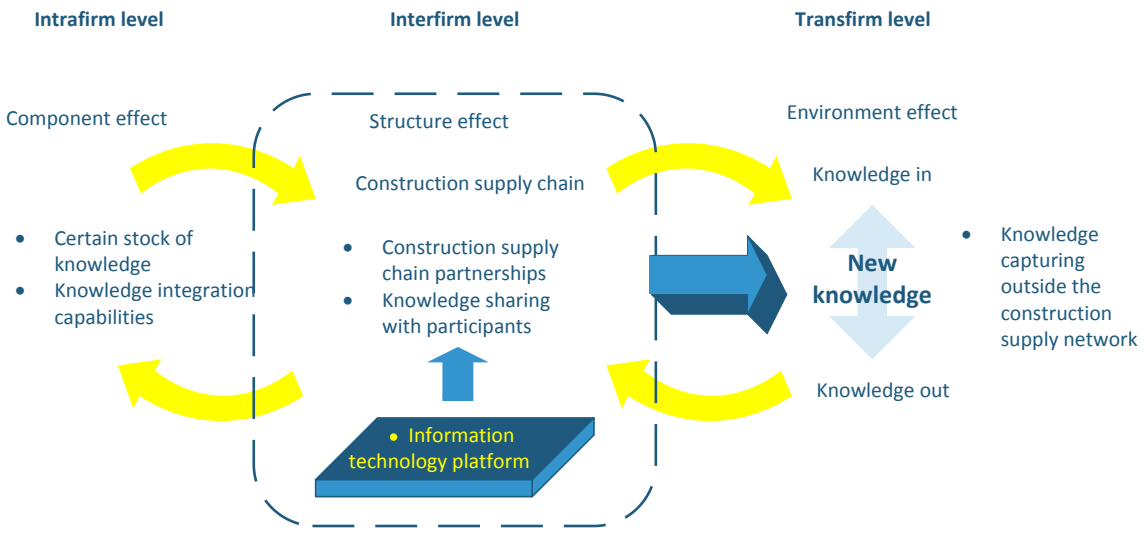


Figure 3.15: interdependencies between levels on innovation (adapted from Wu 2008)

3.3.5 Implementation issues and benchmarking by key performance indicators.

So while we have established the need for supply chain partnerships and constellations within the construction industry to create better knowledge sharing and innovation through the supply chain network on different levels (project, company, network and industry), there is a crucial element in the way supply chain partnerships are implemented on intra, inter and transfirm level. While the concept of supply chain partnering with his strategic character, is still not implemented to the full extent of the concept (Saad, Jones et al. 2002; Briscoe and Dainty 2005) there are some lessons to be learned from this attempts to implemented supply chain partnerships.

Transfirm level

Within the transfirm level there are key barriers signaled that hamper the successful implementation of supply chain partnerships policies in the real world environment (London and Chen 2006). To overcome these barriers some possible general solutions are indentified and addressed, as shown in the flowing table;

Key barriers	Possible solutions
Conflicting objectives & directives at different levels of government, agencies and/or implementing actors	Directly applicable guideline documents
Limited competence	Directly applicable tools related to the specific agency
Insufficient resources	Identification of role to develop policy implementation strategies, tools and techniques which are meaningful and context specific.
Incomplete specification	

Table 3.2: key barriers and possibilities for supply chain partnership implementations on transfirm level (London and Chen 2006)

Furthermore because of the dominated role of the client within the construction industry, the practice of awarding contracts through the lowest price tender are lowest price procurement by public agencies, is signaled as a major barrier for improving innovation and research and development within the downstream supply chain (Holmen, Pedersen et al. 2005). A probably solutions for solving the lowest price procurements is given with the possibility of Economically Most Advantageous Tender award mechanism, to stimulate the supply side in adopting innovative solutions within project and in doing so stimulating innovation within the industry (Dreschler 2009).

Interfirm and intrafirm level

The implementation of an interfirm approach and interfirm focus may call for a step-wise implementation, due to the significant transformation needed within the intrafirm organization. Result of transformation is a clear

change of the interaction and collaboration within the project teams. This may well be seen as a cultural change within the organizations in the supply chain. When changing the organization the central organization need to be aware for the fact that forcing the 'strategic partnering' upon the local project level may result in operational personal blaming their problems on the partnering instead of dealing with the underlying causes (Gadde and Dubois 2010). While this could be the case, Briscoe et al. (2005)shows that, while the general contractor of the downstream supply side is engaging partnering relations with the upstream supply side aligned by the client involved, the principal contractor and clients were reluctant to fully engage with subcontractors and suppliers (Eriksson, Dickinson et al. 2007). The general contractors were usually left to forge their own relationships with the subcontractors within the downstream supply side. Often these relationships stay arm-length, due to insufficient trust. This resulted in traditional adversarial behavior within the project teams and opportunistic behavior of all parties involved to secure their profit within the project. This is also in line with important role of central purchasing within the client and general contractors' organizations, addressed by Gadde (2010), for the development and implementation of local partnering agreements, hence project partnering agreements. This calls for two new roles central roles in the demand and supply system: The demand system integrator and the supply system integrator (Vrijhoef and De Ridder 2007) (Shown in Figure 3.16).

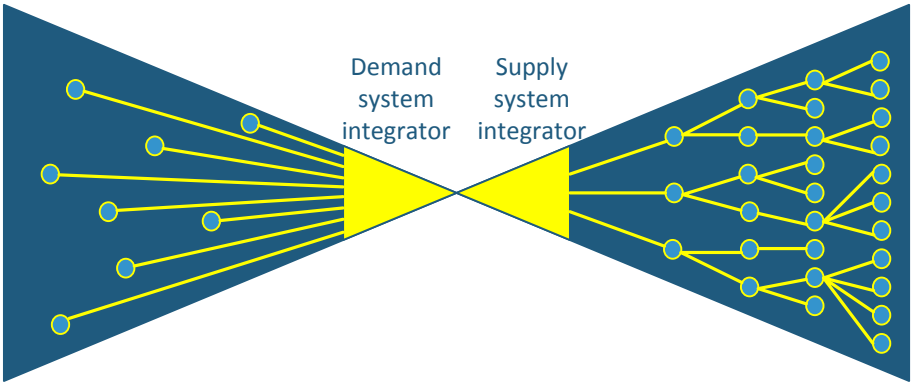


Figure 3.16: The demand and supply system integrator (Vrijhoef and De Ridder 2007)

The important task for the central purchasing department, hence supply system integrator role within the general contractors organization, is the possibility for benchmarking activities to ensure the most productive way of working are transferred over projects and across local teams within the supply base. Furthermore the central purchasing department can ensure that communication towards the suppliers within the supply base will be done in a standardized manner, and it could create a higher maturity towards the supply base in relation towards long term partnerships, which is shown to be a perceived constrain for partnerships integration within the supply base of a general contractor (Frödell and Josephson 2009).

The process for stimulating innovation within an organization is close connected towards the step wise implementation of supply chain partnerships. Key factors associated with implementation of supply chain partnerships include (Saad, Jones et al. 2002); A process comprising a number of stages including the need to innovate, knowledge awareness, evaluation of alternative innovations, planning and implementation. This is in line with the maturity model created to shows the maturity in which the supply chain, and in doing so the organizations within these supply chain, are adapted towards possible supply chain partnerships.

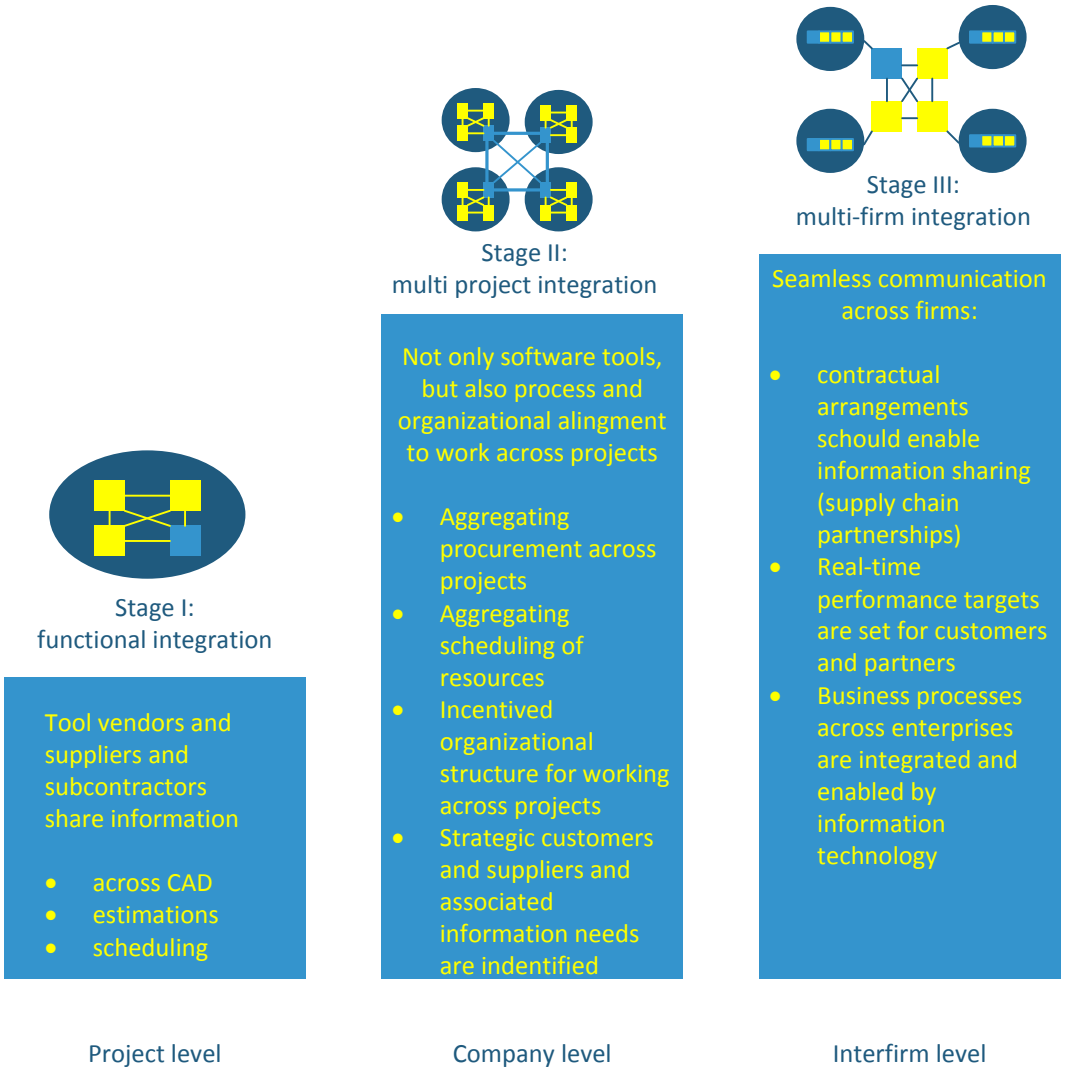


Figure 3.17: Stages of supply chain maturity in construction (aggregation from PRTM and Vaidyanathan and Howell 2007)

This clearly shows the need for well defined and integrated information platform about the organizations within supply chain, and outside the supply chain, in order to evaluated and indentify real time performances within the supply chain. In order to indentify the stages of maturity within an organization depends on an assessment of four categories; Process assessment, technology assessment, strategy assessment and value assessment (Vaidyanathan and Howell 2007). Within stage III the possibilities is created within the supply network to fully engaged a supply chain partnership in which the there is the mutually beneficial strategy and strategic constellation are formed that are not project bounded as described within this chapter. Stage III is the final step for implementation of supply chain partnerships, hence the highest supply chain integration form within the supply network, before acquisition, as stated in chapter 2. It shows in Figure 3.17 that through the stages of implementation of supply chain partnerships the need interfirm performance indicators grows to the point in which there are real time key performance can be used. In these real time performance measurements on the maturity of supply chains, the collaboration between customers, suppliers and within the internal organization should be taking into account (Aryee, Naim et al. 2008). Due to the project nature of the construction industry, this signals the need to supplement the traditional key performance indicators on individual project level with KPI's which measure long term effects of strategic partnering that include supplier and customer collaboration (Baiden, Price et al. 2006; Gadde and Dubois 2010). With this supplementation of

KPI's, the traditional KPI's of cost, time and quality should be broaden and redefined to (Yuan, Zeng et al. 2009):

- Physical characteristics
- Innovation and learning
- Stakeholder
- Process[4]

Due to this redefinition these KPI not only span the performance of the project but also of the firm and the supply base within the constellation. This task can be seen as benchmarking the supply constellation and their products hence projects within the role of supply system integrator.

Implementation issues

CSC, being in its infancy implies typically there are little to no processes and tools that are widely used for CSC at most AEC companies. There are no organizational structures that are aligned for CSC and there is little conscious effort to coordinate requirements across supply chains. All this leads to the general conclusion that the Construction industry is currently at the level I of the maturity curve (Vaidyanathan and Howell 2007). The maturity model and the rationalization of the performance indicators implies a new way of thinking and organizing the disparate construction supply chain efforts around processes, tools, and standards by recognizing the need for a conscious strategy around construction supply chains. Still there is a high unwillingness within the construction industry to rationalization the performance within the supply constellation, in order to come to clear common purpose, and openly exchange of information and the possibilities for shared learning. This result in a drive towards a cultural change in the way we look towards the construction industry and there supply networks, within the construction industry as well as beyond (Saad, Jones et al. 2002; Baiden, Price et al. 2006).

[4] **Full model of kpi by yuen can be found within the appedices**

3.3.6 Findings

Construction supply network and the possibilities for supply chain partnerships are influenced on three different levels: Transfirm, Interfirm and Intrafirm. While innovation and knowledge creation will be increases on all three levels by implementing supply chain partnerships within the construction industry it requires changes and adoptions on all three levels;

Transfirm level

On the transfirm level the procurement policy for public agencies should abandon the tendency of solely ”playing the market” with a lowest lump sum exchange, and on this level there is a need for platform outside the supply networks, which enable the capturing of the new common knowledge and technologies created within the supply constellations. Still the due to the dominated role of the client, the client and policymakers need to make a final consideration in whether innovation-related advantages outweigh the flexibility in control benefits related with the present structure (Holmen, Pedersen et al. 2005).

Interfirm level

All organizations within the prospective supply constellation should be aware that the adoption of supply chain partnerships to improve their competitive position. This requires a change of strategy within all organization on maximizing total benefits of the supply constellations for projects, instead of the current strategies of maximizing their own share within one project. Requirements for this strategy change are;

- Openness of information and information sharing within the constellations
- Longevity of interaction between partners that is not project bounded
- Mutual orientation of all organizations within the constellation based on trust and social cultural aspect within the organizations.
- Mechanisms within the constellations for sharing financial risk of the total benefits of the constellation.

Intrafirm level

- For the general contractor must take on the role of supply system integrator
- give insight in key performance indicators of own organization performance
- Knowledge sharing and evaluations of project through the entire organization

Summarizing there are huge possible benefits associated with supply chain partnerships within construction, but in order to adopt these king of relationships within the supply chain management strategy, there will be a need to look beyond the one of project and create strategies that are not project bounded and are aggregated out of the prospective supply constellations within construction.

Most of the related research within this chapter is based on a case study and or conceptual research due to the high dominance of this kind of research within the particular subject. Furthermore within the case study research on performance and innovation improvement through supply chain management, there is a high dominance of best practices and case studies within the construction industry (Gosling and Naim 2009) that is categorized as residential construction sector, even so the result of the case studies appear to be valid on the total construction industry. The conceptual research tends to cover the total construction industry as one industry, in which the two sectors (residential and civil engineering) are seen as a unified industry with the same characteristics and behavior.

3.4 Conclusion

While in chapter 2 the general strategy for supply chain integration, supply chain partnerships and supply constellation, this chapter has focused on the possibility to adopt this generic strategy within the construction industry. A major aspect of the construction industry is the process nature of the transformations made by the supply side. The strategy for businesses within the construction industry is also influenced by its character and peculiarities, which are a result of this process nature of transformation. These are; 1) project based industry; 2) geographical constrained resources allocation (on-site project delivering) 3) Dominant role of the client and 4) Different decoupling points within the supply side, which creates upstream supply and downstream supply

Due to the peculiarities within the construction industry, the economical behavior within the supply network, organizational lay-out and production process is complex of nature. Although these peculiarities are in place within the construction industry, scientifical theories show that is could be beneficial to adopt supply chain partnerships. This can be done within different layers within the construction industry form transfirm layer to intrafirm level on company and project level.
In order to create benefits within the supply constellations on innovation and knowledge it is needed to adopt supply chain partnerships. To adopt these supply chain partnership effectively different success factors are found within the construction industry theories;

1. Focus and strategy on maximizing business profits instead of maximizing project profits.
2. Benchmark tools and key performance indicators that show the interdepencies and performance of; I) project, II) firms and III) supply constellation
3. The supply chain integrator needs to create smaller suppliers base and more stable project procedures
4. There must be financial disclosure within the partnership on I) investment decisions II) capex opex decisions and III) cost and prices
5. In line with the conclusion of chapter 2 construction supply chain partnerships must have; I) Longevity and II) mutual orientation

It is needed to adopt supply chain partnerships due to the interdependencies of innovation and knowledge sharing within the different layers within the industry, hence the crucial link between intrafirm and transfirm layer. New information technology could facilitate the information sharing and knowledge sharing by an interfirm information technology platform within this layer.

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4 Framework

4.1 Introduction

This chapter will present a framework, which is part III within the report outline given in paragraph 1.5 (Figure 1.5). This framework will be the theoretical model that will be tested on its practical application within the real world. This will be done by making different propositions from the information obtained within the theoretical explorative research of the previous chapter. Within this chapter also a description of the explorative research in the form of a case study will be described in depth. While the research within the construction process and management isn't clear defined (Koskela 2008), the chosen strategy for the case study done is a scenario given by Yin (1994). It states that the most robust outcome for a case study is when the case study consists of a qualitative as well as a quantitative research. Furthermore this chapter will elaborate the research methodology (Baarda & De Goede, Verschuren, Yin) chosen by the researcher used within this research.

4.2 Propositions

The propositions made are based on the theoretical explorative research done within the construction industry

Proposition 1

Supply chain management is another business strategy for competing in the market and creates competitive advantages, which is based on the philosophy of the production theory of lean production, which was a reaction on the theory of mass production and craftsmanship within the manufacturing industry.

Proposition 2

The most integrated relationship within supply chain management strategy is the interfirm long-term relationship, also known as supply chain partnerships. Supply chain constellations created by supply chain partnerships provide competitive advantages for all businesses within the constellations of the manufacturing industry.

Proposition 3

The construction industry in comparison with the manufacturing industry has some peculiarities that affect the strategy of business. These peculiarities do not hamper the implementation of supply chain partnerships within the construction industry.

Proposition 4

The adoption of supply chain partnerships in construction is crucial for an increase of innovation and knowledge sharing within the construction industry and within the organizations within the supply chain.

Proposition 5

The forward shift of the downstream supply side within the construction process creates a strategy buffer for variation of demand, which is needed for the long-term focus needed for the implementation of supply chain partnerships.

4.3 Hypothesis

As stated in the research description within chapter 1 the main hypothesis of the research is;

Adoption of supply chain partnerships will improve knowledge and innovation within the construction industry.

In order to make clear how this hypothesis is connected and logical between the propositions based on the theoretical research and the predictions based on theoretical and practical.

Definition of adoption

- *To take up (a practice, method, word, or idea) from someone else, and use it as one's own; to embrace, espouse.*[5]

The verb 'adoption' is chosen for the characterization of future scenarios from other industries that are put into practice within the Construction industry. Within this research into supply chain partnerships, we can see that the manufacturing industry is already familiar with the concept and implementation of supply chain partnerships, and from which the current theories applied on the construction industry have been originated from. So in order to put scientific theory into practice within the construction industry, they should adopt this new approach towards supply chains.

A graphical representation of the definition of adoption in the context of the research methodology done by the researcher is shown in Figure 4.1. While the desired strategy of adoption of the supply chain partnerships is the desired situation in T_1, the point in time in which the data of the case study in collected is the present time, aka T_0. So by testing the hypothesis by using the theoretical framework insight is given what the implementation issues are within the construction industry for adoption of supply chain partnerships. Furthermore it will give insight on the gap between the desired situation T_1 and T_0. Within the case study this will result in a gap between the perfect supply chain partnership, and the current relationships in place within the construction industry. From this gap between T_1 and T_0 events, issues and constraints can be found that hamper the adoption of supply chain partnerships in full defined as implementation issues. Moreover this gap will give insight in the possible knowledge gap between the theoretical supply chain partnerships and supply chain partnerships within the real world.

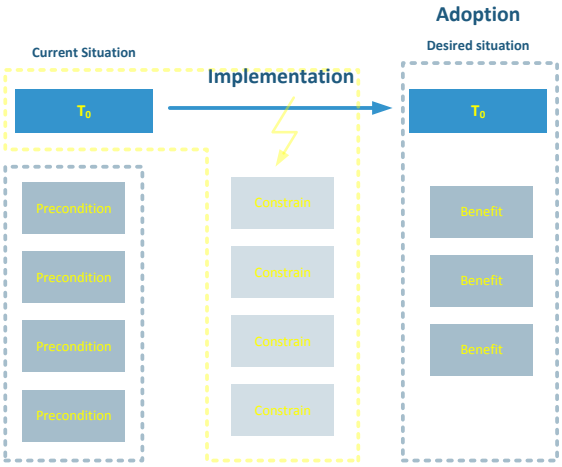

Figure 4.1: Graphical representation of adoption

[5] **Definition given by the Oxford Dictionary**

In order to come to clear understanding of the hypothesis that will be tested, it is necessary to give the researcher view on the definition of data, information and knowledge due to the embiguish nature of definitions in practice. The definitions given by the oxford dictionary are;

Definition of knowledge

- *Without construction: the fact or condition of having become conversant with a body of facts, principles, methods, etc.; scholarship, learning, erudition.* [6]

Definition of information

- *The action or fact of imparting the knowledge of a fact or occurrence; communication of news; notification. Now chiefly with modifying word, possessive, or* of*-phrase.*[7]

Differences between information and data

- *A common distinction within this domain is that data is raw numbers and facts, information is processed data.*[7]

The definition within the hypothesis will be as followed; data is the raw unprocessed numbers and facts, while information is processed numbers and facts. Knowledge is the information that is placed within a context in order to understand or have a correct idea about within the context. So within the context of the hypothesis knowledge of the construction process is a strategic resource of a company or organization that can be exploited in order to become more innovative and/or get a better competitive position within an industry.

Definition of innovation

- *Innovation is concerned with considering ways of generating ideas that will allow the organization to create new products or services or, alternatively, to improve those that already exist (mcCabe, 2010; p 176)*

So while the initial principle for the supply chain management (lean production) was the improvement of production process within the manufacturing process it can be seen as becoming more innovative within the manufacturing process in accordance with the definition of McCabe (2010). It is also in line with the continuous improvement philosophy hence kaizen. So while the lean philosophy merely looks at innovation from the improvement of existing products, innovation is more broadly defined by also looking at new products or services that can be generated by the sharing of knowledge between organizations within the construction process.

So the premise of this hypothesis is that while there are peculiarities within the construction industry and in particular within the civil engineering industry the theoretical concept of supply chain partnerships could be adopted within the construction in order to make sure that the knowledge is shared through the information within a construction project, and that in doing so also the innovation within the construction industry will increase. To research this premise of the hypothesis, predictions of the outcome are created which are tested by a case study. After the predictions that are made in the next paragraph, the research will have a confrontation with the empirical data obtained by the case study and the predictions formulated within a theoretical framework. From this confrontation we can define implementation issues for adoption of supply chain partnerships within the construction industry and also determinates the level of maturity in which the organization subject of the case study (GMB B.V.) has adopted towards supply chain partnerships. This results in new theory by insight into supply chain partnerships within construction industry and especially the civil engineering industry. This methodology of the research can be seen in Figure 4.2.

[6] **Definition given by the Oxford Dictionary**

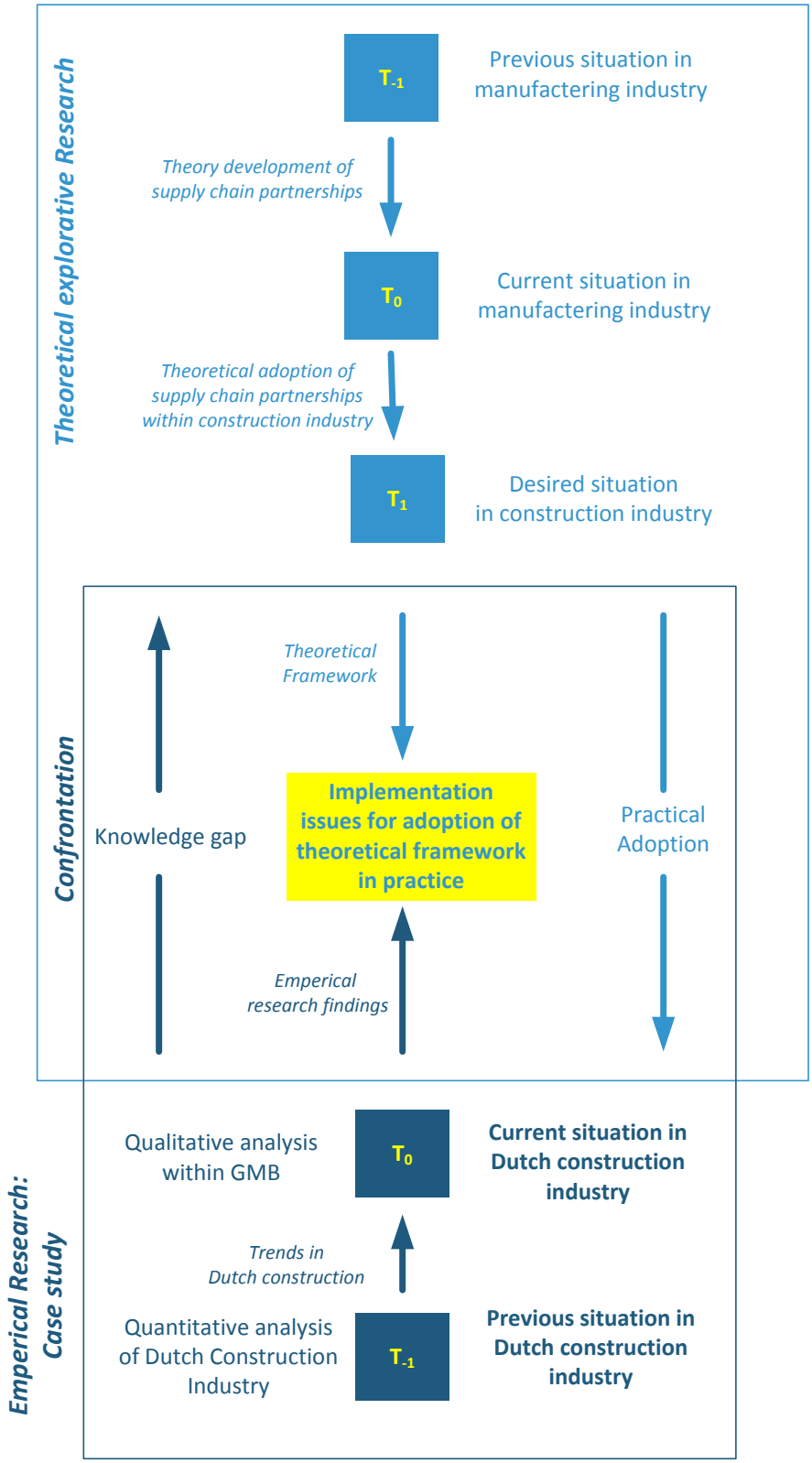

Figure 4.2: Research framework

4.4 Predictions

While the premise shows benefits for implementation supply chain partnerships from a theoretical standpoint, within the current Dutch construction industry a constellation based on interfirm long term relationships aka supply chain partnerships are not fully implemented, therefore the testing of the proposed hypothesis will be focused on the adoption of supply chain partnerships within organizations as also stated within the hypothesis. So the predictions of the hypothesis are the base of the theoretical framework consisting of implementation rules for adoption of supply chain partnerships within construction. The predictions are made on the theoretical explorative research done and the expectations of the researcher on the subject tested (Baarde & de Goede, 1997). With these prediction together with the subject of the case study a theoretical framework is made, that will be tested within the construction industry by the case study. The methodology for the case study will be elaborated in depth within the paragraph 4.5.

Prediction 1

To create higher quality, self empowerment and continuous improvement, hence kaizen is needed throughout the organizations, management, teams and individuals.

Prediction 2

Supplier development only is successful within partnerships if openness and maturity towards the supply base exists.

Prediction 3

Within partnerships there is no room for traditional senior-junior attitude and organizations within the supply chain, and they must be aware of the interdependencies and both organizations must have mutual orientation and common interest.

Prediction 4

For the benefits of transaction cost economics, the market of construction industry needs to have recurrent transaction of moderately and highly specialized assets and operate under high uncertainty and contracts must be based on neoclassical or relational contracting.

Prediction 5

Long term commitment (longevity) and mutual strategy is crucial for supply chain partnerships

Prediction 6

Within partnerships in construction, firm should focus on the competitiveness of the constellations instead of the sole focus on the competitive position of their own firm or their project.

Prediction 7

For successful implementation of partnerships in construction the decoupling point of demand organization should be more focused on CTO and on quality procurement

Prediction 8

Supply chain partnerships should be project unbounded and should be based on mutual orientation and longevity

Prediction 9

To increase knowledge creation and sharing, supply chain partnerships should be implemented and stimulated within project, company, interfirm and transfirm level

Prediction 10

Within supply chain partnerships, the performance and selection of the constellations and projects must be made rational and explicit by clients and within the constellation of organizations.

4.5 Data sampling

As stated by Yin (1994) the most robust case study is the scenario that combines the empirical quantitative and qualitative research together. This approach can be also seen within the research approach described at chapter 1. The quantitave part of the case study will comprehend a data analysis of the situation in the construction industry. Will data for this analysis can only be obtained by looking back this phase of the case study will be defined as T_{-1}. From this analysis trends within the construction industry can be found that influences the adoption for supply chain partnerships within the industry. The second part will comprehend in depth empirical qualitative research into the supply network of GMB B.V. This data will be collected by in depth oral unstructured interview. This is defined as T_0 within the research framework. While in-depth interviews cannot guaranteed representativeness of the results and finding (Malhotra et al. 2003). Although representativeness is not guaranteed a verification strategy of qualitative research is given by Morse (2002). He signals that robustness of qualitative research depends on 1) methodological coherence; 2) sample must be appropriate; 3) collecting and analyzing data concurrently; 4) thinking theoretically and 5) theory development. So while in-depth interviews cannot guarantee representativeness, when appropriated verification strategies are used however, interviews are able to give understanding and insight, to show developments and opportunities on the subject of research, in this case, adoption of supply chain partnerships. This type of qualitative research is unstructured, explorative, based on small samples and aimed to provide insight and understanding. Moreover, an interview is the appropriate method to obtain information on attitudes, opinion and knowledge on adoption of supply chain partnerships. (Baarda & de Goede, 1999). The methodology to obtain the data is done by oral targeted unstructured interviews. The oral interviews are chosen due the social aspects involved within the subject of supply chain partnerships that are difficult to obtain with written interviews.

The verification strategy for the empirical qualitative research must as stated above have a data sample that must be appropriate. This means that the data sample must consist of targeted participants who best represent or have knowledge of the research topic. This ensures efficient and effective saturation of categories, with optimal quality data and minimum dross. Sampling adequacy, evidenced by saturation and replication means that sufficient data to account for all aspects of the phenomenon have been obtained. Seeking negative cases is essential, ensuring validity by indicating aspects of the developing analysis that are initially less than obvious (Morse, Barrett et al. 2002)). In order to come to an appropriated data sample, Prediction 1 and Prediction 9, show that it necessary to obtain a completed picture through the industry on all levels of the industry. This means that the interviewed participants must come from the transfirm, interfirm, company and project level. Furthermore to make sure that the view is robust for the whole organizations of GMB the targeted samples are chosen within different location of the firm. To exclude the risk of bias of the researcher through the formulation of the oral interview (Yin 1994) evaluation meeting of both locations were attended to obtain unbiased data on supply chain partnerships within the organization of GMB. Furthermore to exclude the risk of losing data by processing the interviews, all oral interviews were recorded and the transcripts can be

found within the appendices. From the evaluation meeting of strategic partnerships notes were taken. These notes can also been found within the appendices. The targeted data sample taken can be seen in Figure 4.3.

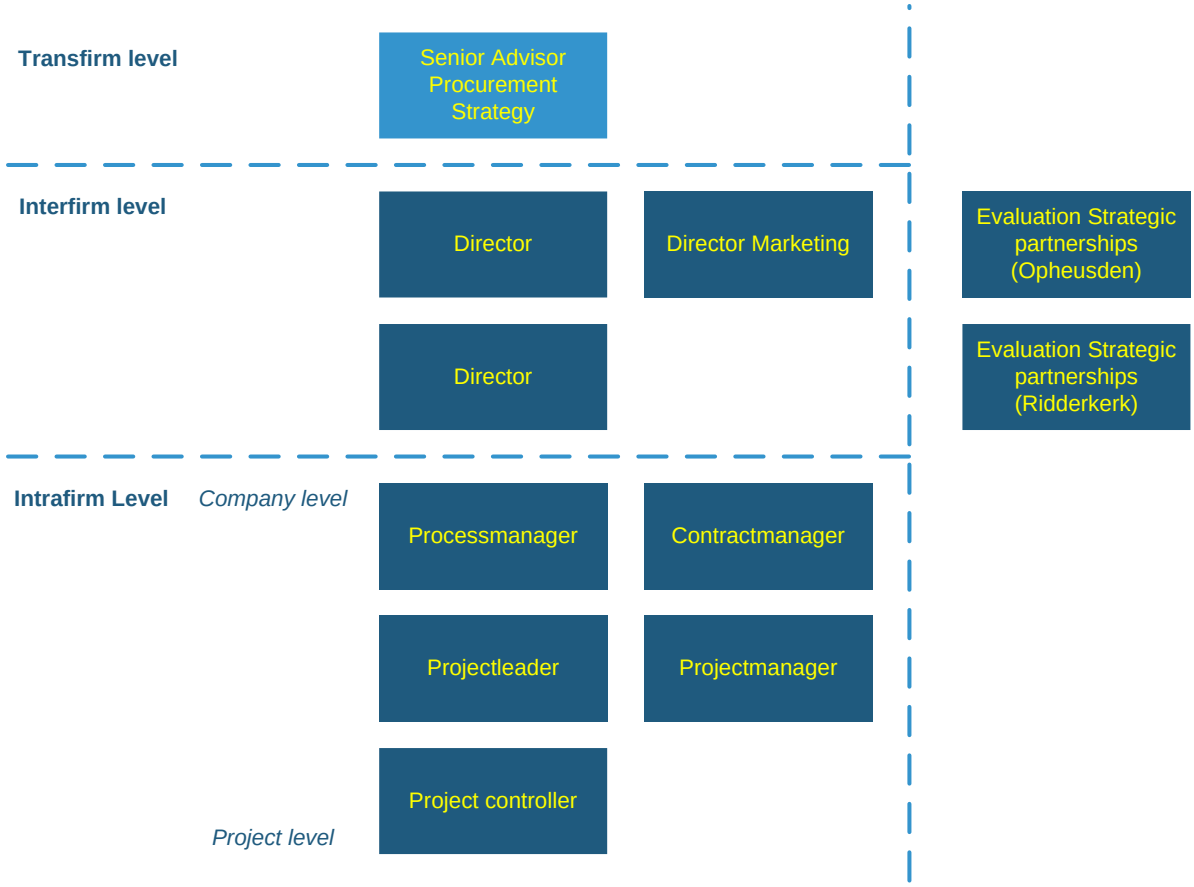

Figure 4.3: Targeted data sample

4.6 Theoretical Research Framework

As stated within paragraph 1.5 the theoretical framework will be based on the aggregation of the propositions and predictions in order to test the hypothesis. Due the nature of the hypothesis, which stated an adoption of a concept within an organization, this is transform to the three aspect of adoption; the preconditions that need to be met by the organization, the possible theoretical benefits of this action on the organization and the constraints that withholds an organizations to fulfill the preconditions. These constraints will be found by the empirical research done within chapter 6.

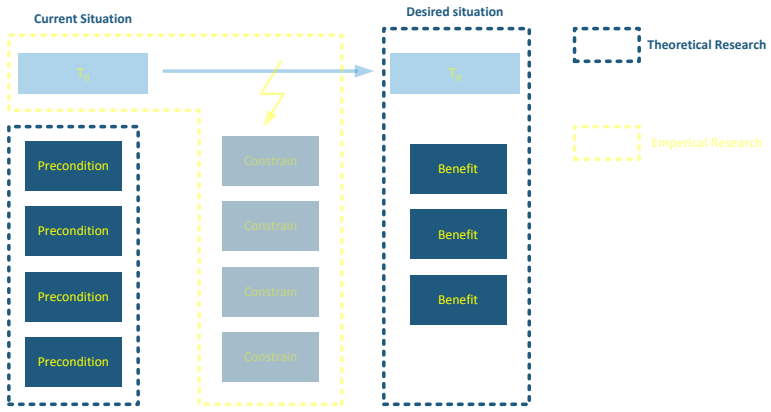

Figure 4.4: precondition and benefits research framework

Precondition	Benefits
Self empowerment and continuous improvement, hence kaizen is needed throughout the organizations, management, teams and individuals.	Working culture that is focused on perfection hence, highest value for customer
Openness and maturity towards the supply base.	Supplier development within partnerships
Within partnerships there is no room for traditional senior-junior attitude and organizations within the supply chain, and they must be aware of the interdependencies and both organizations must have mutual orientation and common interest.	Better collaboration between partners
The market of construction industry needs to have recurrent transaction of moderately and highly specialized assets and operate under high uncertainty and contracts must be based on neoclassical or relational contracting.	Lower transaction costs within the construction projects transactions.
Long term commitment (longtivy) and mutual strategy is crucial for supply chain partnerships	Improvement of innovation and knowledge
Within partnerships in construction, firm should focus on the competitiveness of the constellations instead of the sole focus on the competitive position of their own firm or their project.	Create better competitive position of firm and constellation
The decoupling point of demand organization should be more focused on CTO and on quality procurement	Successful adoption of supply chain partnership.
Supply chain partnerships should be project unbounded and should be based on mutual orientation and longevity	Better value to cost ratio.
Supply chain partnerships should be implemented and stimulated within project, company, interfirm and transfirm level	Increase of information sharing and creation of knowledge
Within supply chain partnerships, the performance and selection of the constellations and projects must be made rational and explicit by clients and within the constellation of organizations.	Openness of performance in supply chain

5 Percularities current Dutch civil engineering sector

5.1 Introduction

As shown in the previous chapter, this chapter will state the current situation of the construction industry. As explained in the research framework (Figure 4.2: Research framework) this will be done by two different data parts. One research is done by looking at economical fact and figures on data collected of the Dutch construction industry. Due to the availability of this figures and the processing of this data it is only possible to distinguish trends in the construction industry, which can be related to the current situation. These trends will be distilled in paragraph 5.2. Paragraph 6 will show the second part of data collected. This data is found by the interviews conducted within this research. The findings of both parts will give insight in the current situation within the construction industry, in order to find constraints that hamper the adoption of supply chain partnerships.

5.2 Findings Dutch Construction Industry

5.2.1 Interorganizational project ventures

Oerlemans et al. (2010) shows that in the Dutch construction industry (without the distinction between civil engineering and housing as sub industries) there is a prevalence of inter-organizations project ventures, in which these ventures can be characterized as short term (7-12 months) and that the organizations have prior experience with collaboration in inter-organizational project ventures. Furthermore it is concluded that engaging in these ventures is mainly motivated by delivering the demand for a specific product of specific service. (trend 1a) More specifically due to these motivation for engaging project ventures Oerlemans indicates that we should distinguish between two forms of prevalence: the number of firms that engages in interorganizational projects, and for those who do, the number of project ventures they engage in. With regard to the former, we find that fewer organizations engaged in inter-organizational project ventures in 2009 than in 2006. Countering much contemporary writing, inter-organizational project ventures thus seem to be undertaken by fewer organizations, not more (trend 1b). Furthermore data signals that through their project task stability, most interorganizational project ventures seem to require roughly the same set of capabilities and routines for their repeated execution. Through the prior ties between partners, they provide the ability to develop partner-specific knowledge in the form of transactive memory systems. Therefore, it is likely that many organizations engaging in inter-organizational project ventures should have an opportunity to develop “economies of repetition” and “project capabilities”.

5.2.2 Impact of low capital on forecast and interaction in market

In 2009 the availability of capital in the world is changed abruptly, due to the financial crisis in the financial sector. Data shows that this financial crisis also has its effects and impact on the construction industry. There are trends that can be signaled within the industry due to the small availability of capital. First of all the demand side of the construction industry tends to ask more offers within the market and demanding lower prices. Moreover there are fewer projects that come in to the market or projects that were planned to come on the market are postponed. (trend 2a) This is also directly related towards the tendency signaled by the suppliers and subcontractors within the construction industry (B&U and GWW). They signal that the prices are being lowered and that the suppliers and subcontractors demand shorter pay-back times on projects (EIB 2010;

Vrolijk 2010). Also is shown that the amount of the available orders in the market is hard to predict, but more of less stable for now (especially due to early public investments made availed to stimulate the economy (crisis&herstel wet)). This means that even though there is more of less stable market (due to invest by RWS) within the GWW industry, the supply side within the industry has a short forecast period if there is any. This in relation to the financial crisis and the fewer projects that are coming onto the market in housing and commercial buildings as well as civil engineering sector. (trend 2b)(It needs to be said that within the data collected by the EIB for the civil engineering industry also includes site preparation of housing and commercial buildings, while the demand is different).

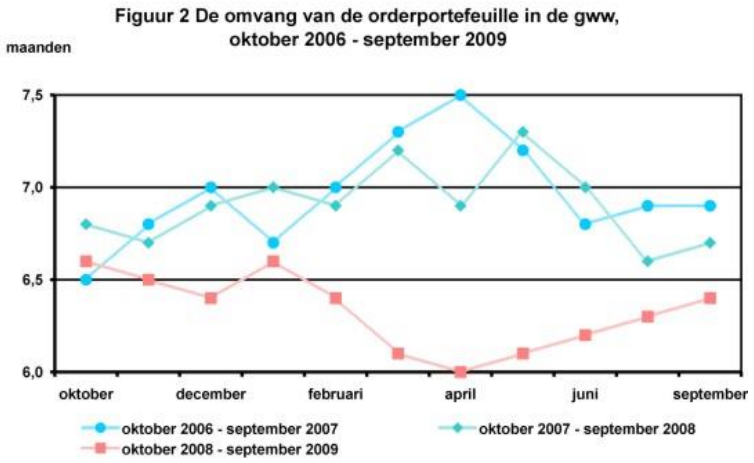

Figure 5.1: Months of orders in stock in GWW sector (conjunctuurmeting 2009, EIB)

5.2.3 Decoupling points in Dutch construction industry

Within the construction industry it is shown that there is a clear distinction in the way the decoupling point are legal formed and which of the project aspects from the supply side are decisive, in order to transfer the risk and reward from the demand side towards the supply side. As shown in figure x, there is a clear distinction between housing and commercial building and the civil engineering industry in the way that within the civil engineering industry is more transparent in the public notification of project that will come into the market. This mainly due to the fact that all public entities and organizations have to comply with European procurement regulation, in which public notification is one of the requirements. (trend 3) Furthermore we see that only a small part of the industry uses the preselection phase within the European procurement regulation, in which the demand parties have influences within the public procurement on how the supply side chain should perform (trend 4). Even so only a small part of the public organizations and companies use the EMAT procedure to look for the possible aspects as quality and time as influences on the procurement of a project. In other words the demand side is still mostly focused on price as the only free variable within the transaction between demand and supply side.

Even so together with the lowest price dominance of the demand side as decisive aspect on rewarding a project towards the supply side, we see that within the decoupling points within the construction industry and especially within the civil engineering industry, that this also result in a high dominance of Make-to-Order decoupling points, within the tasks of exploitation and or maintenance (based on the fact that contracts awarded within the construction industry are still mostly based on contracts that don't included engineering, concept development, maintenance, exploitation (figure x in appendices). (trend 5)

5.2.4 Role of third parties in Dutch construction industry (consultants, advisors, engineering firms)

In the way the demand side approach the construction industry, it is shown that for roughly 35% of the procurement is formally done by third parties. These parties are consultants, advisors and engineering firms. Informally this percentage is could be higher due to the fact that in-house external parties are not included within this percentage. We can see this in the representation of the 2% of third parties within the main government. While the procurement is formally is done in-house, the capacity within the demanding public organization is taken from third parties within the civil engineering industry. These third parties also offer capacity within the upstream supply side depending on the decoupling point between demand and supply and the knowledge that these third parties have in-house (trend 6).

5.2.5 Company lay-out within the Dutch civil engineering industry

Looking at the division of the Dutch civil engineering industry in economical terms we see that the larger part of this industry and sector stay within the lower governments and agencies (around 43%). Looking at the task division it is shown that within the Dutch civil engineering industry the task at hand are heterogeneous (EIB 2010). Furthermore if combined with the figures of the Dutch production we can see within there is a clear dominance of a public or private organization related to a task hence sector. Within the main government it is shown (EIB 2010) clearly see a dominance of Rijkswaterstaat in the road infrastructure (1.463 million euro), also in comparison towards new investments in waterway infrastructure (203 million euro) and water sanity infrastructure (568 million euro). Furthermore figures show that around 500 million of the total investment space is procured with “mega projects” which are project of 50 million of more. Within the private demand side we see that companies (prorail and energy companies) the largest amount of spending goes to the sector of tube an cables laying in the ground, seen by the private energy companies. The other dominant organization is prorail who in the Netherlands is responsible for the network of railways, which is a “semi-public private company”. So in conclusion we can see that within the different sector within the industry there are only a small amount of parties within the demand side, and that there are some dominant parties who invest the most amount of money in each different sector. This is also shown in (Carstens and van Nouhuys 2006) who concluded within each sector (pipe laying, groundworks, civil concrete construction, waterworks, and water sanity works) there are only a small amount of demand parties. (trend 7)

While within the economic production figures we can see that there is a separation in the market for investment in civil works, and maintenance (EIB 2010). This can be related to the fact that budgeting within the Dutch public offices for civil works has the same separation. There is a budget for maintanance and a budget for new investments. (trend 8)

Looking at the supply side we can see that the production capacity in the civil engineering industry in a small amount of companies (EIB 2010; Vrolijk and Holtackers 2010) that exist of 100 or more people. These are the companies that can fulfill the requirement and references asked by the demand side for bigger civil engineering projects. Furthermore we see that within the industry the last year the biggest part are small organizations with 1 till 10 persons within the company. The civil engineering industry is very fragmented with a small amount of big companies with most of the time are also the focal organization in the supply chain (trend 9) this is also were the company of GMB B.V. is positioned within the civil engineering industry.

GMB B.V.

The company GMB is active in the civil engineering industry and has its roots within the processing of sludge. This is also one of the sectors within GMB that has a low bullwhip effect within the supply chain and is around 15% of the total turnover of GMB (Figure 5.2). The other sectors which the organization of GMB is focusing on are the civil concrete works (which included water purification plants), water sanitation technology and construction and maintenance of drainage. With around 450 persons working in the civil engineering industry

GMB is one of 50 large companies (+100 employees) within the construction industry. Looking at this subset of firms, GMB is a medium sized contractor, hence focal organization within the supply chain within the construction industry, in comparison towards the small amount of large sized contractors. One major different within this subset that can be seen is that while GMB has it cost focus on the civil engineering industry only, the large size competitors, most of them also operate within the residential and commercial buildings industry.

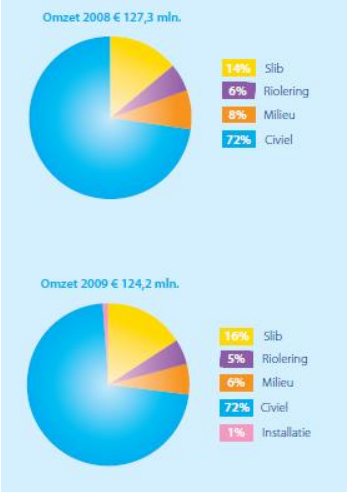

Figure 5.2: turnover GMB in previous years

5.2.6 Summary of perculairties within the Dutch civil engineering industry

Trends	
1a,b	inter-organizational project ventures seem to be undertaken by fewer organizations in the Dutch Construction industry
2a,b	Within the current economic situation fewer projects come in to the market, and the forecast period becomes shorter and have more fluctuation
3	The Dutch civil engineering industry is dominated by public organizations in the demand side
4	Only a small amount of demanding parties uses preselection within procurement to influences the supply chain
5	Still 80% of the works within the Dutch civil engineering industry is based on make-to-order decoupling point
6	35% of all procurement is done by third parties (engineering firms and consultants), and these third parties switch depending on decoupling point between demand and supply side
7	Within every sector within the Dutch civil engineering industry there are only a small amount of demanding parties and there is mostly one dominant demanding organization within a sector
8	Within the Dutch public organizations the budgets for maintenance and new investments of assets are separated
9	Within the Dutch civil engineering's industry there are a lot of (very) small organizations, hence the industry is very fragmented.

6 Perceived constrains case study Comwonen – Dura Vermeer

6.1 Introduction

While there are some best practices of lean production theories within construction projects the implementation of long term partnerships has not been fully implemented within the Dutch construction industry. Although these strategic long term partnership are still not fully implemented, some attempt have been made, which illustrated the possible benefits for the supply chain partnerships. So while the previous paragraph show scientific research on supply chain partnerships and their possible benefits for within the construction industry, the next case study will give an insight into research on a current implementation of supply chain partnership within the Dutch industry. Some of this research has been done and is still ongoing. The result of this research could be expected to be published within a scientific paper. Due to the actual nature of this research within the Dutch construction industry, there are success factors that can be found from this trial implementation. This paragraph will give some insight in the success factors that can be found within this research.

6.2 Case study "supply chain integration Comwonen – Dura Vermeer"

6.2.1 Case description

In June 2008 a residential project developer for social housing[7] (Comwonen) and a general contractor (Dura Vermeer Bouw Rotterdam) decided to investigated and research the possibilities for strategic partnerships. This research is done to find possibility for this strategic partnership in order to create a better competitive position within the market for both firms involved. This strategic partnership should result in reducing lead times and price levels and improve the quality of the housing build. These improvements should be higher than when the two parties are working in traditional way. This traditional way implies the MTO or ETO contracts placed by the project developer.

The goal for the two firms is that the research will generate a new process integrated process from the concept to construction in which there is a greater focus of both organizations on cost, lead times and quality. This is done by the concept of business process re-engineering where firstly there will be research done to the characteristics of both separate process and then determines the perceived bottleneck within these processes also known as process mapping. Furthermore, with this approach it creates the need and awareness within both organizations for change within the current processes and adaptation towards. The research already done is the process mapping of the traditional and the strategic new process of the building process, and the results of this research are already published (Vrijhoef and Wicherson 2009). Implementation of this new process made is currently ongoing. The next paragraph will give further insight into the contributing factors for implementation of supply chain partnerships, that where found during this research within the two organizations.

[7] In Dutch it is called "woningcorporatie"

6.2.2 Case study in context

The case described can be seen as a first attempt to implement towards a supply chain partnership within construction. In the context of the theory elaborated within the previous paragraph of this chapter, there are some aspects of this case that needs to be placed within context of the active theory.

1. This case is within the residential sector of the construction industry
2. The current interaction was based on a MTO competition based lowest price exchange
3. The client, hence project developer Comwonen, is within the private domain of the construction industry, so they are not bounded to European procurement regulations.

So while this research has proven to be effective in reducing waste within the construction process to between the clients' organization and the general contractor. Much of this reduction is related to the interaction within the project team and within companies. The communication of incentives, boundaries of the organizations and project teams and insight in each other processes made it possible to generate an aligned business process for the quasi firm of Comwonen and Dura Vermeer Bouw Rotterdam (process mapping). While this was possible from an economical strategic perspective as beneficial for both organizations within this partnership, the partnerships through the downstream supply chain remains to be based on the lowest price exchange within the organization of the general contractor, and remained constrained by Dura Vermeer Bouw Rotterdam

6.2.3 Perceived constrains for supply chain partnerships indentified

The result of the research done within the two organizations show interesting contributing factors for the current success of this supply chain partnerships and the traditional process. In the following enumeration key constrains will be described

- Within the two organizations (Comwonen and Dura Vermeer Bouw Rotterdam) there was no clear building process outlined in which both organizations are linked to each other, so within the interfaces of these two organizations there were a lot of parallel processes, which results in a diffuse building process in which both parties do not have a clear vision of each other's roles within the construction process.
- Especially from the client, a lot of third parties are hired for the construction of their projects. So a lot of the upstream supply side is hired while there is not enough capacity or in-house capabilities to perform tasks and make strategic decision. Furthermore this result in traditional make to order decoupling points.
- Throughout the construction process there in real-time insight of performance indicators, and even so the information needed for performance indicators on for example quality, lead time and costs, are diffuse and not openly shared. This is only when insight can be given in the information need for the performance indicators, which is not always the case.
- Although there is a risk tool at client side in which knowledge is captured, it is not used to resolve or mitigated the cause of these risks within projects. Also much of the knowledge and information is not fully passed on throughout the appropriated teams within the construction process, due to lack of mutual orientation and a diffuse decision making process through the process. Furthermore the knowledge of projects is not transferred to new projects, due to bad evaluation, project start-up and follow-ups.
- Within the start-up of projects adversarial behavior becomes explicit when the projects are created within a legal context, hence contracts. Furthermore discrepancies between budget and real price and

cost of the project come to light in outsourcing exchange, due to the fact that they are only verified within client's own organization.

- The new approach of collaboration between parties is sometimes difficult to implement because of historic informal ties and project history. This needs leadership within top management of both organization to resolve conflicts within teams and organizations or even legal matters of a conflict. Also to make sure that all parties involved remains collaborative throughout the construction process.

- The collaborative attitude and aligned incentives create social atmosphere in which previous experience and knowledge can be shared within blaming each other for previous mistakes, hence create an atmosphere for continuous improvement also known as kaizen.

- The information sharing and obtaining within the maintenance department is not fully shared within new projects. So asset-management within the project developer is not fully developed within the organization. This makes it difficult to make informed opex, capex decision, within projects where the organizations remains property owner, hence operates the project. Within the supply chain the downstream supply chain is unable to create input for the opex,capex decision within projects due to the disconnection within the client's organization.

- The client's organization does not have a clear distinction within their business process of the final investment decision for a project. This result in high uncertainty of demand within the market and within the supply side.

- A percentage sharing of monetary risk and benefits is proposed as financial mechanism within the supply side. In order for this mechanism to take place all parties involved should be willing to presented "open book" figures. Furthermore the project risks involved for all parties must be made explicit in order for this mechanism to work correctly. An example of the mechanism is given in Figure 3.18.

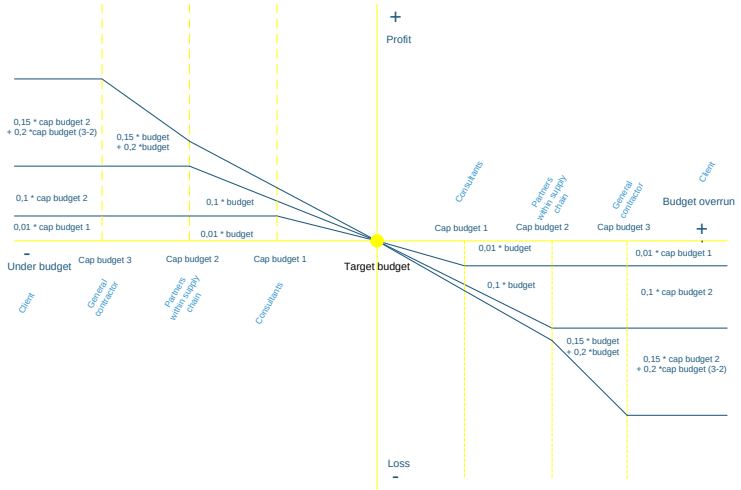

Figure 3.18: Possible financial mechanism within a supply chain partnership (Vrijhoef and Wicherson 2009)

6.2.4 Findings

The practical application of supply chain partnership within the residential construction industry in the Netherlands has proven to increase affiance within the construction industry. The future must tell if this partnership also is beneficial within a new project and within multiple projects. But from the case we can find some practical implementation factors like; I) in order to create partnerships through the supply chain, the client needs to have accurate information about his assets and their capex opex decision. II) interaction within the teams and organizations needs openness of financial incentives, information sharing and process mapping,

in order to make partnerships successful. III) Leadership within top management is needed to resolve conflicts, especially with historical interfirm relationships and IV) in the client-general contractor relationship the process of investment decision has to been made clear and must have been defined by the parties involved. While implementation factor are not all including, futher findings show that althought the attempt to integrate the supply chain is profound, the current setting is to build a tier in the supply chain with locked in buyers. While the integration is intiated from top down in the supply chain, there is no real incentive to use the innovation strength of the supply chain and therefore reduce waste. Due to the top down procedure the current effect is price ersosion within the supply chain hampering collaboration. Futhermore by doing so, comwonen is soley based on price reduction throught the supply chain instead of maximizing value for money. This is in contradiction with the virtues of a social housing organization. So while there arefour practical implementation factors that should be in place, the findings remains that the goal of supply chain partnerschip should be on maximizing value for money within the supply chain in contradiction to lowering the monety for the some value. Clearly in the case of Comwonen and Dura Vermeer this is still not the common goal.

7 Perceived constrains case study GMB

7.1 Introduction

In this chapter the results of the interviews conducted are presented. The persons that are interviewed and the reason why there are interviewed can be found in paragraph 4.5 Data sampling. Results of these interviews showed that there are different aspects that influences or even constrain the adoption of supply chain partnership. This has to do with;

- The current organization of project supply chain, which included partners of combinations, second and third tier supply chain organizations like subcontractors and suppliers, and third parties like engineering consultancy firms.
- Decoupling points in the dutch civil engineering industry,
- Business strategy that is followed by GMB to compete in the civil engineering industry
- Possibility for innovation

Due to the strategic nature of the information given by the persons interviewed the data sampling and persons interviewed are made blind for public. Also the raw data of the meetings and interviews aren't avaible for public, and therefore aren't included in the public report.

7.2 Findings Interviews

7.2.1 Current decoupling points

The demand parties places a lot of trust, delegating power, solution space of design in hands of engineering companies. Thereby they transfer their obligation for procurement towards the engineering companies. One of the reasons why a lot of projects are labeled unique is because the demanding parties find their project unique and writes the specification and requirement to the custom made solution mainly together with an engineering consultancy firm. Together with this perceived uniqueness, there are no redundancies accepted by the demand organizations or engineering firm, even if this result in a qualitative better and cheaper product (Interviewee-1 2010; Interviewee-3 2010; Interviewee-6 2010). Looking at the selection procedures for procurement used by the demand side, research show that the supply side is able to incorporate research and development of products. Even so GMB does not have experience on how to incorporate innovation and intellectual ownership

in contracts. This is the same at the demanding parties within the industry (Interviewee-1 2010). Moreover RWS notices that only a small amount public organizations give room for innovation within a project and that this is mainly constrained by lower government, who still work with traditional standard approach for procurement and authorization of projects (Interviewee-2 2010; Interviewee-3 2010; Interviewee-7 2010). The portfolio of GMB is more diversified by a ratio of 50/50 between lowest price tenders and new design and construct contracts (Interviewee-1 2010).

Research shows that even with "new" integrated contracts within the leading public organizations, the organizations lacks of accurate information about the current status of their assets is still a problem in relation to new performance incentive contracts in maintenances (Interviewee-2 2010). Due to the lack of information together with legal issues, information about the performance of civil works build by the supply side cannot be taken into account when tendering new project, hence past performance of the supply side cannot play a decisive role in awarding contracts at this moment (Interviewee-2 2010). The use of past performance within the procurement, is proven to be very difficult when taken into account the legal boundaries set by the European procurement directives.(Interviewee-6 2010)

Also due to the lack of clear information within the demanding organizations about the capacity/performance of the supply side in the industry, demanding organizations have difficulty to find competitive advantages for demand side in the supply side. Moreover there are examples that prove the competitive disadvantages for the demanding organization because of this lack of understanding the total capacity of the industry of different disciplines. (Interviewee-2 2010). Due to the fact that largest part of the projects are put into a tender by public organizations, the supply side tries to ask these public organizations for more transparency into the information about upcoming projects, in order to create better forecasts for occupation of the capacity within the industry and within the supply side, to reduce the bullwhip effect (Interviewee-2 2010). The lack of this information results in differences in capacity occupation, due to short forecasting and unknown geographical proximity towards production factors. Furthermore short tendering times that are mainly disproportional to the realization times of the projects, but within the organization of GMB they have a great influence on the choice of project that is tendered for (Interviewee-7 2010; Interviewee-8 2010).

Within RWS performance of supply side is measured based on EMAT criteria, mainly on control of the quality of the civil work. While these performance is measured within the project the organizations does not combine this information to create performance indicators for the supply side of the civil engineering industry as a whole, also because as shown above there is no past performance when awarding new projects or maintenances contracts. (Interviewee-2 2010) Looking at the municipalities and water agencies, it is perceived that the life cycle cost approach and EMAT criteria is not fully developed, and within municipal, maintenance is mainly based on traditional procedures, mostly drawn up by engineering consultancy firms, instead of economical impulse (Interviewee-3 2010). Even with D&C contracts and a EMAT score it is shown that the balance between incentives on quality and price are still disproportional(Interviewee-1 2010).

Investment space and budget for new projects by public organizations is divided in two budget streams. One for new projects and one for repair and maintenance. The choice between these two budget streams is made in a very early stage without consultation of the supply side and is mainly political motivated (Interviewee-2 2010) and therefore, choices within the a project about capital or operational expenditures is not available.

7.2.2 Sidewards supply network (partners within project combination)

Selection and creation of the combination of partners for a tender of a project are made on top management level and can be described as very diffuse. Creation and selection is done by informal relationships, in the supplying organizations, before the official public notice is done for the start of these tendering processes.(Interviewee-3 2010). The choice to participate in a project based partnership with other supplying parties' lies within top management, and is mainly based on references needed for the project and previous

experiences with the supplying partners, availability in the market hence capacity and the attainment for reference projects. (Interviewee-1 2010; Interviewee-6 2010; Interviewee-7 2010). The need to attain these references or and the specific nature in which the clients formulates their requirements, makes up for at least 50% of choices in partners, subcontractors and suppliers. (Interviewee-3 2010; Interviewee-5 2010; Interviewee-6 2010; Interviewee-7 2010; Interviewee-8 2010; Interviewee-9 2010; Wicherson 2010; Wicherson 2010)

It is possible that even within projects the strategy and alignment of contractual project partners change and diverge (Interviewee-7 2010). Due to integral, larger scale contracts we see that partnering combinations for projects in the civil industry are more common than ten years ago, in which each partner has his own strength and discipline (Interviewee-2 2010).

Between partners within a partnering combination the split of cost, risk and reward are done at the end of the tender procedure from the perspective of their own organization instead of the combination. This effect is even greater because every partner has his own discipline to deliver in the project. This results in closed book attitude within the tendering phase between partners (Interviewee-8 2010). Contracts and their specificity for the combination of partners involved are formulated and drawn within the tendering process, normally mainly after a public announcement of the procurement calendar but before start of realization (Interviewee-1 2010; Interviewee-3 2010). The split between the combination creates problems during the realization phase of a project on the interfaces and communication between the partners The planning within the preparation phase is an aggregation of the different part instead of one planning made as combination (Interviewee-4 2010; Interviewee-9 2010). From a social culture perspective research show that between partnering team it is still common that project-leaders have a senior junior attitude towards the other partners in the combination. Furthermore it shows that project leaders are not impartial on the relationship towards the other project partners. From the combination towards subcontractors the senior-junior attitude is still common attitude, most commonly dependent on the contract that is in place on a project.(Interviewee-4 2010)

7.2.3 Downward project supply network (subcontractors and suppliers)

By the selection of subcontractors the decisive factor for selection is availability of their services and material and products within a time window over the lowest price. When supplying subcontractor are involved in tender contract they are normally included in the project company as partner.(Interviewee-1 2010; Interviewee-8 2010), but most of the time, if subcontractors are in place during the tender phase, this is not the technical specialist of these organizations but a commercial director(Interviewee-8 2010). Mainly budget estimation are tranfered downwards through the project supply chain, independent of contract sort, which results in price fighting in purchasement (Interviewee-1 2010). Furthermore this also results in trade off between smooth process with subcontractors and partners versus the price of the capacity offered within the project. (Interviewee-4 2010)

Selection of subcontractors is based on specificity of project and capacity in the market on moment of tendering and realization of project. Within project is it possible to create innovation, but these are project specific (Interviewee-6 2010; Interviewee-9 2010; Wicherson 2010). Furthermore the responsibility and final decision of project supply chain is in hands of the project leader and not within a central or decentralize purchasing department. Between project leaders there is only informal knowledge exchange about which supplying parties' are purchasing from by GMB (Interviewee-7 2010; Interviewee-9 2010)

Control and deliverance of projects within GMB has high variability due to the one-of nature of the projects. This has to do with the rigid character of tender procedure and management of expectations with the client, and the reluctance of clients that use Design&construct contracts in combination with competitive dialogue from the European procurement directive (Interviewee-8 2010). Trade off must be made between high expectations given in the tender project delivering afterwards (Interviewee-6 2010). Furthermore most of the

subcontractors have problems planning their production capacity in the market and fall behind of deadlines because of it. (Interviewee-8 2010; Interviewee-9 2010)

During realization phase of projects safety issues for the working staff are difficult to control. This one of the issues subcontractors lower their control on when they are selected solely on lowest price, hence economical benefit, even when from past performance is known that it not the best fit with system integrator (Interviewee-4 2010). This also results in the fact that within the current project there is normally no open book relationships between GMB as system integrator and their subcontractors in the project supply chain.(Interviewee-4 2010; Interviewee-8 2010)

Appointments made with suppliers about material delivering on site variance between projects and are depended on the agreements made by the purchasing department. Logistics on the construction site are not commonly defined before or during realization except when this is from personal order of project leader or client. (Interviewee-4 2010) Quality controls of the product within the realization are done by the focal supply organization (Interviewee-1 2010)

Delays in time schedules during projects originate from 1) planning is made to short by GMB due to bad intelligence about the availability within the market or 2) unrealistic planning by the demand side caused by political issued deadlines (Interviewee-7 2010). Within the commercial buildings project in which the demanding party is commercial, it is possible and thinkable to create long term relations with partners or subcontractors for better realization of a work, but this is only possible if there are more of the same sort project forms or the same sort of clients. It is only possible for commercial buildings when there is enough quantity of projects where the decoupling point is by concept to order (Interviewee-5 2010; Interviewee-9 2010).

7.2.4 Business strategy of GMB

GMB is active in all civil works, in order to reduce the variability on demand within the different disciplines in the construction industry (Interviewee-1 2010). Even so the strategic market for GMB which they are focusing on is water, energy and soil. The water division of GMB has a stable turnover. The main activities that create this stable demand are processing of sludge and projects for water agencies. Within the civil engineering works there is no specific demand organization where we can get a stable turnover in the market (Interviewee-1 2010) and the main strategy remains focused on a demand driven approach where the main goal is to please the client (Interviewee-2 2010; Interviewee-6 2010). Main unique selling point within GMB infra is reliability towards the client, in other words, GMB delivers what they promise to the client as well as the supply side (Interviewee-6 2010). Key strategic position within the market is not the innovative power or specific products of a company, but the in-house capacity for integrated contract, in order to deliver way what the client has asked (Interviewee-1 2010). Findings shows that the main economical objectiveof GMB is to maintain projects in portfolio in order to recover direct cost of material of firms (Interviewee-7 2010). The focus of GMB for the short term is to stand strong on the focus on water, ground, soil, but that within our own organization we will focus on using and perfecting our their process tools within their own organization (Interviewee-7 2010).One way to differentiate in the market is to look more and more on total cost of ownership within integrated design and construct contracts instead of by products itself (Interviewee-6 2010).

7.2.5 Role of engineering consultancy firms

Engineering consultancy firms are gradually making a choice to be working on the supply or demand side of the industry, in order to lower the chance of conflict of interest about information in organizations of the supply side. The supply side needs to be more integrated with the construction parties and less in the role of a consultant in order to make better product (Interviewee-2 2010). The engineering consultancy firms make the design solution space within contracts (RAW as well as D&C) too narrow and specific, which constrains the creation of constellations in the current civil engineering industry. The use of D&C contracts should lift this

constrain if the requirements of the project are made less specific and the role of the consultancy firm isn't leading anymore within the transfer from demand to supply side. (Interviewee-6 2010; Interviewee-8 2010) It is difficult to change risk reward behavior of engineering consultancy within a combination, because risk of project are capped by the DNR contract (Interviewee-9 2010). Within the focus of GMB on water sanity and water safety, the role of the engineering company is more subordinated that in the other civil works (Interviewee-3 2010).

Due to lack of information about new project in the market, it crucial for GMB to select engineering consultancy firms before procurement of a project starts. This is done to find as much information about clients wishes through the engineering consultancy firms and possibility to influences requirements within procurement specifications. Selection of engineering consultancy firms is done on this availability of information about the client and possible project partnering intention within the market (Interviewee-6 2010; Interviewee-7 2010).

7.2.6 Innovation in civil engineering industry

At GMB staff are given means to improve their performance, and in doing so being innovative for the company. Currently there is only money for innovation available if the money invested can be returned within the project, independent of the size of investment. Innovation of GMB-staff on projects are not specifically allocated as knowledge within the organization of GMB (Interviewee-4 2010; Interviewee-6 2010). Looking at the direct return on investment of innovative products within the market from a business economical perspective it is less then profitable, sometimes even provides losses. (Interviewee-7 2010)

Innovations and extra energy to please the customer or higher performance does not have a direct effect on future projects in the market or a higher EMAT score. Additional effect is branding of GMB, which result in possibilities for GMB to influences the specification of the procurement in the market. (Interviewee-3 2010; Interviewee-6 2010; Interviewee-7 2010)

Arrangements between supplying firms are difficult, due to the high risks and capital involved. Experiences shows that non project specific innovations are difficult or even impossible, due to legal issues concerning competition (Interviewee-3 2010; Interviewee-6 2010). Even with concepts created you see that the possibility to use a concept again is just once every 2 or 3 years. Within the Dutch market we see that even with external capital and incentives there is still no business model for innovation, due to a dominance of traditional contracts in the market.(Interviewee-7 2010) Moreover there is not a lot of experiences with how to handle innovations with regard to possible "cherry picking" within the demanding organization. Moreover in the situation where there is an unsolicited proposal, this very difficult, due to unclear legal boundaries for supply side and public organizations. (Interviewee-2 2010)

In design&construct contracts the requirements are formulated by the demanding party and are mainly time specific for the project and for the market, while the solution for the problems is more standard (Interviewee-1 2010). Within private clients D&C contracts are default contract to use, and the give more room for GMB to create the products and general solutions (Interviewee-9 2010). Only once there has been an informal pre selection done within the market where supplying parties where asked about their innovative capacity and possibilities (flexfilter) and this was done informal by the engineering company. (Interviewee-1 2010)

7.2.7 Main findings case study GMB

The main findings of the research are; that the place of the decoupling point in which the demand side transfers risk and task towards the supply side is dominated by a make-to-order decoupling point. This results in project specific supply chains, which change with every project undertaken. The specificity of the requirements of the demand parties is very high and the design within the solutions space mainly dominated

by engineering consultancy companies which leaves only a small area for the supply side to improve products within a supply chain.

Also it is shown that innovation does not give the supply side direct return on investment within the civil engineering industry. The research indicates a dominance of small amount of demand parties per different discipline, and that the supply side reacts in a way, that can be described as a demand driven industry. Research also indicates that per sectors within the civil engineering industry at the supply side there are only a few firms that have capacity and have knowledge of a discipline. The economical behavior and organizational arrangement of the supply networks behaves accordingly.

The main findings give insight in the current situation and the will be used to find constraints that hamper adoption of supply chain partnerships. As also shown in the research framework, the current situation has been described above from empirical research. Together with the preconditions and benefits found in chapter 4, in the next chapter we will conclude with constraints, based on the findings above.

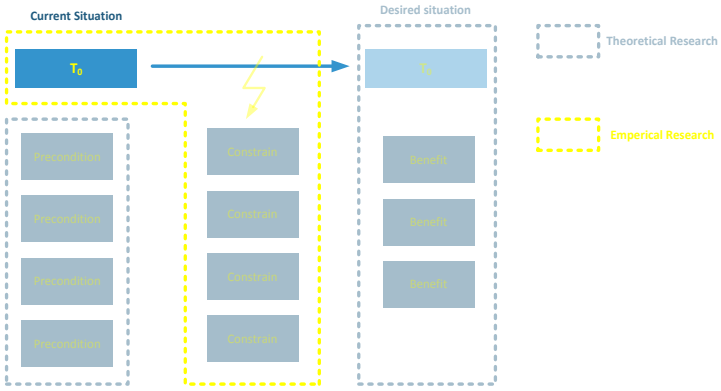

Figure 6.1: Research framework

8 Synthesis

8.1 Introduction

This chapter will provide insights in the critical constraints that can be found within the Dutch Civil engineering sector for adoptions of supply chain partnerships hence fulfilling the preconditions for supply chain partnership. Looking at the theoretical research framework there are three subjects. Within the literature study the preconditions and benfits are defined. This leaves the third part of the research, namely the percieved constraints, which will be dealt with in this chapter. Furthermore the preconditions and benefits will be deliberated in more depth, based on the findings of the case study and theoretical research done. This chapter will therefore give insight into the relation between empirical findings and the scientific research on the subject of long-term highly committed interfirm relationships.

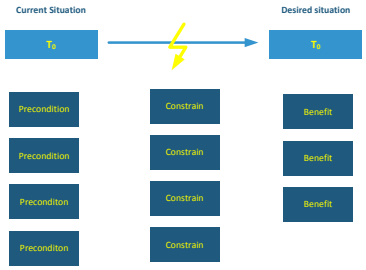

Figure 7.1: completed research framework

8.2 Synthesis

The goal of this research is to identify possible constraints for adoption of supply chain partnerships within the construction industry. To find answers following question need to be answered;

What are the preconditions for organizations in the construction industry to integrated their supply chain through adoption of supply chain partnerships, and identify perceived constrains by the construction industry for not fulfilling the perconditions for supply chain partnerships?

In order to answer this question there are three sub questions needed to be answered. The first sub question has been formulated as followed;

1. **Where does the concept of supply chain partnerships derive from, what is the philosophy and characteristics of supply chain partnerships and which precondtions have to be met?**

Looking at a new way to improve the construction industry one of the possibilities is the new understanding of supply chain management. Supply chain management theory derived from Toyota production system, which gave a new view and concept on the manufacturing industry beside the mass production theory founded by Ford. This resulted in the lean thinking philosophy in which the search for perfection and value creation are the focus point of the philosophy in order to increase the performance of the production process within the manufacturing industry while also creating a theoretical foundation within a broader perspective, including the organizational and economical perspective. This lead to thinking that there is room for a new ways of organizing the supply chain in order to increase the performance of construction and become economically more competitive within an industry based on the lean philosophy. One major precondition for supply chain management to be effective is that a sector needs to have the possibility to create long term collaborative

relationships within sourcing clusters, beside once-off obligated legal transactional exchange relationships. This long-term collaborative relationships hence supply chain partnerships, is the most integrated interfirm supply chain relationships. From this theoretical background we can concluded that not all preconditions needed to create supply chain partnerships are fulfilled, as concluded below, corresponding per precondition;

Precondition 1: Self empowerment and continuous improvement, hence kaizen is needed throughout the organizations, management, teams and individuals.

From the findings, based on the data analytics we can concluded that the organizations of GMB, is focused on innovation and continuous improvement, by means on GMBeter to motivate their staff. Furthermore we can see that GMB invested time and money into human resources by different in-house classes. Moreover it is shown that small improvements from the working staff are taken into account and are funded if they deliver value within a project.

Precondition 2: Openness and maturity towards the supply base.

There is little openness and maturity towards the supply base. The findings show that there are two types of supply base. First of all we have the project coalition partners within a combination. Between these parties is it shown that during within the tender phase everybody has their own agenda and these goals and change per project and even within a project without the other party directly know about, but see the effect within delivering of the project itself. Second, the other part of the supply base is with the suppliers and subcontractors. Within this supply base there is no complete openness with regards to how supply base produces their product and what the strategy of the different subcontractors and suppliers are. Thirdly, if we look at the way GMB acts towards the engineering companies, we can see that maturity is low, due to the fact that GMB does business with all large engineering firms depending on the project and contract.

Precondition 3: Within partnerships there is no room for traditional senior-junior attitude and organizations within the supply chain, and they must be aware of the interdependencies and both organizations must have mutual orientation and common interest.

The organization of GMB is aware of the fact that it cannot perform and deliver project by themselves and find common interest when searching for capacity and knowledge within the industry. When looking in projects the senior junior attitude can be still found and research shows that within a project at that moment there is common interest to deliver the project. This common interest and mutual orientation are not always aligned and this alignment can changes during the realization of a project and mostly isn't aligned after realization and delivering of the project.

Precondition 4: The market of construction industry needs to have recurrent transaction of moderately and highly specialized assets and operate under high uncertainty and contracts must be based on neoclassical or relational contracting.

Within the civil engineering industry where GMB mainly operates we see that there are recurrent transactions of highly specialized assets. This is especially the case with specialized equipment that GMB owns for the production technique of civil engineering. Furthermore we can see that the forecasting time of orders in the portfolio within the supply side is short, and due to the tender procedures also highly uncertain until the project has been procured. The different contracts that are in place are mainly based on the neoclassical contracting between demand and supply side.

Precondition 5: Long term commitment (longtivy) and mutual strategy is crucial for supply chain partnerships

We see that GMB as organizations does not have long term commitments with partners within the supply network that are tied to a mutual strategy of firms outside of the strategy of GMB. What is shown in the research is that under pressure of economical impulse and contracts of the demand side or capacity time restrictions, partners are chosen per project and not always within have the

same mutual strategy. Agreements for long term product innovation and exploitation, are based on of one project or products as seen with the boxbarrier and YOSS system within GMB

Precondition 6: Within partnerships in construction, firms should focus on the competitiveness of the constellations instead of the sole focus on the competitive position of their own firm or their project.

Research shows that within the civil engineering sector, companies are focusing on the competitive position of the partnering combination instead of focusing solely on the competitive position of their own firm. This is only based on the requirements and specificity of one project and this does not concern the competitiveness of the constellations when this constellations is not tied to project but tied to long term commitment.

Precondition 7: The decoupling point of demand organization needs to be focused on CTO and on quality procurement

As shown in the research the decoupling point within the civil engineering industry is on a make-to-order decoupling point. The main impulse for procurement is lowest price still. We can see, based on our findings that a shift in the decoupling point within the private sector, but the public entities stay behind. We can also concluded that the public organizations not also one the status of their assets and the quality of the build in the long term. Together with the legal boundaries of the use of past performance makes that the industry has difficult to procure project based on performance and quality.

Precondition 8: Supply chain partnerships are project unbounded and are based on mutual orientation and longevity

It can be seen that the economical impulse to organize the partnerships on a project base are still decisive in comparison towards partnerships that are not project bounded. Also seen, based on the findings is, that while there are some example of product innovation in which the partnership are not directly bounded towards a project., over the portfolio of project the partnerships based on longevity and mutual orientation.

Precondition 9: Supply chain partnerships should be implemented and stimulated within project, company, interfirm and transfirm level

Looking at the different levels findings show that within project and company there are signals that supply chain partnerships is stimulated, as it where partnerships for the long term partnership. Although looking at the higher levels of the interfirm and transfirm, it stay within partnerships on project base and not project unbounded partnerships.

Precondition 10: Within supply chain partnerships, the performance and selection of the constellations and projects must be made rational and explicit by clients and within the constellation of organizations

It can be concluded, based on our findings, that the selection of partners, suppliers and subcontractors is highly depended and decisive on the availability of capacity within the time frame of the project together with needed qualifications and in-house knowledge. These selection criteria are not made explicit towards client and or the constellations. Furthermore we see that there are no explicit performance measurement through the supply chain of a project, expect from evaluation within the organization of GMB, but these experiences are not communicated through the entire supply chain.

As shown above not all actions needed to adopt supply chain partnerships are met. So we can conclude that long-term highly committed interfirm relationships are still not fully adopted in the current situation of the Dutch civil engineering industry. Therefore it is not possible to fully reap the theoretical benefits of adoption of supply chain partnerships. The assumption made that with the current civil engineering industry there are no supply chain partnerships is proven to be true.

Now we have answered the first research sub-question. The goal for this research was as stated before to indentify the perceived constraints for adoption of supply chain partnerships. So while we now know that there

is no supply chain partnership within the Dutch civil engineering sector, we can now look at constraints that hamper full adoption of supply chain partnerships. The research into these constraints has been formulated in the following research sub question;

2. **What are the perceived constraints within the construction industry for not fulfilling the construction specific preconditions?**

Constrain 1:

In conclusion research shows that one of the major constrain regarding the civil engineering industry is that 90% of the contracts put in place are based on detailed specific products, hence projects (RAW contracts), which shows the high dominance of make to order decoupling point. Theory on competitive advantage show four kinds of strategies that firms can follow in order to create competitive advantages in the market. The dominance of the make-to-order procurement results in price fighting in the construction industry. Due to the fact that quality and time of projects are fixed albeit there is only one way to create competitive advantages within the supply side, by following the strategy of cost leadership. While GMB has a business strategy that is based on differentiation focus, we can concluded that even they tend to fall back to cost focus and cost leadership strategy. This results that the organization is currently stuck in the middle, while wanting to get towards a differentiation focus strategy which is innovative driven. Theory shows that while supply chain partnerships are just another way to compete in a market, the public organizations, which hold 80% of the civil engineering industries demand, do not leave room for other ways to compete in the market, besides cost leadership strategy. This effect is shown in Figure 7.2.

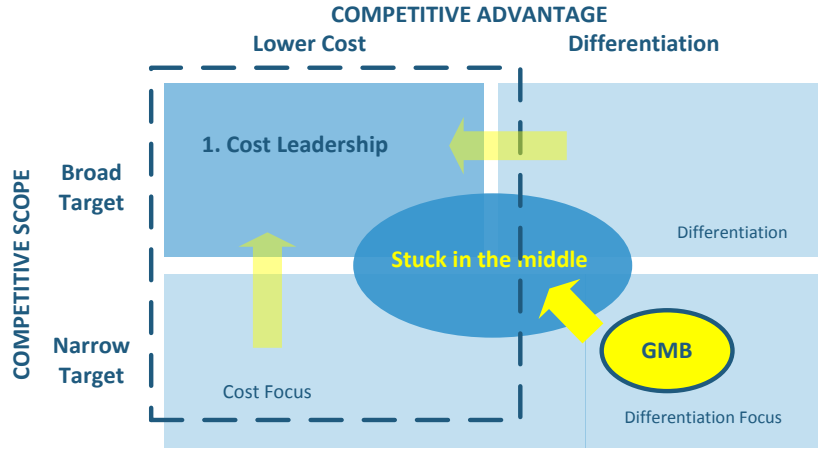

Figure 7.2: Dominance of business strategy in civil engineering industry and position of strategy of GMB

Constrain 2:

The theory shows, that in the construction industry there is a possibility to choose different decoupling points for the demand side, from concept-to-order decoupling point towards purchase and make-to-order decoupling point. This is no problem if there is a strict split between the supply and demand sides of organizations within the market. This is currently not the case. The engineering consultancy firms have focused their business strategy on concept-to -order till make-to-order decoupling points. This makes it possible for engineering consultancy firms to transfer between demand and supply side and take knowledge of each other problems and solutions within projects, while risk and reward of the construction aren't transferred from the demanding party towards the supplying party. Due to this discrepancy between the two sides, the engineering consultancy firms themself also becomes inpaired in the strategy choices they have to make. With each project they have to deside if the tender given by principals for creation design and or engineering are more likely to be profitable than the counterpart offer that will occur in the private supply side for the remaining work. This effect is shown in figure below. The engineering firms need to decide at the very first start of a project if the work load is large enough to tender by the demand, side or that the prospect of work package on supply side are more

profitable. From a business perspective the engineering firms that have chosen to tender on the demand side, are from a strategy perspective incentived to push the decoupling point towards preparation as much as possible as shown in the figure by project A. In project B till E the trade-off choice of the engineering consultancy firms over time. This trade-off result in tension between the demand and supply side on the decoupling point in the perspective to the risks and rewards transferred between demand and supply.

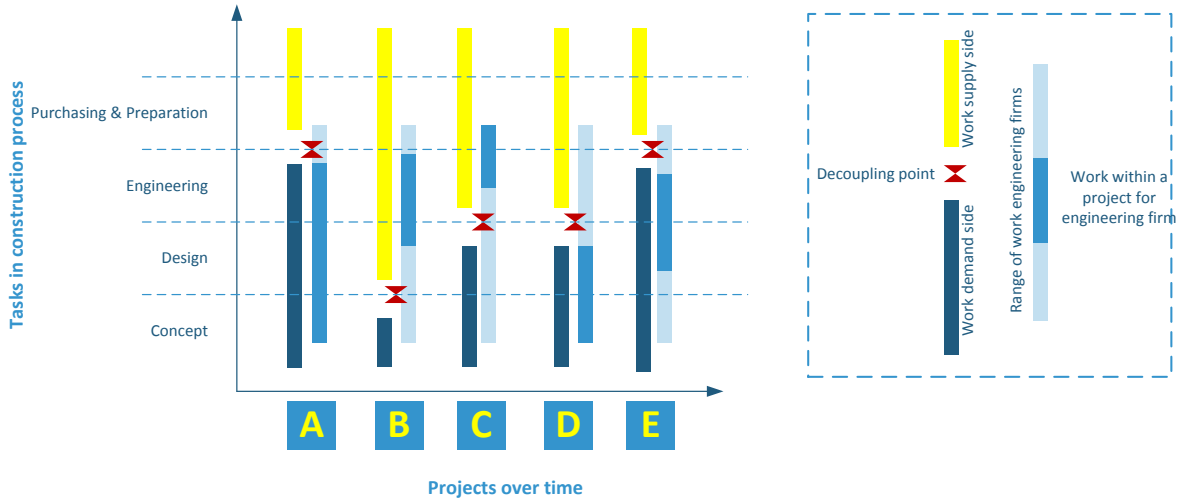

Figure 7.3: Effect of consultancy firms in demand and supply side

The role of the engineering cosultancy firms in the construction process results in information and material flows that are still disconnected from project supply chain, as shown in Figure 7.4. Due to this disconnection the adoption of supply chain partnerships are hampered.

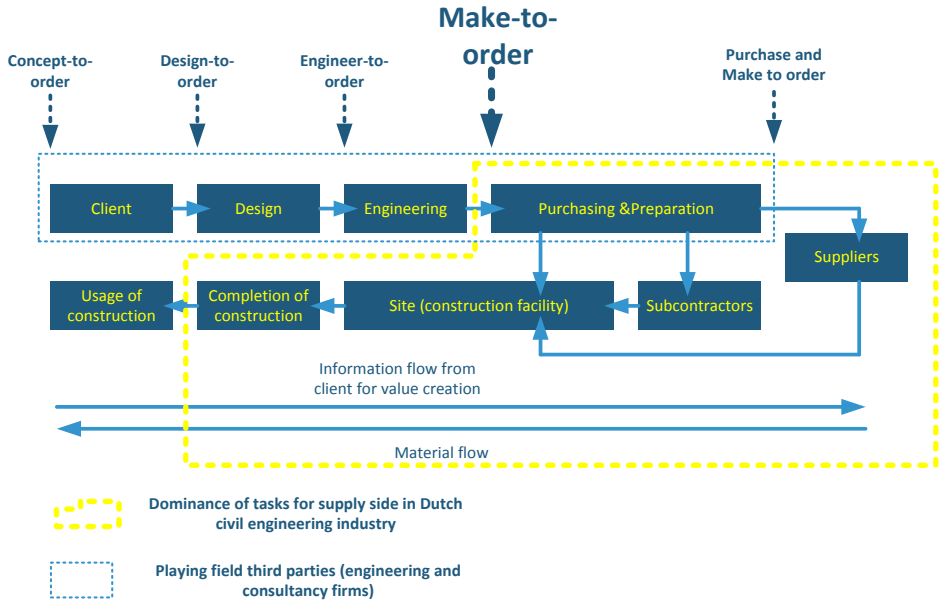

Figure 7.4: Impact of dominance of make-to-order on the role of engineering firms

Even so when innovation or specific products between supply side and engineering consultancy firm are developed, is it difficult or even impossible to put these new concepts into procurement specifications. Due to conflict of interest, engineering consultancy firms cannot and may not specify the new concepts, when hired by demand side. Findings also show that the engineering consultancy firms, specify the requirements of the products or projectsso that at least 50% of the first and second tier of the supply side, unintentionally or

intentionally, is chosen for by the demand side. This effect is also seen by the strategy of GMB which is focused on influences the way in which the client and engineering consultancy firm specify the requirements for a particular project, in order to win the tender of the project. It can be concluded that within a project, the focal organization can changes, depending on wich tender bid is choossen.But what we see is that the focal organizations, need the same second tier organizations and are limited in the selection of partner within the supply chain. This also shows in the findings that there are only project based supply chains. This could indicate, as suggested within the supply chain theory, that while the project might act as a value chain, the civil engineering sector acts like a value shop instead.

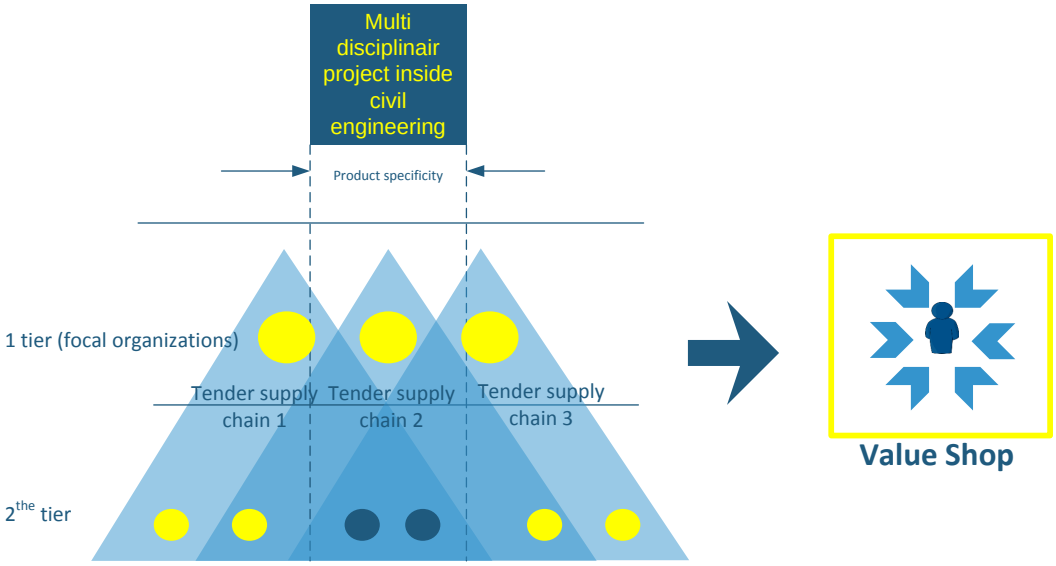

Figure 7.5: impact of specificity of projects on the supply side

Constrain 3:

From the findings we can also concluded that if the demanding parties changes towards the decoupling point of design-to-order. This results that the consultancy engineering firms are not as dominated towards the specific of the project requirements as there are in the make-to-order decoupling point. Even if projects are integrated between different industries together in a multidisciplinary project, a constellation cannot be formed in the supply side of the Dutch market. This constrain follows from the findings that the geographical characteristic together with the integration into existing environment, in which the second part is inherent of the fact that it comprehends a civil project, creates project specificity within the Dutch market due to heterogeous soil circumstances. This specificity result, in the same way as the specificity of product in MTO projects, that the 2th tier project supply chain is dependent on the geographical location project and therefore is project based.

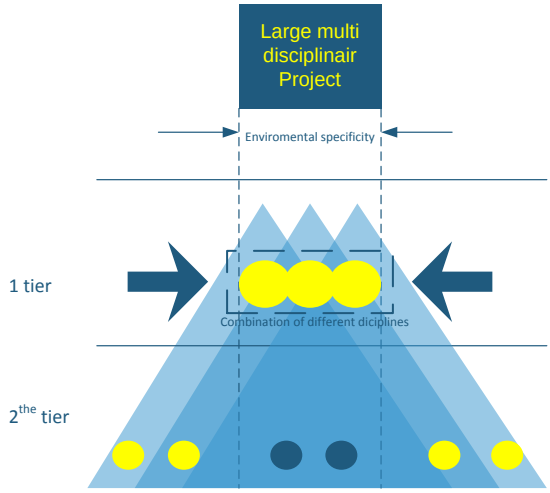

Figure 7.6: effect on D&C contracts hence design-to-order decoupling point

Constrain 4:

Looking at the theory of information and material flow within the project supply chain, it shows that the client is disconnected from the usage of the construction. While this schematization represent the total construction industry, findings show that if we combine this schematization together with the lay-out of the demanding parties within the Dutch construction industry, it can be concluded that there are basically two kind of supply side within the construction industry. Both kinds act differently on the lay-out and organization of the supply side. As explained within the theoretical research, theory is mainly based on data within the residential and commercial building sector of the construction industry. Results of this research show that in the sector of civil engineering the demand side act different with regard to the residential and commercial building industry. This difference is that within the housing and commercial industry there is a high amount of potential buyers in the market, whereas within the civil engineering industry the possibility to transfers specific product towards alternative buyer are far more limited. This is intertwined with the fact that the civil engineering projects are made for the public interest and that there are no directly assignable end-user who profits from the created value of the projects delivered by the supply side.

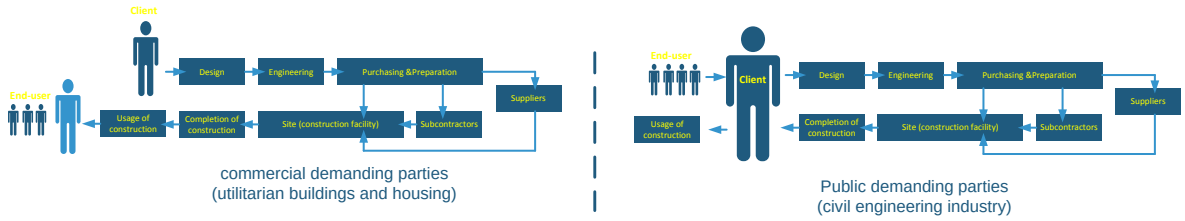

Figure 7.7: difference between housing and commercial building sector and civil engineering sector industry

These economical characteristics of the civil engineering sector and project specificity that results from the integration into existing environment, ensures that within the different disciplines in the civil engineering sector there are only a small amount of demanding parties in the Dutch market, which provide for large amount of the total demand, hence project capacity from the supply side. This result in a time constrain of capacity in Dutch supply side.

Especially because in a time frame given, the information about forthcoming demand is through a non transparent short term notices. This leaves the supply side with little to no room to anticipate or act proactive in activating competitive capacity within the first and second tier of the supply side, while the project is constrained in total time. In the findings this is shown by the fact that selection of project partners and or subcontractors in the supply side are time constrained by the capacity in the market at that moment. This effect is even greater due to the fact that budget and investment decision are political motivated and

structured in a way that maintenance (long term capacity in the supply side) is disconnected from the short-term investment budget for new projects and big renovations in all public organizations.

With these constraints for adoption of supply chain partnerships within Dutch civil engineering industry indentified, it is possible to answer the following research sub question;

3. **How do the peculiarities of the construction industry affect the concept and characteristics of supply chain partnership and under which construction specific preconditions could this be beneficial?**

Research shows that while the theory indentifies characteristics of the construction industry as peculiarities that do not hamper the adoption of supply chain partnerships, and that this is also true within the housing and commercial building sector of the Dutch construction industry, some of these peculiarities are perceived as decisive constraints for adoption of supply chain partnerships in the current Dutch civil engineering industry. Furthermore theory shows that adoption of supply chain partnerships and the creation on constellations increase innovation and knowledge sharing in the supply chain and therefore increases innovation in the Dutch construction industry. In the current Dutch civil engineering industry, based on the findings of the case study done, full adoption of supply chain partnerships hasn't occurred yet. Therefore only future practice can give insight about achieving the proclaimed benefits if it is possible to adopt supply chain partnerships in the Dutch civil engineering industry.

Research does however show that innovation of products or processes does not directly create better competitive advantages and therefore there is no direct return on investment made for innovation. This is mainly due to the dominance of make-to-order in the Dutch civil engineering sector. On the first place there are product innovations that can be found in the organization of GMB, and within horizontal combination in the civil engineering sector, but this is hampered by national and European regulation and there is low experiences on how to handle product innovations in procurement, both on demand and supply side. Looking at process innovations, they can be found within projects. However these process innovations are project and supply chain bounded and are not explicit transferred as knowledge in the organizations of the project based supply chains, even if these process innovations are done at the DTO decoupling point in which disciplines from different sectors work together as project partnering combination.

9 Conclusion & recommendations

9.1 Final conclusion

1. **Where does the concept of supply chain partnerships derive from, what is the philosophy and characteristics of supply chain partnerships and which preconditions have to be met?**

The concept of supply chain partnerships derives from the impulse given by production perspective from the Toyota production system. The way of handling the supply chain as focus organization showed another view and approach than the production philosophy by Ford. It leads to the concept of supply chain management which goes beyond the perspective of solely production. While supply chain management is "just another way to compete within a market", the most integrated way in doing so is by supply chain partnerships. These should be adopted from an intrafirm perspective within the top-management of all organizations within the supply network. This should be done while having a strategic goal in mind, that fosters long-term relationships, hence having a long term business strategy which included supply chain partnerships. In these long-term relationships value creation and innovation of excisting product and processes or new product, towards perfection, should be embedded within the culture of all organizations in the supply chain.

2. **How do the peculiarities of the construction industry affect the concept and characteristics of supply chain partnership and under which construction specific preconditions could this be beneficial?**

Theoretical research shows that while there are specific peculiarities in construction industry (geographical bound, outside in unstable working conditions, different decoupling points and role of prinicipal) this does not prohibit the adoptions of supply chain partnerships, in order to increase knowledge and innovation within the construction industry. As shown in the empirical research, the adoption of supply chain partnerships is still constrainted and the proposed benefits of increased knowledge and innovation therefore can not yet been seen in the civil engineering industry.

3. **What are the perceived constraints within the construction industry for not fulfilling the construction specific preconditions?**

There are different constraints that can be found in the civil engineering sector resulted from the theoretical and empirical research. First of all the current procurement of the public organizations are dominated by a make-to-order decoupling point in which there is no possibility for long term highly commited interfirm relationships. This dominance of this particular decoupling point is also the result of the hampering role of the engineering consultancy firms in the construction process. Furthermore the geographical specificity of the Dutch civil engineering sector results in specific partners in the project supply chain. The empirical research indicates that the quantities of these specific projects are to low too maintain long term highly commited interfirm relationships within a supply constellation. Futhermore research indicates that there is a dominance of a small amount of demanding parties per disciplne in the Dutch civil engineering sector, which holds large parts of the total quantity of projects in the sectors discipline.

What are the preconditions for organizations in the construction industry to integrate their supply chain through adoption of supply chain partnerships, and identify perceived constrains by the construction industry for not fulfilling the preconditions for supply chain partnerships?

Concluding and summarizing, this research shows that;

1) **The preconditions derived from current scientific research needed for adoption are not fully met and therefore, based on the research, it looks like no supply chain partnerships can be found in the Dutch civil engineering sector and the proclaimed benefits cannot be achieved.**

2) **There are perceived constraints that prohibit project unbounded long term highly committed interfirm relationships. These constraints are;**

    a. **Dominance of make-to-order decoupling point in the Dutch civil engineering sector**

    b. **The hampering role of the engineering consultancy firms in the construction process, especially within the make-order-decoupling point**

    c. **The environmental specificity of projects within the Dutch civil engineering sector**

    d. **The dominance of small amount of demanding parties with a large amount of the total capacity of demand per discipline in the Dutch civil engineering sector**

This raises a question for further research. Even when public organizations transform from the current practice and do not fix the time constrain in projects and give transparent information about upcoming capacity of demand within the market based on their accurate information about the status of their assets, if there is enough quantity of projects in time within the Dutch civil engineering demand side for the adoption of multiple constellations in the supply side per discipline, which are able to compete with each other based on different constellation strategies?

Furthermore due to the dominated role of the public client within the Dutch civil engineering sector, the public clients and policymakers need to make a final consideration in whether innovation-related advantages of adoptions of supply chain constellations outweigh the flexibility in control benefits related with the present structure of make-to-order decoupling point in which information flow and material flow are disconnected and there is solely competition on lowest price in the supply side.

9.2 Recommendations

9.2.1 For GMB

If we look at the critical actions that are needed for adoption of long-term highly committed interfirm relationships, it shows that most of the actions depend on the way the sector as a whole react on each other. Especially how demand and supply side transfer risk and reward from the demanding parties towards the supply side. This is a part in which GMB as organization does not have direct control over; however there are some actions, which if changes in the organization can be fulfilled, can help the organization towards possible adoption op supply chain partnerships. The recommendations for the organization of GMB are as follows:

1. Where research shows that in the current Dutch civil engineering sector the possibility for adoption of supply chain partnerships is not yet available, within the commercial market it is possible. With the current transition of GMB towards a customer based organization, it is recommendable to look for possibilities for creation of supply chain constellations for commercial demanding parties. For example Van Benthem, in which the second tier supply chain, hence the so called subcontractors (for example Van Noordenne) are long term committed to the organization of GMB for future works of the commercial demanding parties

2. The critical action 3 and 10 from the theoretical research framework are focused solely on the supply side. Those are two actions that could be changed by GMB. In order to do so, GMB must create an indicator structure in which the performance of the supply network is made explicit to all members in the network (for example by the KPI model from (Yuan, Zeng et al. 2009)). This is where within the organization of GMB there should be an integrated function of Supply Network Manager, who overlooks all information created by the kpi's of the whole process of GMB (tendering, purchasement, realization, maintenance, marketing sales, and logistics). Eventually this part of the organization takes over the responsibility of purchasement from the project leader when a supply chain constellation can be and has been created.

3. Focusing on delivering services for the demand side, in the shape of asset management in which GMB can provide information about the actual status of the civil works created by GMB. This order to help the demanding parties to gain better insight in the current status of their assets and in doing so give GMB better forecasting information about possible capacity needed which leads to direct ties towards these public organizations

9.2.2 For the sector civil engineering

4. It is recommendable for public organizations to use more alternative decoupling points beside the make-to-order dominance in order to potential create better flow of information and material within the supply side. Within this new procurement the public organizations need to focus on life cycle cost and cost of ownership. The budget of investments and maintenance needs to be put together for different problems in order to give the supply side options and trade-off between capex and opex decision, which creates room for innovation. Within this procurement the public organizations need to be aware of the possible for competitive dialogue before tendering in order to give room for the supply side to show their creative and innovative power.

5. It is recommendable that the public organizations combine and share their information about projects that are placed in the market. This will give better insight into the capacity demanded from the supply side over time. Furthermore it is recommendable that public organizations become more transparent about upcoming civil works that are going to be tender in due time and become more stable, in order for the supply side to create better forecasting of demanded capacity.

9.2.3 For further research

6. Look within public agencies what the contrains are towards choosing other decoupling points beside typical choosen make-to-order decoupling point.

7. Look at the legal boundaries and procurement regulations more closely for possible use of past performance in selection and tendering of supply side.

8. Look at other construction sector (housing and commercial sector) benefits of adoption of supply chain partnerships in practice.

9. While these conclusions are done on the base of one case study it is recommendable to do the same research within other organizations of the Dutch civil engineering sector.

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11 Appendices

11.1 Index

11.2 Model for KPI in construction

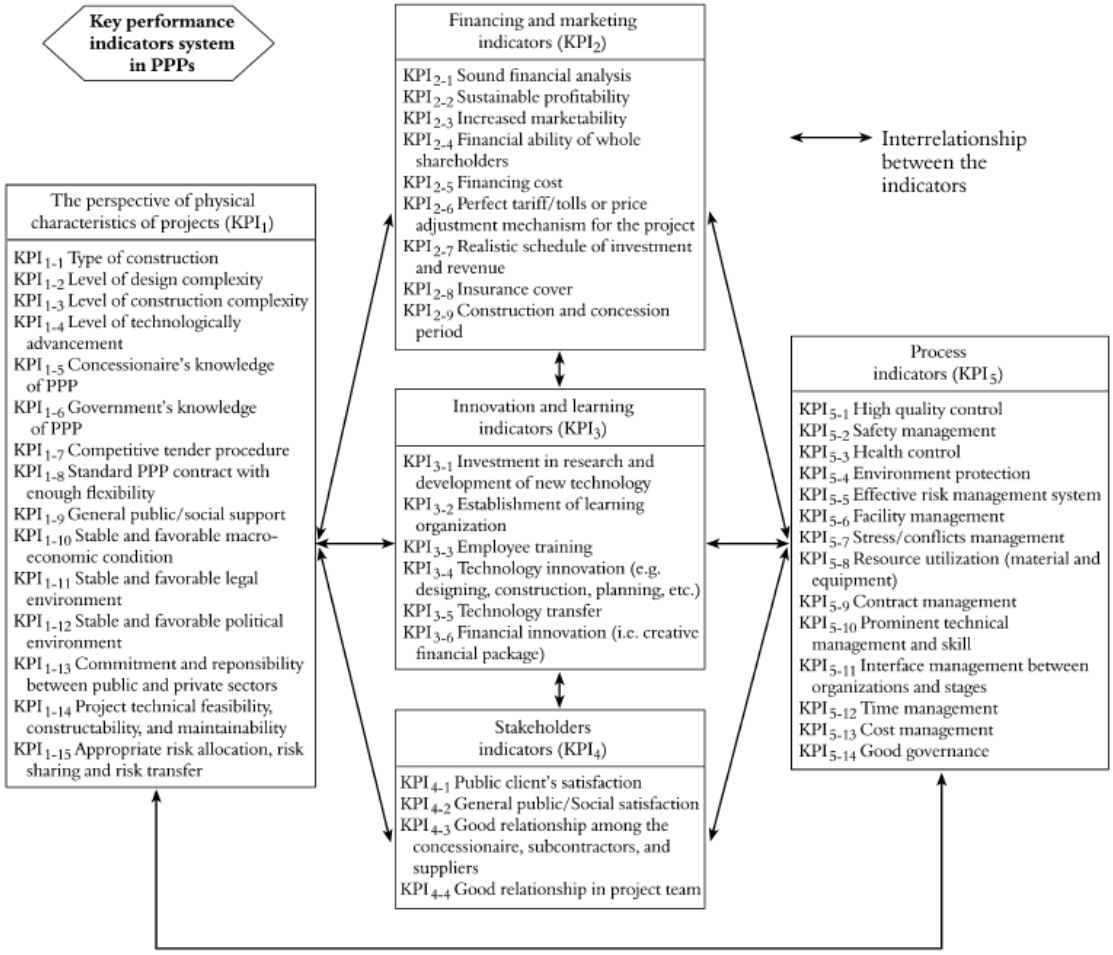


Figure 8. 1: Framework for KPI's in PPS relationships in construction (Grover and Malhotra 2003)

11.3 Data Dutch construction industry

Table 6
Main motivation to engage in an inter-organizational project venture
2006→2009.
2006 2009
Making a specific product 16.7% 25.4%
Providing a specific service 44.3% 49.2%
Enhancing the production process 3.9% 4.6%
Developing new production technology 4.0% 1.1%
Exploring or entering a new market 18.9% 7.4%
Organizing an event 3.4% 1.3%
Other, namely 8.7% 3.6%
Unknown 0% 7.3%

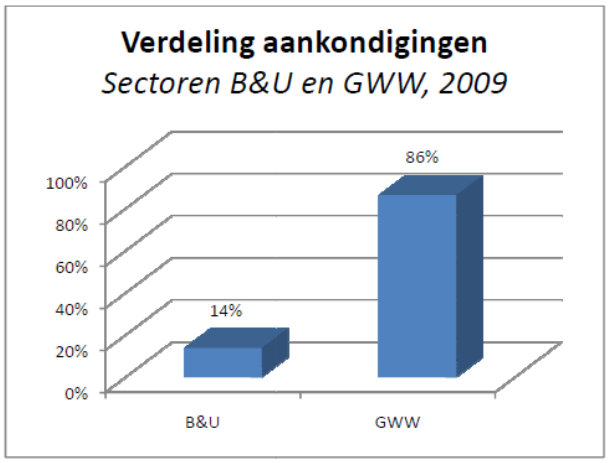
Table 8.1: data Dutch construction industry (Oerlemans, Bakker et al. 2010)

Table 7
Duration of inter-organizational project ventures (2009).
Duration Absolute % Cumulative %
1–6 months 19.6% 19.6%
7–12 months 33.5% 53.1%
13–18 months 10.8% 64.0%
19–24 months 7.8% 71.8%
25–30 months 5.6% 77.3%
33–36 months 8.2% 85.5%
37–42 months 1.6% 87.1%
37–48 months 0.4% 87.6%
N49 months 12.4% 100%
Total 100%

Table 8.2: data Dutch construction industry (Oerlemans, Bakker et al. 2010)

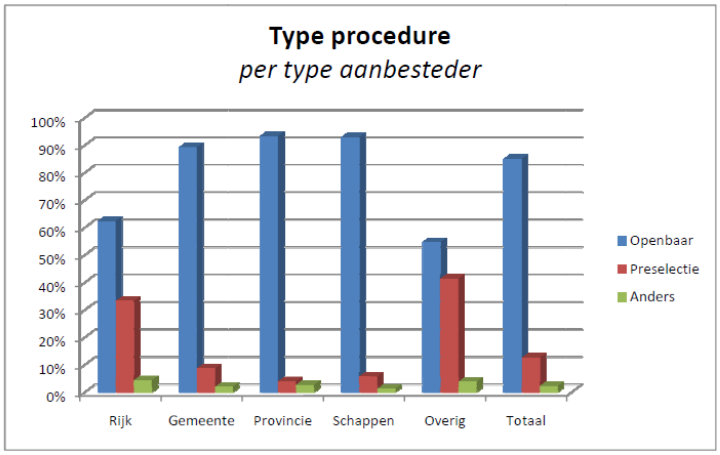
Table 10
Embeddedness of Inter-organizational project ventures (2009).
Sector Prior ties between the organizations
collaborating in project venture
Present Absent Unknown
Manufacturing 55.2% 43.3% 1.5%
Construction 67.0% 33.0% 0%
Trade and Repair 55.4% 43.5% 1.1%
Hotels and Catering 51.7% 48.3% 0%
Transport and Communication 57.6% 42.4% 0%
Financial services 46.7% 53.3% 0%
Business services 67.1% 32.9% 0%
Other services 50.0% 50.0% 0%
Total 60.1% 39.5% 0.4%

Table 8.3: data Dutch construction industry (Oerlemans, Bakker et al. 2010)



Figuur 2 – Aandeel van de sectoren Burgerlijke en Utiliteitsbouw (B&U) en Grond-, Weg- en Waterbouw (GWW).

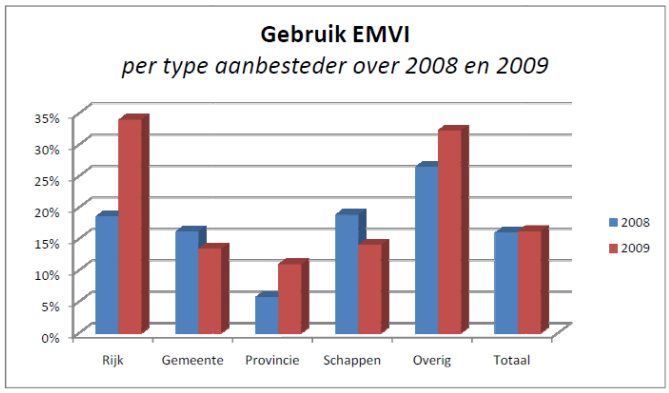
Figure 8. 2: data Dutch construction industry (Aanbestedingsinstituut 2010)



Figuur 4 – Aandeel van de Openbare procedure, de Niet-openbare procedure en andere procedures per type aanbesteder en voor het totaal.

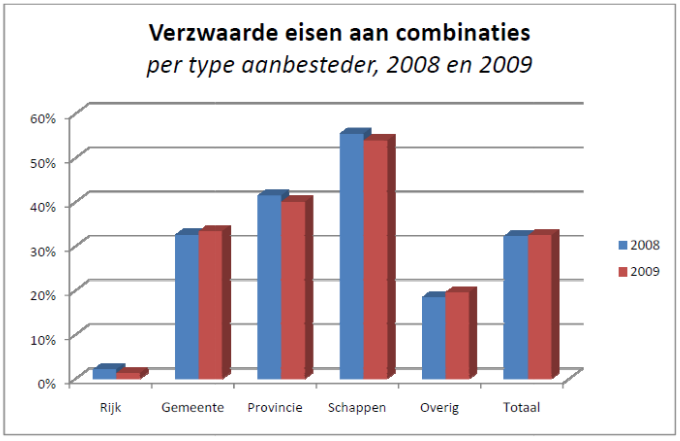
Figure 8. 3: data Dutch construction industry (Aanbestedingsinstituut 2010)

3. **Gunningcriteria**



Figuur 5 –Gebruik van EMVI als gunningcriterium in 2008 en 2009 per type aanbesteder en voor het totaal. Geen EMVI betekent vanzelf dat de Laagste Prijs geldt als enig gunningcriterium.

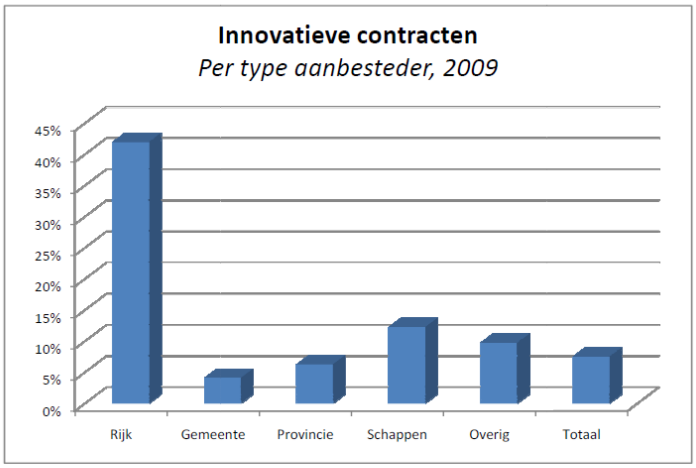
Figure 8. 4: data Dutch construction industry (Aanbestedingsinstituut 2010)



Figuur 10 – Voorkomen van het stellen van verzwaarde eisen aan combinaties in 2008 en 2009 per type aanbesteder en voor het totaal

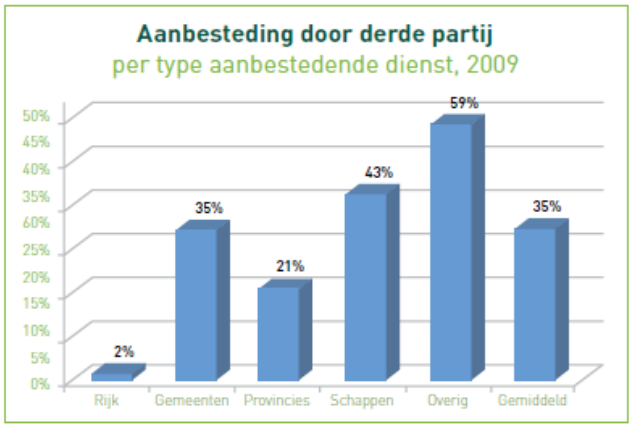
Figure 8. 5: data Dutch construction industry (Aanbestedingsinstituut 2010)

5. Innovatieve contractvormen



Figuur 11 – Voorkomen van de vermelding van innovatieve contractvormen als D&C, DCM, E&B en dergelijke, dan wel de vermelding van de UAV-GC in 2009 per type aanbesteder en voor het totaal.

Figure 8. 6: data Dutch construction industry (Aanbestedingsinstituut 2010)

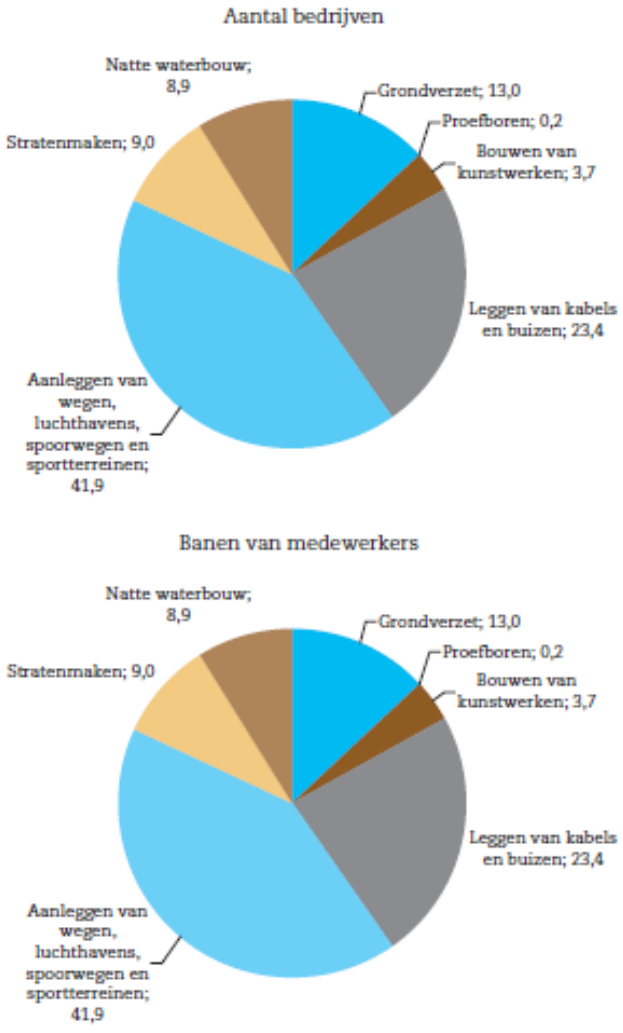


Figuur 9 – De mate waarin materiedeskundige, derde partijen ingezet worden om een aanbesteding te begeleiden in 2009, per type aanbesteder en gemiddeld over het geheel

Figure 8. 7: data Dutch construction industry (Aanbestedingsinstituut 2010)

Het onderzoek is gebaseerd op openbare aanbestedingen van gww-werken, welke zijn aangekondigd in de periode januari 2009 tot mei 2010. Hoewel een aanzienlijk deel van de markt voor openbare aanbestedingen van gww-werken in dit onderzoek is betrokken, is dit geen volledig overzicht. De gebruikte dataset omvat alleen aanbestedingen van gww-werken door Nederlandse gemeenten welke op prijs worden aanbesteed. In totaal hebben er in de onderzochte periode ongeveer 2.025 openbare aanbestedingen van gww-werk door 322 van de in totaal 441 Nederlandse gemeenten plaatsgevonden. Ongeveer88% van alle openbare aanbestedingen in de onderzochte periode werd gegund op prijs. De gebruikte dataset bevat 500 openbare aanbestedingen van werk, door 157 gemeenten, waarop in totaal 4.792 inschrijvingen zijn gedaan door 850 verschillende aannemers. Het totaal van de aanneemsommen waarop dit onderzoek is gebaseerd bedraagt € 317 miljoen. (Hardeman and Van der Vlist 2010)

Figuur 2.2 Samenstelling gww-sector in procenten naar segment, 2007



Aanleggen van wegen, luchthavens, spoorwegen en sportterreinen is exclusief stratenmaken

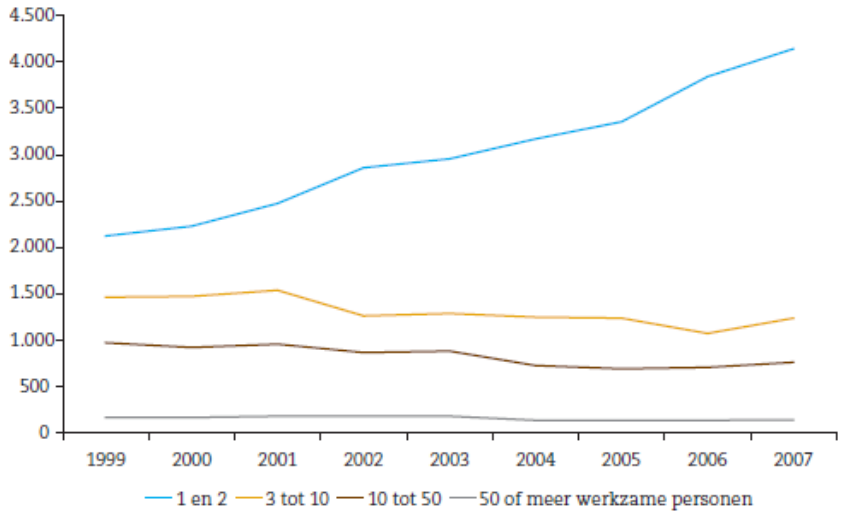
Bron: CBS (2011b)

Figure 8. 8: Lay-out construction industry(Jansen and Van der Vlist 2011)

Civil engineering production (2008-2015)						
	Million euro		Yearly change (in percentage %)			
	2008	2009	2009	2010	2011	2015
New investment and recovery						
Main government	1.470	1.650	12,0	9,0	1,5	-3,0
Lower government	3.428	3.350	-2,5	-4,0	-2,0	1,0
Companies (including prorail and energy companies)	2.903	2.800	-3.5	-2,0	-0,5	0,5
Subtotal	7.801	7.800	0,0	-0,5	-0,5	-0,5
Maintanance	5.786	5.850	1,0	-1,0	-0,5	1,0
Total	**13.587**	**13.650**	**0,5**	**-0,5**	**-0,5**	**0,0**

Table 8.4: production civil engineering sector (Hardeman and Van der Vlist 2010)

Figuur 2.1 Aantal gww-bedrijven per grootteklasse



Bron: CBS (2011a)

Figure 8. 9: lay-out contruction (Jansen and Van der Vlist 2011)

Tabel 4.2 Kostenaandelen van productie-input per grootteklasse, 1999

Kostenaandeel (%)	Klein		Midden		Groot		Totaal	
Inkoop	49,1	(22,5)	55,4	(17,1)	61,1	(14,6)	53,2	(20,1)
Arbeid	32,3	(19,0)	28,8	(13,4)	25,3	(8,6)	30,0	(16,0)
Kapitaal	5,7	(5,4)	4,8	(4,8)	4,5	(5,3)	5,2	(5,2)
Overige input	12,9	(9,4)	11,0	(7,6)	9,1	(7,4)	11,6	(8,6)
Totaal	100		100		100		100	

Gemiddelde kostenaandelen in totale kosten, standaarddeviatie tussen haakjes

Bron: EIB

Conjunctuurmeting bouwnijverheid oktober 2009 (EIB 2010)

Herstel orderportefeuille in de grond-, water- en wegenbouw zet door

De omvang van de orderportefeuille in de grond-, water- en wegenbouw vertoont vanaf april een gestage stijging met één tiende maand per verslagmaand. Ook in september is de orderportefeuille in de gww gestegen met één tiende maand tot 6,4 maanden (zie figuur 2). Net zo als voorgaande maanden wordt deze stijging gedragen door de bedrijven die actief zijn in de grond- en waterbouw. In deze subsector van de gww steeg de orderportefeuille sinds april met acht tiende maand tot 7,7 maanden. In de wegenbouw vertoont de orderportefeuille weinig beweging en komt eind september uit op 5,1 maanden.
In de burgerlijke en utiliteitsbouw is de omvang van de orderportefeuille in de maand september niet veranderd. Eind september is deze, net als eind augustus, 6 maanden. Uit figuur 1 blijkt dat de orderportefeuille in de b&u, in tegenstelling tot die in de gww, nog geen tekenen van herstel vertoont.
De orderportefeuille van de hele bouw is in september niet veranderd en bedraagt nu 6,1 maanden.

Dit constateert het Economisch Instituut voor de Bouwnijverheid in de zojuist verschenen conjunctuurmeting van oktober 2009.

Het verschil in ontwikkeling tussen b&u en gww wordt ook teruggevonden in de overige uitkomsten van de conjunctuurmeting. Voor één derde van de bedrijven in de b&u zorgt het uitblijven van orders voor de meeste hinder voor de voortgang van het werk. In de gww geldt dit voor 15 procent van de bedrijven. Bovendien is dit percentage in de gww sinds april gehalveerd, terwijl het in de b&u sinds april praktisch gelijk is gebleven.
Ruim een kwart van de b&u-bedrijven denkt de komende periode personeel te moeten laten gaan, in de gww is dit slechts één tiende van de bedrijven. Ruim 85 procent van de gww-bedrijven verwacht dat de omvang van hun personeelsbestand niet zal veranderen.

In de b&u is het oordeel over de werkvoorraad negatief. Deze wordt door ruim 45 procent van de b&u-bedrijven als klein beoordeeld en slechts door 4 procent als groot. In de grond- en waterbouw is het oordeel per saldo positief: bijna een kwart van de bedrijven in deze subsector vinden de werkvoorraad groot, 14 procent klein.

Deze gegevens blijken uit de conjunctuurmetingen in de bouwnijverheid van oktober 2009 van het Economisch Instituut voor de Bouwnijverheid. Deze meting wordt uitgevoerd in opdracht van de Europese Commissie. Aan de conjunctuurmeting verlenen ruim 400 hoofdaannemingsbedrijven met meer dan tien personeelsleden hun medewerking.

Tabel 1

		bouwnij-verheid	**b&u**	**gww**
Bedrijvigheid	+ *)	6	4	14
	=	59	56	74
	-	35	40	13
Onderhanden werk	+	5	4	13
	=	54	50	70
	-	41	46	17
Onderhanden werk in mnd productie		6,1	6,0	6,4
Voortgang onderhanden werk				
- geen stagnatie		61	57	79
- stagnatie als gevolg van				
. onvoldoende orders		30	33	15
. weersomstandigheden		0	0	0
. personeelsvoorziening		0	0	0
. materiaalvoorziening		1	1	0
. financiële problemen		1	1	0
. onderaannemers		0	0	0
. overige oorzaken		6	7	1
Verwachte personeelsbezetting	+	3	3	4
	=	74	71	86
	-	23	26	10
Verwachte prijsontwikkeling	+	3	2	7
	=	78	77	85
	-	19	21	8

*) + toename
= blijft gelijk
- afname

bron: EIB

Tabel 2

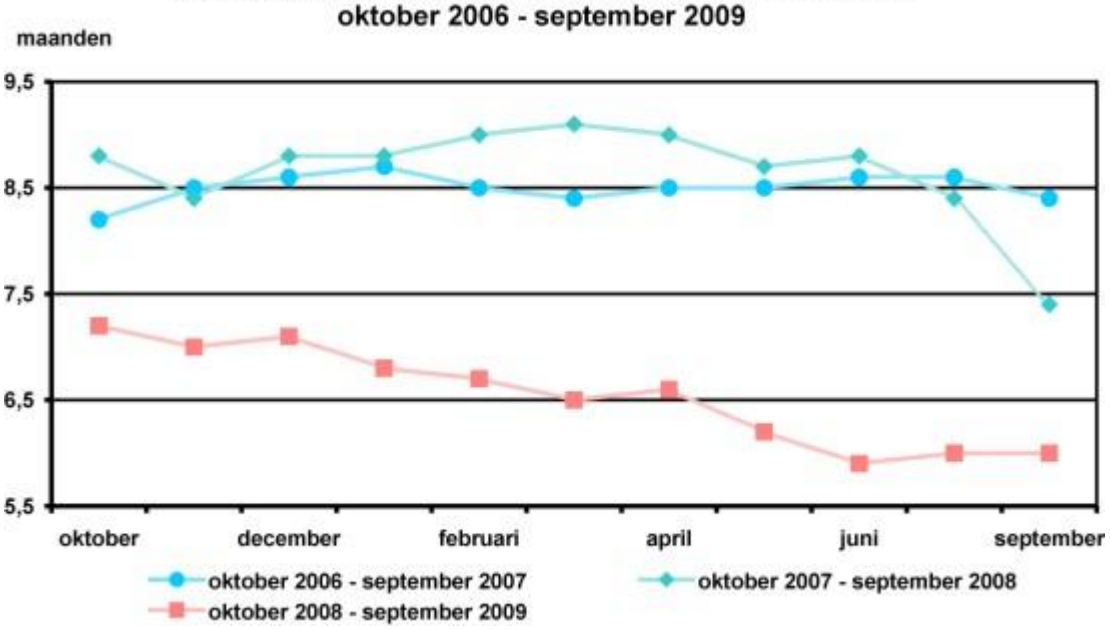
		woning-bouw	utiliteits-bouw	wegen-bouw	grond- en waterbouw
Bedrijvigheid	+ *)	5	4	7	20
	=	50	63	84	63

	-	46	34	9	16
Onderhanden werk	+	5	3	2	23
	=	48	52	76	63
	-	47	45	21	14
Onderhanden werk in mnd productie		6,3	5,7	5,1	7,7
Voortgang onderhanden werk					
- geen stagnatie		55	60	83	83
- stagnatie als gevolg van					
. onvoldoende orders		34	32	15	15
. weersomstandigheden		0	0	0	0
. personeelsvoorziening		0	0	0	1
. materiaalvoorziening		1	1	0	0
. financiële problemen		1	1	0	0
. onderaannemers		0	0	0	0
. overige oorzaken		8	5	1	1
Verwachte personeelsbezetting	+	3	3	1	7
	=	72	71	86	86
	-	25	26	13	8
Verwachte prijsontwikkeling	+	2	2	1	13
	=	75	79	93	77
	-	22	19	7	10

*) + toename
= blijft gelijk
- afname

bron: EIB

Figuur 1 De omvang van de orderportefeuille in de b&u, oktober 2006 - september 2009



Figuur 2 De omvang van de orderportefeuille in de gww, oktober 2006 - september 2009