

Building New Roads in Tendering

Towards Selection Based on Values and Competencies



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PREFACE

This thesis is the final result of my graduation thesis as part of the MSc programme Construction Management & Engineering at the Faculty of Civil Engineering & Geosciences at Delft University of Technology. I could not have done this on my own, and for this part, I would like to thank a few people that helped me through the whole process.

First of all, I would like to thank Arcadis Nederland BV and Frank van Schaik for once again believing in me and taking me in charge. I am truly grateful for receiving this chance of doing my graduation thesis at an established engineering company as Arcadis Nederland BV. Special thanks to my internal supervisor Ivo Kreetz, who helped me a lot with his practical and structured view on the problems that I was facing.

This research would not have been possible without the interviewees, who despite their busy agendas found time for me. I hope the results of this research will serve you all and the whole engineering industry as a small step to better and more honest understanding of each other's interests.

Also, I would like to thank my graduation committee for all their feedback and guidance. Each time we had a meeting, I was amazed by all your knowledge on the industry level and on all aspects involved with doing an academic research.

Further, I would like to help my friends Veronica, Oliwia and Oswaldo, whose support has been crucial and who motivated me to keep on working each day. Fan, Polina, Mariska and Philine, thank you for helping me with the content and keeping my courage alive. To not forget my family and especially my mom, who made it possible for me to study abroad and be where I am today. Last but not least, I would like to thank my boyfriend Luciano for his patience. I know I was not easy to deal with in the previous months, but I could not have done this with anyone else but you by my side.

Best regards,

Mariya Ivanova
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EXECUTIVE SUMMARY

Procurement plays an integral role in all kinds of organizations. Through this process, suppliers help organizations to successfully achieve their objectives by the timely delivery of services, goods and works. The type of procurement method where clients assess the offers of the contractors and select the most appropriate one is called tendering. Awarding bids to the right party is the most important item concerning competence as a critical success factor for construction projects (Garbharran, Govender, & Msani, 2013). Currently used procedures like Competitive Dialogue, Best Value Procurement and others shape the selection process around different competencies. The objective of this research is to find out what the necessary competencies that describe the vendor expert are, by answering the following research question:

Based on what competencies should the vendor expert be selected during tendering procedures of infrastructure projects?

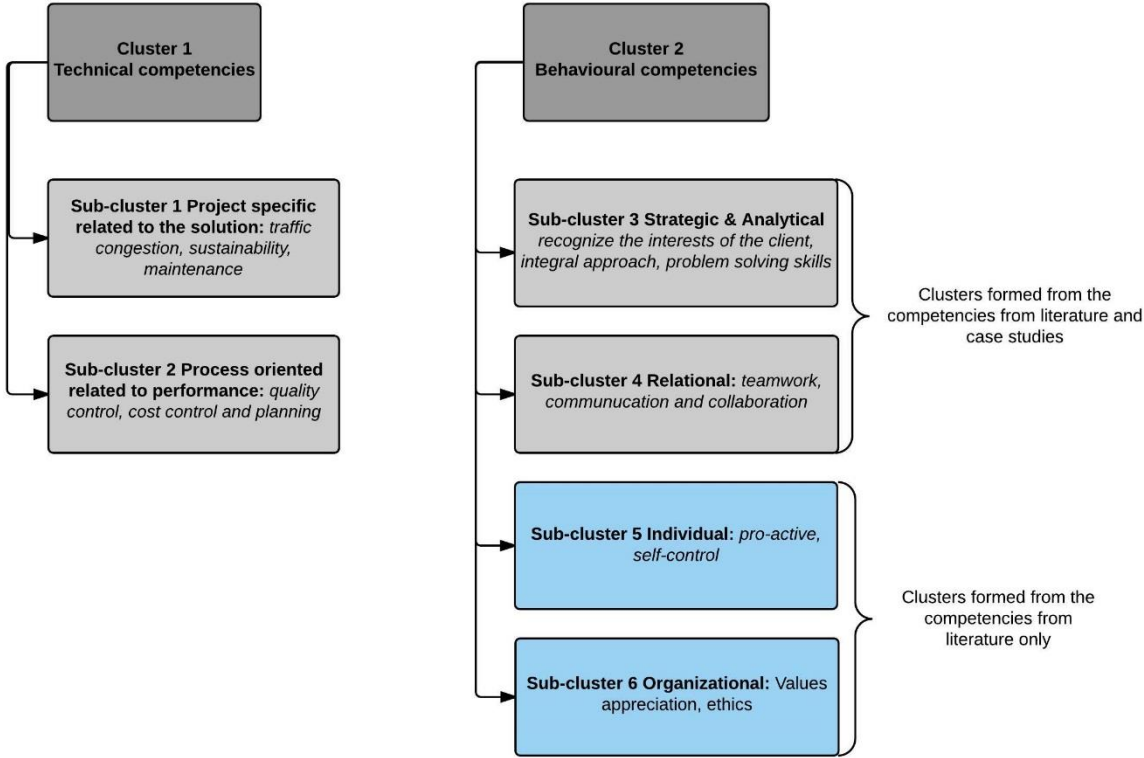
The research is mainly valuable for clients, to find the best method of selecting the vendor expert and for the contractors, who want to improve their participation in tenders. The reached domain of this research is within the Infrastructure department of Arcadis Nederland BV, who as a consulting and engineering company are interested in this subject from both sides.

The competence level of the project team and especially the project manager is proven as a critical success factor in construction projects (Wagner, 2014). On top of the Integrated Project Management (IPM) model, the general project manager is responsible not for the technical content of the project only but also for processes within the team and the communication with the client. The long list of Technical and Behavioural competencies based on which the project manager must be selected according to literature is used to create sub-clusters of competencies.

To find the competencies based on which the vendor must be selected according to case studies, interviews have been performed with the client and the winning contractor of six Arcadis Nederland BV infrastructure projects. During the interviews questions were asked about the competencies based on which the contractor was selected in the particular case, about general competencies based on which the contractor should be selected and about recommendations for competence based tendering. The competencies based on which the vendor should be selected are used as input for the cross-case analysis where clusters and sub-clusters of competencies have been developed just like in literature.

The comparison of competency clusters between literature and case studies show that there are two main clusters of competencies, which should be taken into account when selecting a vendor. The first cluster '*Technical competencies*' includes competencies or factors that are covered by the expertise and the experience level of the vendors participating in the tender. Those technical aspects have been derived in this research within two sub-clusters: the '*Process oriented*', including different project management fields like Risk management and Quality control, and the '*Project specific*' expressing how the vendor deals with the unique situation. The second cluster '*Behavioural competencies*', includes non-technical factors or soft skills, which also shape the selection- and award process by two sub-clusters. Within the '*Strategic & Analytical*' sub-cluster, there is the vendor's strategy for participating in the tender and his analytical skills among other competencies. The '*Relational*' sub-cluster includes competencies like communication skills and collaboration.

From the in total six behavioural sub-clusters defined from literature, there are two sub-clusters being the 'Individual' and 'Organizational' which are not seen back in the case studies. During the interviews, clients and contractors were reserved on whether individual competencies of team members should play a role in a tender since the team preparing the tender in most cases is different than the one executing it. For this reason and a few others mentioned in this report, the grey sub-clusters from the figure below that were all four present in literature and case studies should be taken into account during a procedure while clients are advised to include the blue 'Individual' and 'Organizational' sub-clusters from the figure below as option.



The results of this research show that vendors of infrastructure projects should be selected on their technical and behavioural competencies. For clients, it is important to have a contractor who uses his expertise and knowledge to find project specific solutions and knows how to monitor the project performance. When participating in a tender, vendors need a certain strategy of how they will deliver an integrated solution, which fits the clients requirements. At the same time, the ability of the contractor to collaborate and communicate within the team, with the client and the stakeholders involved, is also considered to be of general importance when selecting the vendor.

More research on the effective measurement of competencies, their dependencies, their relation to the contract and possible translation into selection- and award criteria, is needed before clear recommendations can be given on whether to include individual and organizational competencies in a competence based tendering procedure.

SAMENVATTING

Inkoop speelt een belangrijke rol in allerlei organisaties. Dat is het proces waarbij leveranciers hun klanten helpen met het succesvol behalen van doelstellingen door de tijdige levering van diensten, goederen en werken. Het type inkoop waarbij opdrachtgevers de aanbiedingen van de aannemers beoordelen en de meest geschikte selecteren heet een aanbesteding. Toekennen van de biding aan de juiste partij is bewezen als een kritische succesfactor voor bouwprojecten (Garbharran, Govender & Msani, 2013). Aanbestedingsprocedures zoals Concurrentiegerichte Dialoog, Best Value Procurement en anderen selecteren de aannemer op basis van verschillende competenties. Het doel van dit onderzoek is om erachter te komen welke competenties de aannemer expert beschrijven door de volgende onderzoeksvraag te beantwoorden:

Op basis van welke competenties moeten aannemers selecteert worden tijdens aanbestedingsprocedures van infrastructuurprojecten?

Het onderzoek is vooral waardevol voor opdrachtgevers, die de selectieproces van aannemers willen verbeteren, en voor aannemers die beter willen scoren tijdens aanbestedingen. Het onderzoek is uitgevoerd binnen de afdeling Wegen, Verkeer en Informatiemanagement van Arcadis Nederland BV, die als een ingenieursbureau opdrachtgevers helpen met aanbestedingsprocedures of zelf deelnemen.

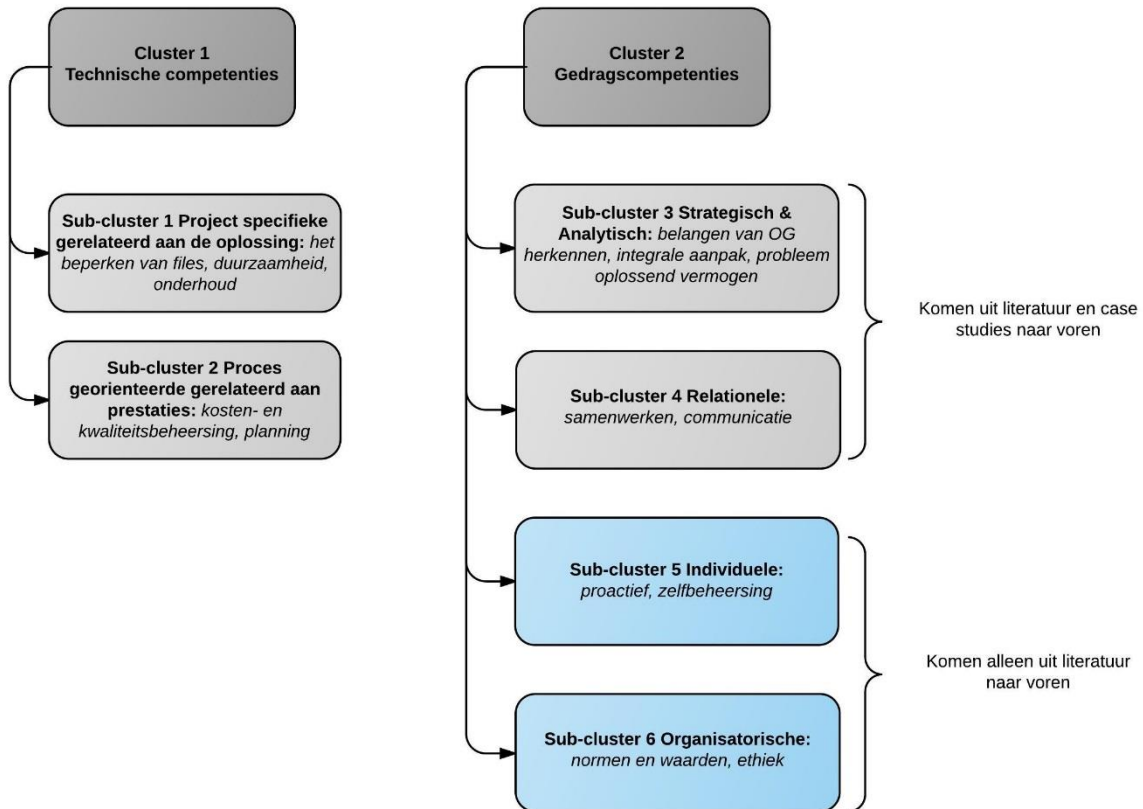
Het competentieniveau van het projectteam en vooral van de projectmanager is bewezen als een kritische succesfactor in bouwprojecten (Wagner, 2014). Aan top van de Integrated Project Management (IPM) model, de algemene project manager is verantwoordelijk niet alleen voor de technische inhoud van het project, maar ook voor de processen binnen het team en de communicatie met de opdrachtgever. De lange lijst van technische- en gedragscompetenties op basis waarvan het project manager geselecteerd moet worden volgens de literatuur is gebruikt om sub-clusters van competenties te creëren.

De competenties op basis waarvan de aannemer geselecteerd moet worden zijn ook onderzocht in interviews met de opdrachtgever en de winnende aannemer van zes Arcadis Nederland BV infrastructuurprojecten. De antwoorden van de geïnterviewde personen zijn gebruikt als input voor de cross-case analyse, waar clusters en sub-clusters van competenties zijn ontwikkeld.

De vergelijking van de competentie clusters tussen literatuur en case studies tonen aan dat er twee belangrijke clusters zijn, waarmee rekening moet worden gehouden bij de keuze van een aannemer. De eerste hoofdcluster '*Technische competenties*' gaat om de kennis en de ervaring die de aannemers hebben. Deze technische aspecten zijn binnen dit onderzoek ontleend in twee sub-clusters: '*Proces georiënteerde*' met begrip van verschillende project management gebieden zoals risico- en kwaliteitsbeheersing, en de '*Project specifieke*' dat over de unieke situatie gaat. De tweede hoofdcluster '*Gedragscompetenties*' bevat niet-technische factoren of de zogenaamde soft skills. Binnen het sub-cluster '*Strategisch & Analytisch*' wordt onder andere aandacht besteed aan de strategie die de aannemer gebruikt bij zijn deelname aan de aanbesteding en zijn analytische vaardigheden om het probleem van de opdrachtgever op te lossen. De '*Relationele*' sub-cluster omvat competenties als communicatieve vaardigheden en samenwerking.

Binnen de '*Gedragscompetenties*' zijn er twee sub-clusters, de '*Individuele*' en '*Organisatorische*' die wel gevonden zijn in de literatuur maar niet in de case studies. Opdrachtgevers en aannemers hebben tijdens de interviews duidelijk aangegeven dat individuele competenties misschien niet zo relevant zijn tijdens een aanbesteding aangezien het team die de inschrijving voorbereid in de meeste gevallen anders is dan het team die het project gaat uitvoeren. Om deze reden en een aantal andere die verder

in dit verslag zijn genoemd, wordt de keuze om deze sub-clusters (blauw in de figuur hieronder) wel of niet mee te nemen in een aanbesteding overgelaten aan de opdrachtgever.



Uit de resultaten van dit onderzoek blijkt dat aannemers van infrastructuurprojecten geselecteerd moeten worden op basis van hun technische en gedragscompetenties. Voor opdrachtgevers is het belangrijk om met een aannemer samen te werken, die weet zijn expertise en kennis te gebruiken om project specifieke oplossingen te vinden die ook binnen tijd, budget en kwaliteit uitgevoerd kunnen worden. Tijdens een aanbesteding dienen opdrachtnemers een goede strategie van inschrijving te hebben, waarin ook blijkt dat ze een geïntegreerde oplossing kunnen leveren die aan de eisen voldoet. Tegelijkertijd zijn de samenwerkingsgerichtheid en de communicatieve vaardigheden binnen het team, met de opdrachtgever en de betrokken partijen ook belangrijk bij de keuze van een aannemer.

Verder onderzoek naar de effectieve meting van competenties, hun onderlinge afhankelijkheid, en de mogelijke vertaling van competenties in selectie- of gunningscriteria, is nodig voordat een duidelijke conclusies kan worden gegeven op de vraag of de individuele en organisatorische competenties van een aannemer meegenomen moeten worden binnen aanbestedingsprocedures.

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LIST OF ABBREVIATIONS

BVP	Best Value Procurement
CD	Competitive dialogue
CV	Curriculum Vitae
D&C	Design & Construct
DBM	Design, Build & Maintain
DBFM(O)	Design, Build, Finance, Maintain & Operate
E&C	Engineering & Construct
EIA	Environmental Impact Assessment
EMAT	Economically Most Advantageous Tender
EVZ	Ecologische verbindingszone
IPM	Integrated Project Management
PIPS	Performance Information Procurement System
PM	Project manager
PMBok	Project Management Body of Knowledge
PPPs	Public- Private Partnerships
QPI	Quantifiable Performance Information
RAVA	Risk Assessment and Value Added
RWS	Rijkswaterstaat

1. INTRODUCTION

Procurement plays an integral role in all kinds of organizations. Through this process, suppliers help organizations to successfully achieve their objectives by the timely delivery of services, goods and works. Although by principle the procurement processes of public and private parties look the same, when outsourcing a project by public parties, specific rules ensuring the general principles of objectivity, transparency and non-discrimination are followed (Bruggeman, Chao-Duivis, & Koning, 2013). After the job has been announced, the parties that may make an offer determined, and the offers competing assessed, the most appropriate partner is awarded the contract. This type of procurement method is called tendering.

While in the past public infrastructure projects were financed and constructed by the state, the large capital needed and the often occurring cost and time overruns, have caused the involvement of the private sector in construction practices (Flyvbjerg, 2005). In the civil engineering sector tendering is obligatory for public parties like Rijkswaterstaat for projects above a certain financial threshold, since the projects outsourced are on a large scale and need to be financially justified and transparent. The tendering procedure ensures competitive bidding between suppliers and may optimize the chances of finding the best price-quality ratio for the client.

Applying a clear tendering procedures ensures the integrity of public parties. For this reason, the laws and regulations for tendering procedures of public parties are laid down in legislation ("Aanbestedingswet," 2012). In traditional procurement, the client specifies his requirements in great detail and chooses the best vendor based on the lowest price. By using the lowest price as an award criterion, vendors are forced to stay close to the cost price for which they do not make a lot of profit, and make sure their bid just fits the requirements of the client (Figure 1).

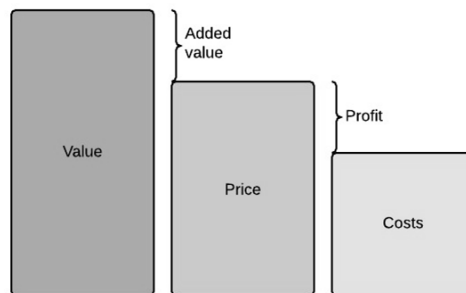


Figure 1 Transaction model Value-Price-Costs (Ridder, 2011)

The different types of tenders can be divided into two main categories: tenders under the threshold for works, services and supplies and tenders above the threshold, set by the European Commission each year. Tenders above the threshold can be open, restricted, Competitive Dialogue (CD) or Best Value Procurement (BVP).

	Tender Procedure	Explanation	Award mechanism
Under threshold	Single negotiated	One provider is asked to submit a bid. After possible negotiation, the order can be placed.	Individual offer
	Negotiated	A number of tenderers (3-5), chosen on objective grounds, is asked to submit a bid.	Lowest price or EMAT
	National	On a national level, the open and negotiated procedures can be performed.	EMAT/BVP
Above threshold	Outline agreement	The outline agreement is a long-term agreement between the client and vendor for material or services for a defined period of time.	Individual offer
	Open	All parties have the right to register for the tender	EMAT/BVP
	Restricted	All parties have the right to register. Based on pre-announced criteria, the client chooses the candidates, who are invited to submit a tender.	EMAT
	Negotiated - With publication of a contract notice -Without publication of a contract notice	After the tender is announced, and parties have registered themselves, the client selects, at least, three candidates who are invited to submit a tender. Without an announcement, the client selects, at least, three candidates, who are invited to submit a tender. The procedure is only allowed under certain circumstances.	EMAT/BVP
			EMAT/BVP
	Concession	An operator receives substantial remuneration through being permitted to develop the work	
	Competitive Dialogue	Several discussion rounds between client and potential vendors, during which all aspects of the tender can be discussed. The procedure is only allowed under certain circumstances. (1.1 Value based tendering)	EMAT
	Best value procurement	Selection through limited items to be submitted and the use of dominant information (1.2 Competence-based tendering)	EMAT with higher quality component

Table 1 Types of tendering procedures (European Commission, 2015)

An important step in the Dutch procurement world is made with the new tender law, introduced in 2012. According to this law, public clients are not allowed to award projects based on the lowest price, but should use quality oriented tendering methods like the Economically Most Advantageous Tender (EMAT). When using EMAT, criteria on which the bids are assessed are set in advance, where quality criteria are given the same monetary value as price. This way price and quality units can be compared through the same unit. In EMAT, the vendor having the best quality price ratio and this way differentiating himself in added value wins the tender.

1.1 VALUE BASED TENDERING

1.1.1 Economically Most Advantageous Tender

The use of the economically most advantageous tender makes it possible for clients to take account of criteria that reflect qualitative, technical and sustainable aspects of the tender submission, as well as price when reaching an award decision. Selection criteria from the contract very often include sub-criteria, which should together with their weights be notified to the vendors. Examples of selection criteria for EMAT are (CROW, 2015): *Functionality, Availability, Aesthetics & integration, Durability of the product, Competencies or skills, Lifetime, Risk Management, Environment friendliness, Sustainability of the process, User-friendliness.*

Apparent unfair competition, adverse subjective judgments, unclear assessment processes and increasing costs at EMAT procurement are the key problems, faced by actors involved during EMAT procurement procedures (Veerman & Jonge, 2015). Another difficulty within the EMAT award mechanism is how to combine price and quality in such a way that it still satisfies the guiding principles for legal procurement being Transparency, Proportionality, Equal treatment (Dreschler, 2009). Within the EMAT award mechanism Dreschler (2009) also identifies four types of EMAT mechanism: (1) the Point System, where both price and quality are expressed in point, and the bid with the best combined score wins the tender, (2) the Ration System, where the total value of the bid is expressed in a number that is divided by the price; the bid with the highest ratio wins the tender, (3) Price Correction System, where extra performance of the bid is rewarded with an added value that is subtracted from the initial tender price; the bid with the lowest fictitious tender price wins the tender or (4) the Value maximisation system, where price is fixed and for this reason not taken into consideration and the bid with the highest value is awarded the contract.

1.1.2 Competitive dialogue

Competitive dialogue is a value based tendering procedure, introduced to the Dutch construction market by the European Commission in 2004 (Hoezen, 2012). Competitive dialogue is often used as a procurement method before for the formation of alliances or public- private partnerships (PPPs) between public client and contractor(s). According to this method, when entering into separate dialogues with the vendors, the client can optimize his question by creating room for specific and creative solutions from the market. The use of competitive dialogue is only allowed when the project is particularly complex, with two conditions: 1) when the client is not able to objectively define the technical means and 2) not objectively able to specify the legal and/or financial make-up of a project ("Explanatory note- Competitive Dialogue- Classic Directive1," 2008). Just like every procedure, however, competitive dialogue has its pitfalls as well. It is important that parties do not hold to earlier views, but enter into an open dialogue, very often leading to the choice of an alliance as a contract form. Opposite to competitive collaboration between parties in traditional tendering, an alliance is characterized by actively participating client and contractor(s) in a project-based relationship, with compromises on common goals, conflicts are reduced and added value is created (Vrieling, 2008). The public client's role changes from delegating to actively participating in the construction process and the role of the private contractor changes from supplier of products and services to an equivalent partner of the client.

1.2 COMPETENCE-BASED TENDERING

In 2008, a new tendering method was introduced in the Dutch civil engineering sector. This method, called Best Value Procurement, was developed in 1993 by Dean Kashiwagi at Arizona State University. According to this principle, hiring the right people to do the job increases the value of the end product and minimizes risks and decision making during tendering. While EMAT revolves around defining quality criteria, so suppliers show what they can deliver above the minimum requirements, BVP goes further and aims to deliver the best value for the lowest price (Wenselaar, 2011). Instead of delivering an extensive and detailed plan about the projects as in traditional tenders (Figure 2: Quadrant I), vendors' performance and ideas are presented through a limited amount of information (Figure 2: Quadrant II).

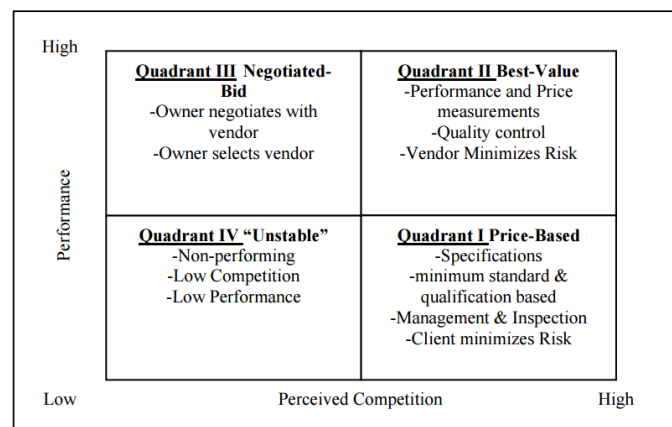


Figure 2 Industry classification matrix (Kashiwagi, 2011)

The most important client of public works in the civil engineering sector in the Netherlands, Rijkswaterstaat (RWS), first applied the BVP approach in the 'Fast track' projects (Spoedaanpak in Dutch) in 2008 and because of its success expects increasing use in the future (Witteveen & Van de Rijt, 2013). The current configuration of the procedure, however, brings a few repercussions with it, causing doubt on whether the procedure objectively carries up the vendor expert or whether there is talk of 'Best Friends Procurement', where winning vendors get to know the client and succeed in pleasing the client's assessment committee even better during a tendering procedure (Gaaff, 2014). BVP differs from traditional methods since it assesses dominance, rather than expertise. When vendors have the expertise needed but are not able to transfer their knowledge according to the BVP philosophy, the *perceived* instead of the *actual* expert might be chosen by the client.

1.3 DIFFICULTIES IN COMPETENCE MEASUREMENT

Selecting competent parties is essential during a tendering procedure. One of the reasons is the aim of a tendering procedure, which is to find the most appropriate vendor to do the job. Awarding bids to the right party is the most important item concerning competence as a critical success factor for construction projects (Garbharran, Govender, & Msani, 2013). The competence level of the project team is proven to be a critical success factor in construction projects (Wagner, 2014). At the same time, competence development is very costly and expensive, which stresses the importance of hiring people or teams who already have the competence level needed (Mulder, 2011). However, while selecting vendors on the lowest price has a very objective character, involving more quality criteria to the assessment and scoring on quality, has increased the subjective character of the tendering procedure (Dalmolen, 2002). At the same time measuring competencies is very difficult for a five reasons (Luken, 2004). First of all, competence is not a homogenous concept. It involves knowledge, attitudes and

skills, which all represent something different. To make competencies measurable, they should be linked to abilities and behaviour. The second reason is that competencies are not stable and can improve or demote within time. At the same time, personal preferences play an important role in assessing competencies, which might mean that the one who is convincing the best is seen as competent enough. Fourth, competencies are related to ability, while it is more important to know if the performance is actually delivered. Nevertheless, the measurement of competencies includes the context as well, instead of only personal characteristics.

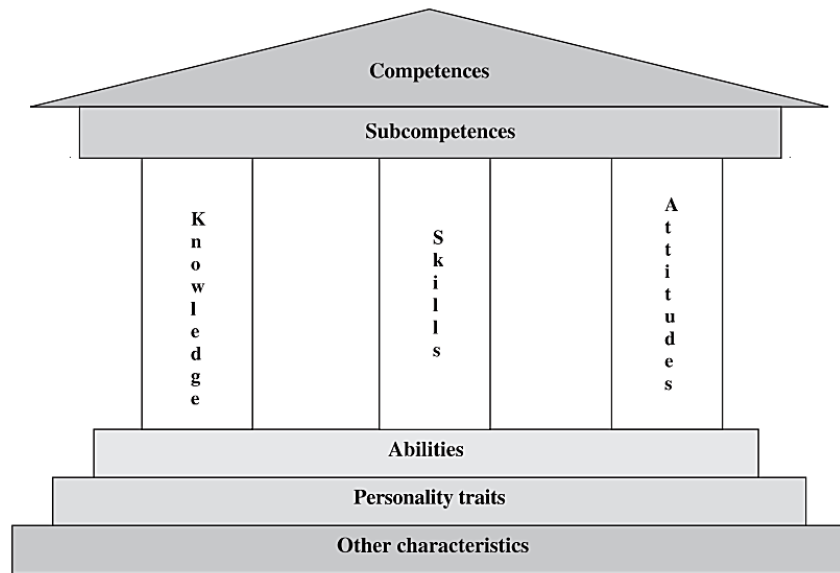


Figure 3 Competence architecture model (Roe, 2002)

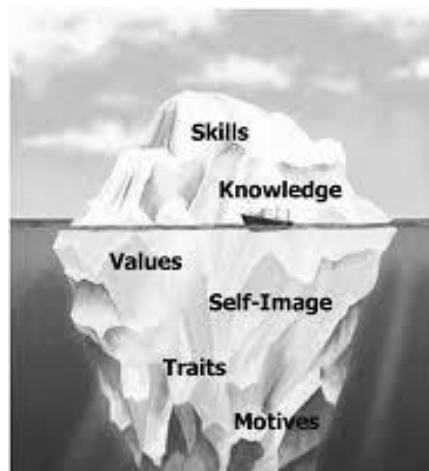
1.4 COMPETENCE AND EXPERTISE

Competence is defined as the set of capabilities consisting of content related clusters of knowledge, skills and attitudes in a certain context (Figure 3) and should be linked to performing effectively (Mulder, 2011). Besides knowledge and skills, more dimensions are related to this term being ability, understanding, action, experience and motivation (Weinert, 2001). As part of project success Garbharran et al. (2013) consider past experience and tacit knowledge involved an important part of competence, together with obtaining relevant skills. When looking at competencies, distinguishing contextual performance behaviours from task performance behaviours is very important (Ahadzie, Proverbs, & Olomolaiye, 2008). The same authors describe-competence as “a person related concept that refers to the dimensions of behavioural action underlying competent performance” (Ahadzie et al., 2008). The fact that competence is context or person related, together with the relation with action and performance seen in earlier literature, can be seen here as well. Task performance behaviours are job specific and are associated with functions such as organising, programming, planning, coordinating and controlling, being input or output competencies like on cognitive ability, job knowledge, task proficiency and experience. Contextual performance behaviours are those not formally recognised as part of the job, being personal competencies like commitment, dedication, or will to help others. The link between job experience and competence is facilitated through job knowledge. Cognitive ability as well draws on job knowledge according to the same research.

An expert is someone whose level of performance exceeds that of most others within a specific domain of activity (Bradley, Paul, & Seeman, 2006). The differences in expertise are conceptualized through

general information proceeding like problem-solving, nature, quantity and organization of expert knowledge (Ericsson, Charness, Feltovich, & Hoffman, 2006). Expert performance depends on *experience* and *knowledge* (Shanteau, Weiss, Thomas, Pounds, & Hall, 2003).

The fundamental difference between expertise and competence is that while expertise concerns exclusive knowledge in a certain kind of field, competence involves not only knowledge, but skills and deeply rooted attitudes like motivation and values (Liu, Gao, & Liu, 2011). When looking at the Iceberg model for competence, it is seen that traits related to competence are directly expressed at the lower levels of the iceberg, while traits concerning expertise are at the highest point. According to the iceberg model, knowledge and well as skills and those underlying characteristics are needed to deliver superior performance (International Project Management HayGroup, 2003). There are two reasons why is has been chosen to use competence instead of expertise through this report. The first one is the more comprising definition of competence and the second one is the fact that competence instead of expertise is considered a critical success factor in construction projects.



*Figure 4 Competence Iceberg model
(Management Study Guide, 2013)*

1.5 THE T-SHAPED ENGINEER

The idea of T-shaped skills was first mentioned by David Guest in a 1991 article discussing the future of computer jobs, and then championed by Tim Brown, CEO of IDEO design firm, as an approach to hiring the right talent in order to build interdisciplinary teams that can come together to create new ideas. The T-shaped concept is a metaphor for the depth and breadth that an individual has in their skills. The vertical bar of the T represents the depth of related skills and expertise within particular specialism, whereas the horizontal bar represents the ability to collaborate across disciplines with experts in other areas and to apply knowledge in areas of expertise other than one's own (Flyvbjerg, 2005).

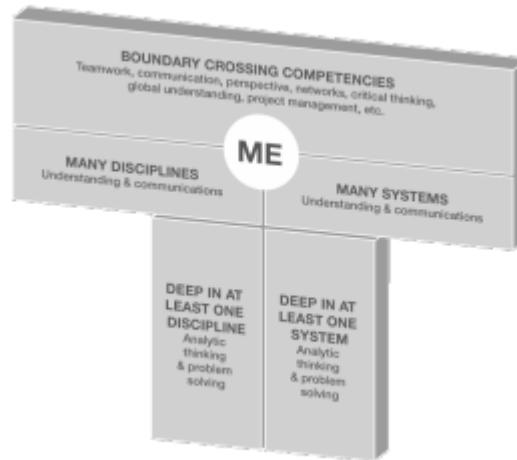


Figure 5 T-shaped engineer (Flyvbjerg, 2005)

The changing environment in which construction and civil engineering projects take place and the greater need for integrated projects, cause all engineers to adjust their skills and attitude within the field. The importance of these T-shaped engineers has also been described by Foundation Sustained Responsibility (2010). In order to achieve the integrated approach of a project, a team should exist of specialists, who do not only possess deep technical skills but also have broader attributes like communications skills and the ability to collaborate (Hertogh, 2013). This integration takes place not only between disciplines but also within new types of contracting, giving market parties more responsibilities and involving them in early stages of the design process.

2. RESEARCH DESIGN

This chapter describes the problem definition, the research questions that are answered through this research and the scope and relevance.

2.1 PROBLEM DEFINITION

The procurement procedures explained earlier have the aim of increasing the value of a project by creating room for input from the market. But at the same time, there seems to be a conflict between these procurement procedures in general. While collaboration is the most important key to success in a competitive dialogue and risks are shared during the execution phase, in a BVP procedure risk control is left to the contractor or engineering company, and there is almost no collaboration. Each procedure has another starting point and focus and selects the vendor on different competencies. None of them provides a comprehensive view on the competencies that describe the vendor expert and for this reason, the aim of this research is to find out what competencies of the vendor are important in tendering procedures of infrastructure projects in the construction sector.

2.2 RESEARCH QUESTION AND SUB-QUESTIONS

The main research question and the sub-questions necessary to answer the main question adequately are as followed:

Based on what competencies should the vendor expert be selected during tendering procedures of infrastructure projects?

Q1: What are the key competencies on which parties should be selected according to literature?

Q2: What are the key competencies on which parties should be selected according to case studies?

Q3: What recommendations can be given when considering the use of competency-based selection?

2.3 RESEARCH SCOPE

In tendering procedures, there are three types of criteria used to assess the vendor: exclusion, selection, and award criteria. Exclusion criteria include for example tenderers being bankrupt, having been guilty of grave professional misconduct, or not being in compliance with their obligations relating to the payment of social security contributions or the payment of taxes (European Commission, 2015). Selection criteria are used as the first filter, after which the amount of participating parties in the tender is limited. Financial and economic capacity, technical and professional capacity are examples of commonly used selection criteria. Award criteria on the other side are less organization-specific and more project-specific and involve the price, quality, delivery time and other extra requirements of the project. Since competency can be expressed through both selection- and award criteria, the main focus of this research is on both of them, giving vendors the opportunity of distinguishing themselves from the competition, based on their key competencies.

Tendering procedures include the preparation phase of a construction project and the selection of a contracting party. Within a tender document, the choice of a contract is also described by the client. However in this research, the influence of competence measurement is only projected on different types of tendering procedures with integrated contracts in general. The differences between contacting forms and their relation to competencies are not taken into account.

2.4 RELEVANCE

2.4.1 Theoretical relevance

Until today the studies on competence-based selection have focused on the competencies of the project manager (Ahadzie et al., 2008; Arendse, 2013; Brill, Bishop, & Walker, 2006; Cheng, Dainty, & Moore, 2005; Crawford, 2005; Edum-Fotwe & McCaffer, 2000), selection of the project team members and project team building (Levin & Ward, 2011) or the complexity of this selection process (Cooke, Salas, Cannon-Bowers, & Stout, 2000). The research done on the competencies of the project manager in the construction industry, however, has not been compared in order to provide more general results on this topic. By shifting focus to the link between competencies and the way they are expressed through selection- and award criteria, this study aims to contribute to the existing theory and knowledge with a more balanced view on the process of selecting the right vendor in infrastructure projects. The research will contribute to the creation of a range competencies, defining the expert and predicting the performance of the expert. Next to this useful insights for educational training, the concretization of team roles and the competencies that a construction project team should have.

2.4.2 Practical relevance

The practical relevance of the research is very broad since it is meant to optimize the effectiveness of a competence-based selection of vendors for the infrastructure construction sector in the Netherlands. The results of this research can be of great interest for several vendors and clients since recommendations for the optimal tender procedure can improve the selection process in general. The reached domain of this research is within the Infrastructure department of Arcadis Nederland BV. As a consulting and engineering company, their strategic choices for tender submissions and tender advice on procedures for clients can be underpinned.

2.5 RESEARCH STEPS

The different steps needed to achieve the objectives stated in the previous section are as followed:

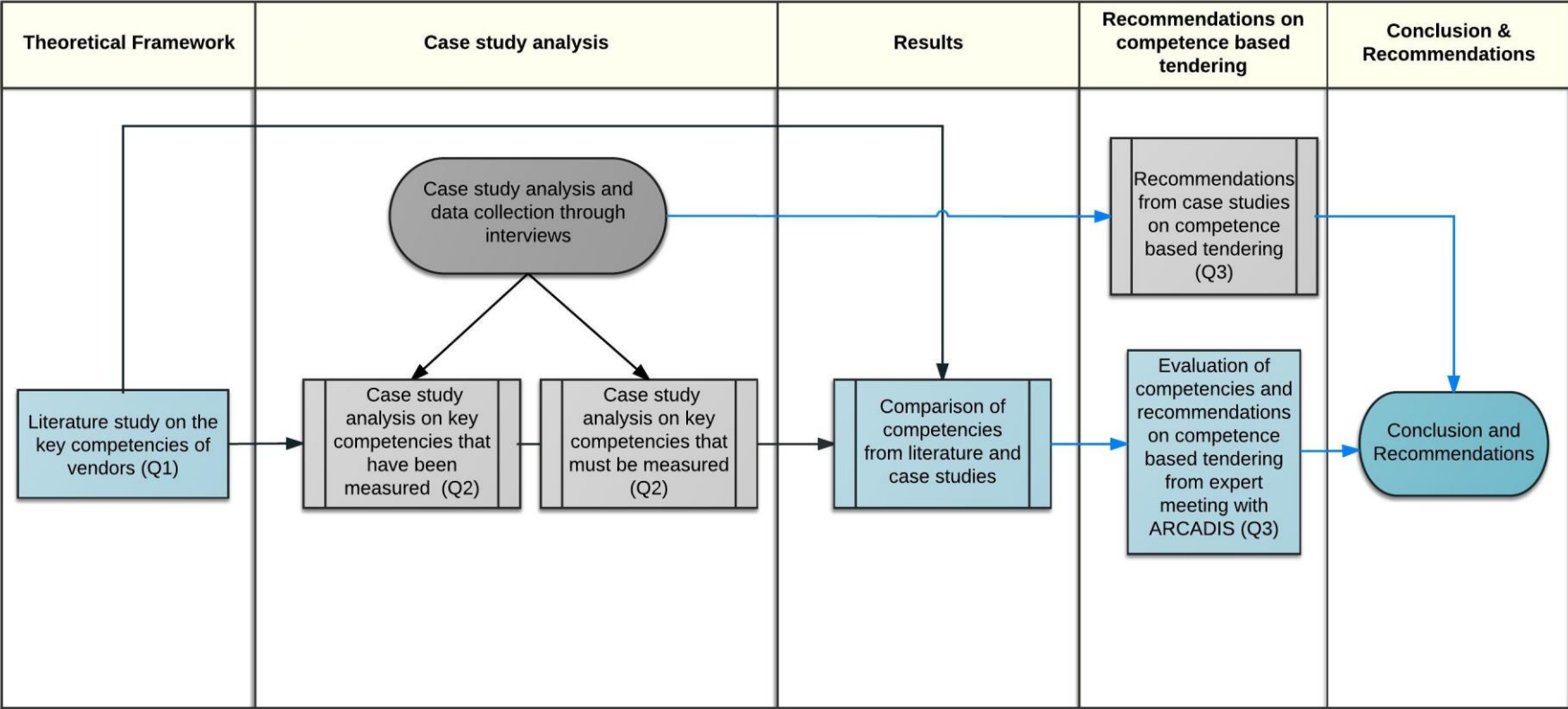


Figure 5 Research steps

During the phases shown in Figure 5, different types of knowledge will be produced. Descriptive knowledge is mostly generated during the theoretical part of the research, where literature about competency and its role in selection and tendering is accessed. Exploratory knowledge is mainly generated through the interviews in the case study analysis, chosen as the most appropriate research strategies suitable for generating data, above other possible methods that are not taken into account like a questionnaire, an experiment, the grounded theory approach and desk research (Verschuren & Doorewaard, 2010).

When choosing the best strategy, it is important to make three key decisions between breadth versus depth; qualitative versus quantitative research; empirical versus desk research. In case of competence-based tendering, it is relevant to set up a broad approach, instead of in-depth since the focus is on the differences and similarities of using competence as a measuring criterion in infrastructure projects.

Desk research is not considered to provide a complete overview of the key competencies that have played a role since evaluations of the tenders are confidential or might not have taken place for smaller projects. For this reason, in the practical part of the study data is mainly generated through interviews from the case studies. Performing interviews within the case studies makes it possible to ask specific questions about the relation between the project requirements, the process and the key competencies that played a role during the tender while general interviews with experts might not give the focus needed. Performing interviews within case studies gives the opportunity of interviewing as well someone from the clients' side and someone from the contractors' side and aligning the theory developed.

The research has both a theoretical as well as a practical orientation since it is primarily meant to examine the use of competence-based selection and tendering and subsequently translate learning points from theory into a framework suitable for infrastructure projects. The practical component can be found in the case studies and eventually interviews, which will be performed to determine how past projects have been tendered on competence-based criteria and how this can be improved. Before designing a framework for competence-based management, a brainstorm session for experts involved within tenders at Arcadis Nederland BV is organized. This way the practical applicability of the created framework and the value of the research, in general, can be improved.

2.6 CASE STUDY METHODOLOGY

2.6.1 Data collection

Yin (2003) makes a distinction between single and multiple case study designs. Single cases are mostly used when a rare case is examined or a well-defined theory tested. Multiple cases, on the other hand, are considered when similar or contrasting results are wanted. Since the main aim of this research is to create a general framework for competence-based selection, multiple cases are used. At the same time theoretical replication, testing the contrasting results in success between cases is considered as more relevant than literal replication on similarities. Theoretical replication is considered more relevant to this research since prepositions about key competencies and the way they can be measured are linked to the more or less successful performance of projects from real life. When using multi-case studies and theoretical replication, Yin (2003) recommends the comparison of 6-8 cases. The same author describes five ways of analysing case study evidence. Those methods are Pattern matching, Explanation Building, Time-Series Analysis, Logic Models and Cross-Case Synthesis. Pattern Matching compares an empirically based pattern with a predicted one. The internal validity of the case study can contribute as a proof for an expected pattern. However, in the case of competence-based selection, the research has an exploratory character with the main aim of finding out the best way to study

competencies. Explanation Building analyses the case study data by building an explanation about the case. This is not considered to be the most appropriate technique since explanation of the cases does not provide sufficient general knowledge of the best way to measure competencies. Time-Series Analysis and Logic Models are considering respectively the “how” and “why” questions about the relationship of events over time and the repeated cause-effect-cause-effect patterns over time. Time, however, is not relevant to this research. In a Cross-Case Synthesis, each individual case is studied as a separate study. This analysis helps the creation of a uniform framework according to the analysis of the separate cases and is considered the most appropriate one for this research.

During the case studies different sources of evidence like documentation, archival records, interviews, direct observations, participant observation and physical artefacts can be used (Yin, 2003). In this research Interviews with the project manager of the winning contractor and project manager of the client are used as the main source of information. Because of the confidential status of tender evaluations, documentation is not expected to provide enough information for the desk research and for this reason not chosen as the main source of information. Although the opinion of losing parties might be relevant in order to give a comprehensive view on the subject, it will not be taken into account due to the limited time available for this research.

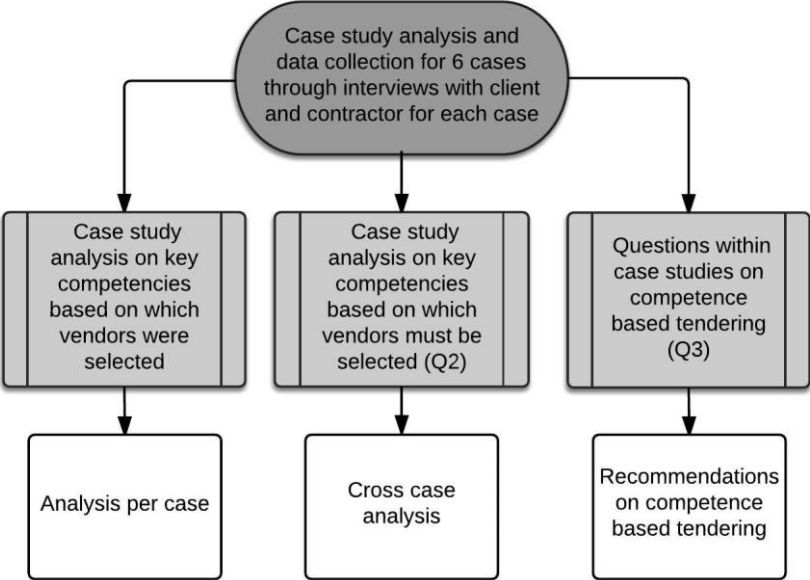


Figure 6 Data collection scheme

2.6.2 Case study analysis

Case study analysis is determined by five components being: the study's question, its propositions, its unit(s) of analysis, the logic linking the data to the propositions and the criteria for interpreting the findings (Yin, 2003). This section describes each one of those aspects.

Study's questions

The main purpose of the questions asked during the interviews is find out, on what competencies the vendor has been selected in the cases and what the competencies are on which the vendor must be selected in general. Those two aspects are needed in order to answer the first sub-question of the research. Yin (2003) describes interview questions on 5 different levels, each one of them described shortly in this section together with an example from the real questions used for the interviews. During the interviews questions were asked for specific interviewees, for the individual cases, for the pattern findings across multiple cases. Questions about what competencies vendors must be selected during tendering procedures are the type of questions for the entire study, next to which also normative questions were asked on general recommendations. All questions asked during the interviews can be found in Appendix B interview questions.

Propositions

Propositions help to direct the attention to what needs to be examined in the case study. When the research has an exploratory character propositions are not very common. For the same reason, no explanation can be given on the link between data & propositions.

Units of analysis

In this research the scope is on organizations, wanting to participate in tendering procedures and clients who prepare and organize those tendering procedures. Their competence level is examined during the procedure, based on which the most appropriate expert is chosen to do the job. The two main units of analysis themselves are competencies on which the vendor was selected and competencies on which the vendor must be selected. Next to this questions are asked on how clients and contractors actually see shaping a competence-based procedure.

Criteria for interpreting the findings

Four different criteria can be distinguished for interpreting the findings of the analysis. First of all, construct validity can be used to expose and reduce the subjectivity of the findings by linking data collection questions and measures to research questions and propositions. Internal validity is used for explanatory or causal studies only, and not for descriptive or exploratory studies since it establishes a causal relationship whereby certain conditions are shown to lead to other conditions. External validity is used to establish the domain to which a study's findings can be generalised. For example, when using analytic generalization, previously developed theory is used as a template with which the empirical results of the case studies are compared. Reliability is demonstrating that the data collection produced can be repeated with the same results. Since internal validity and reliability are not common for exploratory studies, and the external validity of the research is limited, due to the focus on the construction sector, construct validity is the most relevant criteria for underpinning the findings of the case studies. Due to the limited time available, in this research, it has been chosen not to validate the framework created for competency based measurement, also shown as a limitation in section 7.2 Limitations.

3. THEORETICAL FRAMEWORK

Chapter 3 presents the theoretical framework that is used in the research. This theoretical framework is based on a literature study and divided into six sections. In order to assess the competencies of the vendors in a tendering procedure, it is first important to have a closer look at the composition of the tender team, which is presented in section 3.1. The project manager has a very important role, leading up the whole team and managing the overall progress of the project. The competencies that can be related to the project manager according to different authors are compared in section 3.2. The competencies of the project manager described in section 3.2 are in section 3.3 clustered into sub-categories and in section 3.4 linked to the project team members from section 3.1. Sections 3.1 and 3.2 are mainly based on literature, while section 3.3 and 3.4 present interpretation of the findings from the literature. Section 3.5 provides a summary of the whole chapter.

3.1 INTEGRATED PROJECT MANAGEMENT ROLES

Rijkswaterstaat as the biggest client of public works in the Netherlands has developed an Integrated Project Management (IPM) model, which simplifies the internal and external collaboration with other parties. IPM describes a standard organizational structure for project teams of infrastructure projects. For each of the five processes distinguished in the process of each project, being *1) the overall project, 2) the project environment, 3) the most suitable technical solution, 4) good and appropriate contract and market approach and 5) the management of the project* a different role can be assigned: general project manager, stakeholder manager, technical manager, contract manager and project control manager.

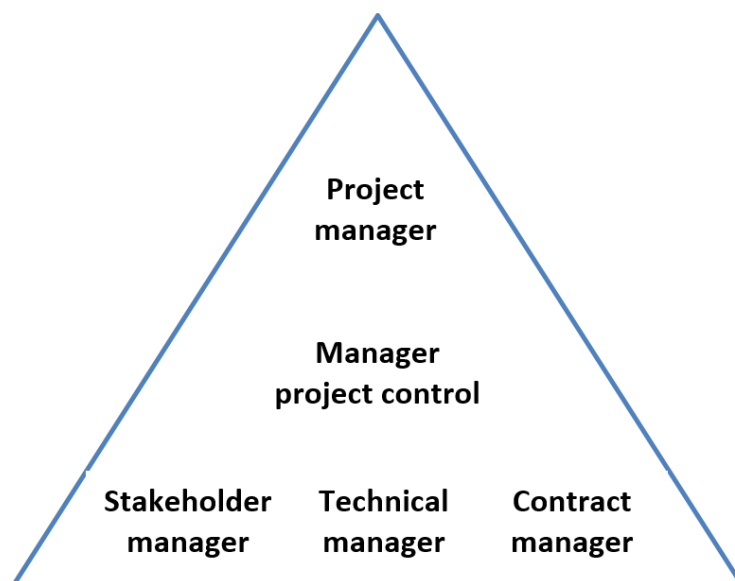


Figure 7 Project team roles (adjusted from Wermer, 2012)

Because of the structured project organization, the clear division of tasks and responsibilities within the team members and the possibility of reflecting each of these roles in the project organization of the contractor, the IPM model is often used on a lower level by Dutch municipalities and Province authorities as well. Depending on the requirements of a specific project and the available resources, the model can be adjusted, so different roles can be filled by one or more team members.

On top of the IPM model the general project manager can be found, who is responsible for the overall processes within the team and the communication with the client. The competency level of project managers (PM) is considered to be critical to the success of projects (Wagner, 2014). For this reason, a lot of research is available on the competencies of a project manager in the engineering sector, and they are taken as a starting point for the literature review.

3.2 COMPETENCIES OF THE PROJECT MANAGER

A distinction between technical, behavioural and contextual competencies for the project manager is developed by IPMA (2006) and later on used to rank the criteria from these categories according to their importance (Arendse, 2013; Shahhosseini & Sebt, 2011). Due to the changing industry and the shift from traditional to D&C contracting, the project manager is not only responsible for the technical content of the project, but also for the accuracy and reliability of the facility, for which he needs knowledge and skills others than the traditional ones. Mahmood, Hamidaddin, and Shafiei (2006) account in their model the competencies of the project manager to be for 34% determined by knowledge and cognitive competencies, for 24% by values and ethics and equally divided by 21% for personal or functional competencies. At the same time, the competencies of the project manager in PMBok (PMI, 2000) are criticized by Morris (2003, cited by Brill, 2006) and Crawford (2005) due to their narrow focus on technical knowledge and minimal focus on project strategy, value management, leadership and team-based development. In recent editions of the PMBok (PMI, 2008), the soft skills of the project manager are taken into account. Literature shows that in order to give a comprehensive view on the competencies of the project manager, behavioural characteristics and context related issues should be taken into account next to technical competencies.

3.2.1 Technical competencies

Technical competencies determined by Shahhosseini and Sebt (2011) are very similar to the project management knowledge areas distinguished by PMI (2008). Since technical competencies are considered to be more project specific than the more general behavioural and context competencies, this means that technical competencies have a stronger relation to hard competencies like technical knowledge required.

From the 19 technical competencies by Shahhosseini and Sebt (2011), the 10 most important ones resulting from the research have been used in the comparison. From the research of Edum-Fotwe and McCaffer (2000), the ranking given to technical, legal and financial competencies is used to form the top 10 of technical competencies. The first seven primary knowledge competencies (*Planning & Scheduling, Construction management activities, Basic Technical knowledge in own field, Productivity and Cost control, Establishing budgets, Reporting systems and Drafting contracts*) are completed by the three most important secondary competencies (*Forecasting Techniques, Quality management, Estimating and tendering*). Together with the results from Arendse (2013), Cheng et al. (2005); Crawford (2005); PMI (2008), previous research has been used to find out the technical competencies which are considered as important for the project manager. Although the research of Brill et. al (2006) does not only include the civil engineering industry and also concentrates on the project engineer in general instead the project manager, it is taken into account for the comparison in order to provide a more general and broad view on the technical competencies. The same counts for the technical

competencies of ECITB (2010), which are not the result of research, but the result of a framework that has been created. The list of technical competencies, however, consists of 30 competencies, making it difficult to distinguish the most important ones and finding a way of how to measure them. For this reason, no selection is made based on how competencies have been ranked, but they are clustered in subcategories, after which the measurement of each sub-category is expected to be simplified.

3.2.2 Behavioural competencies

Behavioural competencies are determined by somebody's personal characteristics. Although not all authors have used the term behavioural competencies in their research, all kind of relational (Lampel, 2001), managerial (Edum-Fotwe & McCaffer, 2000) or personal (Mahmood et al., 2006) competencies can be linked to this category. The comparison of behavioural competencies, presented in a table in Appendix A Competencies of the project manager also includes results from Hagberg (2006), ECITB (2010), Crawford (2005) and Brill et al. (2006). While the research of ECITB concentrates on the project engineer and not on the manager and different technical industries are taken into account in the research of Brill et al. (2006), Crawford (2005) finds only a few personal competencies and Hagberg's ones are quite different than all the others found in the literature. However once again, just like within the technical competencies, they have been included in order to provide a general view on the topic. Although communication is mentioned as both technical and behavioural competence, it is important to keep in mind the fact that effective communication in the technical sphere includes listening, oral and written communication, while within the behavioural context special attention is paid to oral communication.

A strong relation can be found between some of the behavioural competencies. For example the link between Self-control and Leadership, and between Engagement & motivation and Leadership or between Negotiation and Leadership. 'Self-control' is also strongly related to the emotional intelligence of project manager and team members, which is also available within teamwork and cooperation. In order to deliver good results and prevent conflicts, not only the project manager but all team members should be conscious of their emotional intelligence and be able to name and accept feelings without doing anything about them (Goleman, Boyatzis, & McKee, 2013). The dependencies of competencies are not used to shorten the list of 31 behavioural competencies, but can be used in order to cluster them within the next paragraph.

3.2.3 Contextual competencies

From the research on the competencies of the project manager, only Shahhosseini and Sebt (2011) and Arendse (2013) mentioned contextual competencies, which are presented in the third table of Appendix A Competencies of the project manager. While competencies like '*Portfolio management*' and '*Handle a management programme*', together with a few others concern a more strategic level of operation of the company, other competencies like '*Personnel development*' (similar to '*Team selection*'), '*Finance*' (similar to '*Cost control*' and '*Establishing budgets*'), or '*Develop PM professionalism*' (similar to '*Ethics*'), '*Promote personnel competencies and learning*' (similar to '*To promote and share knowledge*') have already been mentioned under similar titles into the Technical or Behavioural cluster. In order to keep the competencies structured, avoid ambiguities though the similar names given and taking into account the fact that the contextual competencies are relevant on a higher strategic level of the company and not the level of tendering, it has been chosen to exclude the contextual competencies from further integration in the research and go further only with the technical and behavioural cluster.

3.3 INTERPRETATION OF THEORETICAL FRAMEWORK

3.3.1 Clustering of technical competencies

Since the general project manager is responsible for the overall management of the project, he is supposed to have a certain level of knowledge in different areas. The results show this very clearly. However in order to create a tool for the selection of a vendor it is important to structure the competencies and give recommendations of how the clustered can be measured by the client during the procedure. There are different ways in which technical competencies can be clustered. That can be done based on first of all competencies describing certain knowledge level and next to this skills, needed to achieve a certain level of project performance.

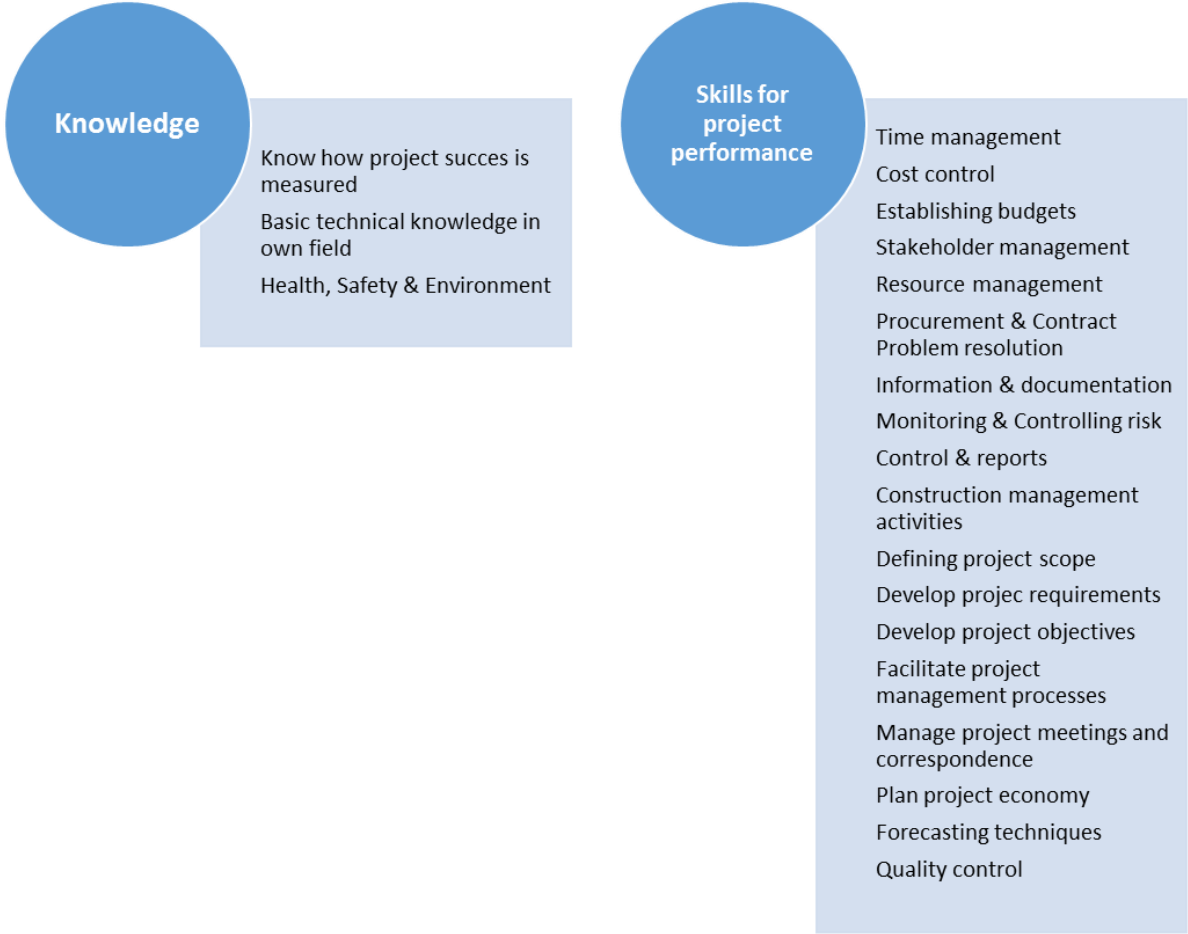


Figure 8 Clustering of technical competencies

3.3.2 Clustering of behavioural competencies

Different clustering has already been performed on behavioural competencies. According to Goleman et al. (2013), emotional intelligence is underneath the behavioural competencies of team members. They have clustered their competencies within four categories being *Self-awareness, Self-management, Social Awareness and Relationship Management*.

Levin and Ward (2011) have done research on the competencies of the program manager instead of the project manager and have clustered the personal competencies into eight categories: *Communicating, Leading, Building relationships, Negotiating, Thinking critically, Facilitating, Mentoring, Embracing Change*.

Later on, another research of Levin (2014) based on complexity relates human behaviour to four categories being *Organizational design & development; Communication & control; Group, organizational, political behaviour and Individual behaviour*.

In their research about competencies in the construction sector Pye Tait Consulting (2014) distinguish four categories being: *Situational awareness, Self-awareness, Risk-awareness and Communication*.

Comparing those clusters shows that at least one cluster should be about the **'Individual'** competencies concerning personal characteristics as self-confidence, self-control and determination. A second cluster is all about the people and social awareness and describes the **'Relational'** aspects of working with one another. Other aspects of importance in this cluster are collaboration and team building, communication, embracing change, managing, leading and developing one another. The third cluster chosen called **'Organizational'** is all about the business done and focuses on achieving and delivering the result, innovation, quality focus and integrity. This cluster focusses on all what is needed in order to serve the client's needs. The fourth and last cluster that is created is called **'Analytical'** and involves special skills like creativity, analytical thinking, and problem-solving.

Oral and Written communication have been merged in one competence called 'Communication', which means that instead of the 31 behavioural competencies from Appendix A Competencies of the project manager, 30 competencies are related to the four conceived clusters, as shown in Figure 9. It is essential to realize that the list of competencies is not complete and probably can never be completed. Next to this not all of them might be as relevant for a certain project. Some of the competencies can also be related to different clusters, which in this case has not been taken into account.

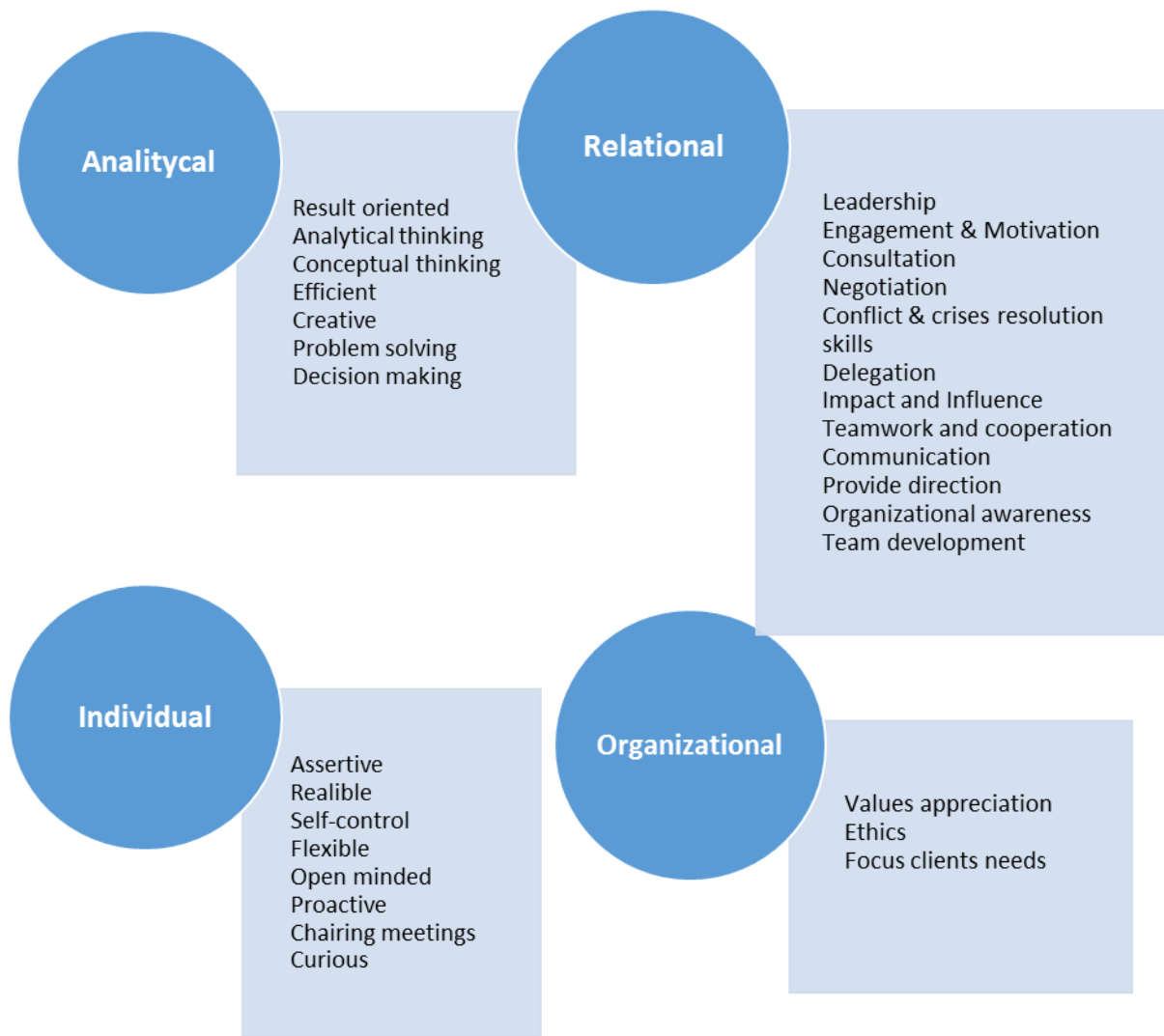


Figure 9 Clustering of behavioural competencies

3.4 COMPETENCIES OF THE PROJECT TEAM

Looking at the two clusters of technical competencies being Knowledge and Skills for project performance it can be stated that all of them are equally important for all members of the team.

When considering the clusters of behavioural competencies of the project manager, it seems not that difficult to relate the competencies of the project manager to all team members. All of them should have strong personal characteristics while at the same time being able to build a relationship with others and comply with the organizational rules. Analytical skills are important for all team members too, whereas sometimes problem-solving skills are expected from the stakeholder manager and analytical thinking from the contract manager. However within each cluster, some competencies might be more important for certain roles. For example within Individual competencies ‘Chairing meetings’ is not as relevant for the other team members as for the project manager. The same counts for ‘Leadership’ within ‘Relational’. In the same cluster, ‘Negotiation’ is not as important for the Technical manager as for the Contract manager or the Stakeholder manager. ‘Teamwork & cooperation’ and

'Communication' next to all competencies from the cluster 'Organizational' are important for the whole team, in order to achieve better results.

Since the measuring of the competencies is not considered on the individual level, but on the cluster level, it is not that essential to relate all technical and behavioural competencies to the different IPM roles. On cluster level, all of them are as important for the project manager as for the rest of the team.

3.5 SUMMARY

To summarize the theoretical part, competence does not only involve skills and knowledge but more deeply rooted attitudes like values, self-image, traits and motives. To improve tendering procedures based on values and competence, a full-scale translation of these attitudes into selection criteria is essential. While skills and knowledge are seen as more technical competencies, the more underlying traits, values, motives and self-image are more of behaviour and contextual character. While most technical competencies can be measured during a tender by assessing the solution the vendor has in mind, behavioural competencies are quite difficult to measure since they are unique and personal related. No one can work as a professional for any length of time if being incompetent. Although there seem to be a positive correlation between experience and expertise, there is no proof this relation applies universally. In more complex tasks, experience does not provide the best results and needs to be combined with cognitive abilities in order to determine certain competency level (Ahadzie et al., 2013).

Based on the literature available for the selection of a project manager, two main clusters of competencies have been defined, the Technical and the Behavioural. Within the Technical competencies, two sub-clusters have been defined, the first one based on 'Knowledge' and the second one based on 'Skills related to project performance'. Within the Behavioural cluster, four sub-clusters have been defined, related to individual characteristics, to relations with others, to analytical skills and ethics and professionalism, under the organizational sub-cluster. A relational sub-cluster was mentioned in both the Technical as the Behavioural competencies and has been merged into one. Although competencies were mentioned under a Contextual cluster too, most of them were already repeated within the Technical or Behavioural cluster. The Contextual competencies were considered more relevant on the strategic level of the vendor's operation and for this reason, are not taken into account in this research. A summary of the defined clusters and sub-clusters according to literature is provided in Figure 10.

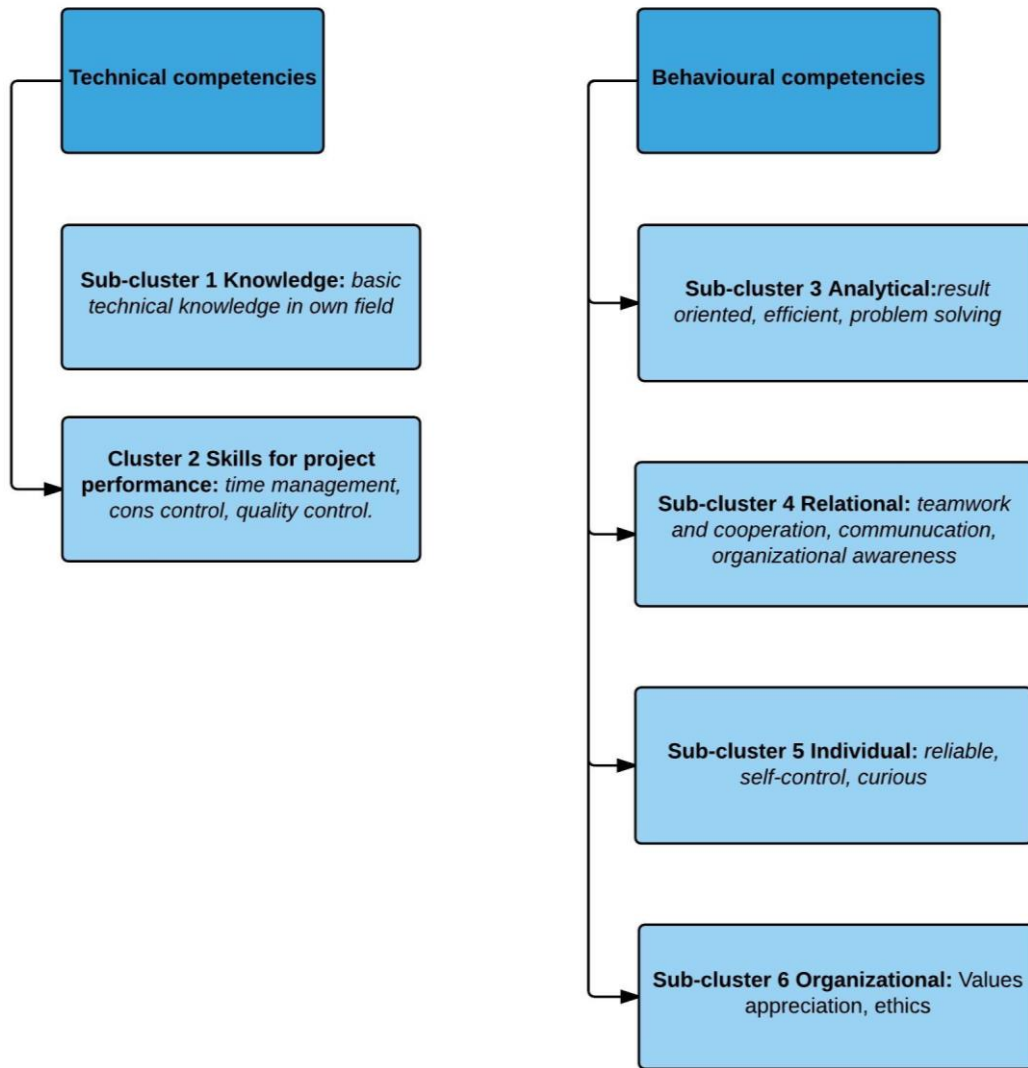


Figure 10 Competency clusters from literature

4. CASE STUDY ANALYSIS

4.1 CASE SELECTION

Different methods and sources are used to perform the research. While the literature study is used for the theoretical part, the main source of information for the practical part are the case studies. After the case study analysis, the framework for competence-based tendering in the civil engineering sector will be established.

A few selection criteria are established, based on which the cases for the analysis are chosen. In order to simplify the data collection, only cases in which Arcadis Nederland BV has participated are analysed. An overview of this and other criteria is given below:

1. Infrastructure projects of Arcadis Nederland BV on the client's or contractor's side
2. Executed in the last 10 years or in advanced stadium of execution
3. Tendered above the European threshold for works
4. Tendered with different procedures like Competitive Dialogue, EMVI or Best Value Procurement
5. With multidisciplinary character and executed under an integrated contract like Design & Construct or DBFM(O)
6. Projects tendered in the exploration phase for engineering services or for execution
7. Different clients like Rijkswaterstaat, Province Authorities and Municipalities.

The projects for the case studies have been divided into 3 categories based on their budget, see **Fout! Verwijzingsbron niet gevonden..** Next to this Arcadis Nederland BV as a consulting and engineering company has been involved either on the client's or contractor's side, giving in the total room for six projects. Since the BVP projects in which Arcadis Nederland BV is currently participating are not in an advanced stadium of execution, they have been excluded from the case study analysis.

Category	Arcadis Nederland BV in charge of:	Name	Client	Costs	Procurement method	Contract
Small projects <€25 million	Client	Noordwestelijke Randweg Zundert	Municipality of Zundert	€11.5 million	EMAT	D&C
	Contractor	Noordoosttangent Tilburg	Municipality of Tilburg	€10.1 million	Concession	D&C
Middle projects €25-€100 million	Client	A12 Parallelstructuur	Province Authority Zuid-Holland	€65 million	CD	DCM
	Contractor	De Haak om Leeuwarden	Rijkswaterstaat	€60 million	EMAT	D&C
Large projects >€100 million	Client	A50 Ewijk-Valburg	Rijkswaterstaat	€317 million	CD	D&C
	Contractor	A2 Maastricht	Rijkswaterstaat	€683 million	CD	D&C

Table 2 Cases selected for the analysis and their characteristics

4.2 CASE DESCRIPTIONS

The following sections provide a few characteristics of the six projects, together with a short description of the work and more information on the tender procedure performed.

4.2.1 Noordwestelijke Randweg Zundert

Client: Municipality of Zundert

Contractor: BAM Wegen

Project price: €11,5 million

Project completion: end of 2015

Tender procedure: Restricted procedure with selection criteria and EMAT award criteria

Contract type: Design & Construct

Description

The Noordwestelijke Randweg Zundert is part of the N638 provincial road between the E19 at Meer (Belgium) and the A58 at Rucphen. The project is prepared by the municipality of Zundert in collaboration with the Province Authority of Noord-Brabant. The project concerns the design and realization of the Noord Westelijke Randweg Zundert and the new bicycle bridge between the villages Klein-Zundert and Zundert. This new road will redirect the traffic from the centre of Zundert. In particular, the Molenstraat will become less crowded, more attractive and safe. Waterboard Brabantse Delta participates in the project with the construction of an ecological connection zone (*Ecologische Verbindingszone, EVZ in Dutch*).

Tender procedure

This project has been tendered under a restricted EU-procedure. After the public notice of the project, 14 parties signed in for the project. Based on the selection criteria, 9 equally qualified parties remained. The client wanted only 5 parties to take part in the tender subscription. Since 9 parties had the same score, they were drawn to 5 based on a draw. One of them was excluded because they did not meet the registration requirements. Four parties entered into the tender, of which two had a similar score at the end. BAM Wegen B.V. has won the tender and is executing the project until the scheduled end in October 2015. The EMAT criteria on which the tender took place were Quality optimization of design bicycle bridge and Landscaping, Limited traffic congestion and nuisance, CO₂ ambition level and Price.

4.2.2 Noordoosttangent Tilburg

Client: Municipality of Tilburg

Contractor: Arcadis Nederland BV

Project price: €10.1 million

Project completion: 2013

Tender procedure: Concession

Contract type: Design & Construct

Description

Noordoosttangent Tilburg is composed of the national highways A58 and A65 and the newly constructed ring for the N260 Burgemeester Letschertweg and N261 Burgemeester Bechtweg. De Bugeemeester Bechtweg, as part of the Noordoosttangent, had a limited capacity. Because of the strong economic activity of the area, a consortium of developers decided to develop a residential and a business park area in the area of Berkel Enschoot, together with the expansion of the tangent because of the additional pressure expected. Over the entire length, the road is changed to a minimum of 2x2 lanes.

Tender procedure

A concession between the Municipality of Tilburg and the consortium was signed. The consortium had all project responsibilities with one clear premise: to outsource the realization of the project on the market, according to the procurement policy of the Municipality of Tilburg. They did not see the execution of the project as their core business and were not able to do that on their own based on a few complexities in the project like the transportation of a SABIC pipeline under the railway, doubling the capacity of the road and the construction of power lines. Not a contractor but an engineering company with execution branch had the expertise to execute and, even more, important manage the project. Based on a few consultations, both parties agreed to outsource the project to Arcadis Nederland BV, who themselves had to put the project on the market and manage the successful completion of the project. Based on risks and different trade-offs Arcadis Nederland BV decided to tender the work based on traditional contract. They also had to participate in the tender of the rail viaduct themselves, which ProRail put on the market. Arcadis Nederland BV as having the overall technical and financial responsibility did not want another party to design the viaduct and invested in winning the tender for design, which execution was later on done by Ballast Nedam. However, in this case, the special relationship between Arcadis Nederland BV, the consortium and the Municipality of Tilburg is examined and not the procurement of sub-contractors, since that has been based on traditional contract and not on an integrated contract as taken into account in this research.

4.2.3 A12 Parallelstructuur

Client: Province Zuid-Holland

Contractor: Heijmans B.V.

Project price: €65 million

Expected project completion: end of 2016

Tender procedure: Competitive dialogue

Contract type: Design, Construct & Maintain

Description

The A12 highway is realized as a parallel structure, giving a significant boost to the accessibility and traffic flow in the Gouda region. The project involves two tracks: the Extra Gouwe Crossing (*Gouwe Kruising in Dutch*) and Moordrecht Arch (*Moordrechtboog in Dutch*). Besides design and realization, management and maintenance of the project. The Gouwe Crossing is one of the eight special objects, together with viaducts, tunnels, and an underpass beneath the main road by the A12 built. Since the environment is an important issue for the Province authority of Zuid-Holland, as a client, sustainable lighting and asphalt are used, in order to minimize maintenance needed.

Tender procedure

Based on a few complex aspects of this project like the construction of a bridge next to an aqueduct of RWS, the soft soil and the underpass of the A12 highway, the province authority of Zuid-Holland decided to outsource the project under a competitive dialogue. It has been the first time for the province authority to use this kind of procedure. According to the tender documents eight contractors were allowed to join the selection phase and eventually eight registered. They were asked to submit a project plan, where their philosophy on Risk management, Maintenance and Environmental nuisance had to be described within 3 A4 each. The client did not want to use a draw but wanted to make a conscious decision on the best three parties based on their plans of action. Three parties were selected to enter the negotiation phase, followed by an orientation meeting where parties were able to get to know each other. Contractors were asked to establish a dialogue proposal, being part of their concept application and based on which the second negotiation round took place. Having a concept proposal had two advantages: the contractor did not have to make a separate document for his final application

and would give the client a better idea of what the market was proposing. Two out of the three contractors had a solution in mind, where the underpass would go above the A12 highway, which would be associated with other noise calculations and zoning procedures. Although the province authority did see the advantages of this solution like less disturbance on the A12 highway, they wanted to have the maintenance responsibility of the underpass, which was only possible if the underpass would go underneath the A12. The contractors were asked to change their designs, based on which the EMAT criteria were tested and the winning contractor Heijmans BV chosen.

4.2.4 De Haak om Leeuwarden

Client: Rijkswaterstaat & Provincie Friesland en Gemeente Leeuwarden

Contractor: De Heak Súd (KWS Infra B.V. & Van Hattum en Blankevoort B.V. & GMB Civiel B.V)

Project price: €60 million

Project completion: 2014

Tender procedure: Restricted procedure with selection criteria and EMAT award criteria

Contract type: Design & Construct

Description

On the west side, the project is confined by the connection with the A32 highway, being an old DBFM contract of RWS. Coming from the south, two times traffic lights were keeping the smooth transition of the highway into a provincial road. A cut has been made between the responsibilities of the different clients involved. The Municipality of Leeuwarden is responsible for a few roads; Provincie Friesland has knowledge on the aqueduct at Sneek and, for this reason, is taking the northern part of the project for its responsibility. RWS, who is responsible for the southern part of the project, has the vision of keeping the contract together and has outsourced all the work to one consortium. The province authority derives the contract in three different parts, being the Aqueduct falling under their own responsibility, the highway crossing the railway three times being ProRail's responsibility and a third part contracted on the local market. ProRail is also involved in the southern part of RWS. In this case, only the purple part, which RWS is responsible for, is taken into account.

Tender procedure

The preparations of the tender were based on the Tracébesluit, where aspects that were important for the project were translated into award criteria. A spaghetti-like junction is created at an existing intersection. Dealing with traffic congestion and the accessibility of the area was an important award criterion. The other two were Sustainability and Risk- and Interface management. The latter had much to do with the fact that a separate collaboration between RWS and ProRail was expected on the southern part. Later on, this collaboration was changed, but the criterion was kept, still paying attention to a few important risks for the market. The three EMAT criteria were evaluated based on expert judgment. There was no pre-defined checklist. Two teams, containing the same type of experts were established. Each criterion was represented in the team by an expert, sometimes being an external one. Each plan was rated unanimously, after which the two teams sat together with the project manager to reach a final decision. Eventually, the collaboration between KWS Infra B.V, Van Hattum en Blankevoort B.V. and GMB Civiel B.V was chosen as the winning contractor.

4.2.5 A50 Ewijk-Valburg

Client: Rijkswaterstaat

Contractor: Waalkoppel (Mobilis, Van Gelder en Dywidag)

Project price: €317 million

Expected project completion: 2015

Tender procedure: Competitive dialogue

Contract type: Design & Construct

Description

The A50 between the junctions Ewijk and Valburg is one of the major traffic bottlenecks in the Netherlands. RWS broadens this road, therefore, in both directions. The road goes from 2x2 to 2x4 lanes, while an additional bridge is built over the Waal river, to the west of the existing bridge. In addition, the junctions Ewijk and Valburg are changed as well. With total costs of € 317 million, this project started in 2011 and was completed in 2014 (Rijksoverheid, 2011) under the integrated D&C contract based on functional requirements and conditions of the UAV-GC 2005. Competitive dialogue is used as a procurement method, where special attention is paid to the design of the additional Waalkruising.

Tender procedure

The selection criteria used in the competitive dialogue were the company's revenue, experience with the construction of a particular span of a bridge; experience with concrete or steel bridges, experience with System-oriented contract management and a few others. Four parties were allowed to enter the competitive dialogue while during the procedure one of them dropped out. Out of the three remaining contractors, two had similarly high scores, while the difference in price was still €50 million. The EMAT award criteria were: Planning, Limited Traffic congestion, Landscaping Waalkruising, Lifecycle costs (LCC) and Price.

4.2.6 A2 Maastricht

Client: Rijkswaterstaat, Provincie Limburg, Gemeente Maastricht en Meerssen

Contractor: Avenue2 (Ballast Nedam, Strukton)

Project price: Budget of €630 million, current realisation price €683 million

Expected project completion: infrastructure 2016 and properties 2025

Tender procedure: Competitive dialogue

Contract type: Design & Construct

Description

The Municipalities of Maastricht and Meerssen, Rijkswaterstaat and the Province of Limburg have all expressed a need for improved accessibility to Maastricht and faster traffic flow on the A2 motorway. The Municipality of Maastricht also wished to improve road safety and quality of life for the surrounding neighbourhoods.

Tender procedure

In the case of the A2 Maastricht, no ready-made plan was available for the contractor. Based on the programme of requirements, the planning area, the budget and the property opportunities, the market was asked to design the best total solution for the traffic-related problems within infrastructure as well as the wished on planning and urban development. This innovative and comprehensive approach ensures that knowledge of the market can be used optimally, provides advantages in the price/quality ratio of the plan and avoids the selection of a design that cannot be realised or is too expensive. The five parties that met the selection criteria showed that they are able

to improve the flow of traffic on the A2 and the accessibility of Maastricht, promote the quality of life and traffic safety, remove barriers in the city and create opportunities for urban development.

In the assessment of the plans, two things are paid special attention: the final solution and the situation during project execution. The accessibility of Maastricht and limited inconvenience for local residents are extremely important. The assessment is done by an independent commission of experts: the Award Advisory Committee, with professionals in the field of administrative and social development, traffic engineering, urban planning, environmental and (construction) technical field. In addition to the Award Advisory Committee, a Tender Board is set, who ensures the procurement process and has an advising role (Projectbureau A2Maastricht, 2007). In July 2009, after a procedure of 2 years, the consortium Avenue2 between Ballast Nedam and Strukton won the tender with its plan 'De Groene Loper'. This party was able to comply with the project requirements and implement as many wishes of the client as possible within the fixed price (Lemans, 2010). As a consultant to the consortium, Arcadis Nederland BV is responsible for various components of the plan, ranging from Environmental Impact Assessment to road design.

4.3 CASE STUDY ANALYSIS PER CASE

This section presents the results of the interviews of client and contractor of the six cases on the competencies that have been taken into account in the specific tender procedures. The competencies on which the vendor must be selected are not presented in this section but are used only for the cross-case analysis in paragraph 4.4.

4.3.1 Noordwestelijke Randweg Zundert

During the interview the client explained that in a tendering procedure it is not only important what the vendors are writing in their proposals, but how they will actually live up to what they are promising

"It was supposed to be a narrow bridge, one that would not be notable in the landscape. Yet there were vendors who came up with a very dominant bridge. It is important to read carefully what the client wants." - Client Noordwestelijke Randweg Zundert

to the client. This means that the vendor must not just have a good solution in mind, but have an idea of managing the whole process and living up to the expectations. The difference between the two best parties based on the award criteria was according to the client minimal. When one vendor has given just one more example of the usage of sustainable materials in the project, the final score in the award criteria is influenced although on the level of details. Considering the competition aspect of a tendering procedure, this means vendors must challenge themselves and really deliver the most value for the client. The contractor was chosen on specific award criteria like landscaping and limited traffic congestion but must also have some competence in recognizing the risk for the client according to the interview performed with the client from the Municipality of Zundert. During the assessment of the vendor, the client made use of expert judgement, where groups of experts had to score the vendors and then form discussion about the trade-offs.

Although the winning vendor had completed his project organization according to the IPM roles on paper, in practice the client says project organization has been underestimated as an EMAT criteria. He was disappointed by the fact that in the end different roles were performed by one person. The

client is however also conscious of the flexible character of the industry where employees are set on another project or decide to change themselves. In that kind of situations already the backup person must be known and have been assessed too, in order to cover all the processes in the project. The vendor's team and especially the project manager from that team need certain qualities like knowing how to deal with project control, being able to take decisions and having the authority of doing so. A suitable way of measuring those competencies is having some kind of interview setting where past performance can be discussed. Other competencies that have been underestimated according to this client are knowledge of the responsibilities that come with with an integrated contract and stakeholder management. Contractors put a note in the mailbox of inhabitants about the start of the work, but that is not the active attitude that is expected from them.

Just as the client, the interviewees from BAM Wegen BV, the winning contractor, agreed on the fact that the EMAT criteria and especially landscaping have played an important role when awarding the contract.

“Landscaping was very important at Zundert. Often, the entire design depends on landscape architects and architects, and it takes some time to tune everything. Some things are very decisive for the rest of the work. Also for the EMAT criteria.” - Contractor Noordwestelijke Randweg Zundert

According to the client, the short lead time of a tendering procedure and how the vendors manage to deliver an integrated proposal within that limited time available are essential for winning the tender. Processes like landscaping, engineering, planning, execution and design run parallel to each other and although, in a lot of cases the contractor was missing the interaction with the Municipality of Zundert, they managed to recognize the interests of the client. This contractor recommends more contact and open dialogue between client and contractor during the tendering procedure, in order to find a solution with the best fit of the requirements and limit different interpretation of ideas. A presentation is according to BAM Wegen BV a suitable method of solving this problem and visually showing that certain solution is feasible too. This way the vendor gets a chance of showing their solution, but also a chance of answering the clients' questions. After a presentation however, a vendor should have time available to improve his submission. Although, on a higher level of the company, BAM uses team role tests when developing the team, this is not a common procedure on the local level where BAM Wegen has done this project. According to them doing an assessment of the team member competencies during a tendering procedure does not make it clear on what grounds the contract is awarded. As a client you can compare the expected team performance against each other during the selection phase, but not on the level of the individual and not in the award phase. If you want to do that, the criteria for fixing the team members must be established. The ones who prepare the tender must also be the ones executing the project, which is not realistic according to BAM. A better method is taking past performance of the company and the team into account. Giving this criterion a weight of 25% still gives inexperienced vendors a chance of winning the tender by the other qualitative criteria.

They, however, won the tender based on their competencies of using the people with the right experience in the field, being able to make decisions with uncertainties and knowing what is technically feasible in the project. According to BAM, certain aspects of a project like risks are easy to measure, while others like stakeholder management are not, since it is difficult to foresee the reaction of the

environment. However, all factors must be approached integrally, taking into account dependencies and trade-offs. When selecting a party to work with when preparing a tender, BAM Wegen BV very often takes the experience of this party into account before working together. This makes it possible to actually live up to what has been promised in the tender, where according to the contractor they were able to achieve 95% of what they promised and allowed changes to occur only on the lowest level of detail. According to this contractor however a competence-based tendering is more suitable for the bigger project because of the higher amount of interfaces, sub-projects, employees available from the vendor and employees from the client available to assess those competencies.

4.3.2 Noordoosttangent Tilburg

The project is tendered with a concession contract between Municipality of Tilburg and the consortium. In earlier phases of the project, the Municipality of Tilburg had tried to put the contract through a traditional contract on the market, but that did not work out well technically and financially. For this reason, the concession procedure was chosen. By the time this project was in the preparation phase, this representative of the consortium states that there were almost no engineering companies with the experience needed to bring this project to success. Arcadis Nederland BV was already involved in the spatial planning of the project, and consultations between the consortium and the Municipality of Tilburg clearly showed that because of their expertise and the fact that they were already known with the team, Arcadis Nederland BV would be a suitable party for the contract. For the Municipality and the consortium, this decision was taken based on the experience of Arcadis Nederland BV and the confidence that this was a company that can handle the complex situation.

The interviewee from the consortium, in this case, has a strong opinion on the fact that the core of a tendering procedure should not be how to select and who to select, but how to make sure the problem gets solved:

“Of course we need people with expertise who are capable and know what they are doing. I trust that our people have those competences. However, the relationship between our team and the client is what really matters... You have to give the client the feeling that it is going well and that we will deliver the results we agreed to. But creativity is important. When the customer is having a particular problem, how well do we handle the situation and how fast can we come with a perfect solution.” – Client Noordoosttangent Tilburg

In order to be in line with public law regulations, the construction of the road was in this case added to the total development of the area and the procurement policy of the Municipality of Tilburg transferred to Arcadis Nederland BV, who received the obligation of procurement. According to him in a tendering procedure, everyone concentrates on the solution and not on the relationship with the client. It is first important to take a step back, find out what the concerns of the client are and then distinguish as a vendor. Only this way the potential solution is one that solves the real problem and fits in the requirements of the client, something that Arcadis Nederland BV understood really well and this case and something that contributed to the success of the project. This representative of the client recommends traditional contracting for small projects and open dialogue for bigger projects. During a dialogue it is important for the vendor to analyse the attitude of the client, his answers and this way

steer the conversation in a certain direction that is important to the client. A vendor should talk to the client about the problem and not about the solution and can easily be assessed on his competencies based on past performance.

The contractor on the other side does recognize the importance of the fit of personalities aspect, but also recognizes the importance of optimizing the design of the client on technical aspects, by saying:

“There is also a lot happening on a personal level, do I like you or not and are we going to be able to come to a final product. In the end I think that is very important. Expertise is also important, but there has to be a click on a personal level too ..Also on the technical side, we have made very clear to the municipality that the standard asphalt construction they were planning to use, was not a good construction in terms of maintenance and acoustics...In the past we have shown that can deliver good quality on time without having any trouble with money and without making too many mistakes” - Contractor Noordoosttangent

According to him, the incentive to bring a project to success from both sides is important. The key competency of Arcadis Nederland BV that helped them through the negotiations and the execution is that they have a complete range of services and disciplines, which make an integral approach possible. The complexity of the project was not in the technical aspects, but in the different management disciplines like keeping the residents satisfied, the accessibility of the area and the collaboration between the different parties like clients, ProRail, SABIC and subcontractors. Arcadis Nederland BV was able to live up to the expectations during the execution and even when the road was not accessible on time because of late delivery of the tubes for SABIC, Arcadis Nederland BV prevented a claim from the owners by temporary emergency road access.

When talking about the personal characteristics of the team members the interviewee from Arcadis Nederland BV reflects in few personalities that were involved in the project. According to him especially the project manager must be clear, have a consistent approach and live up to the commitments made.

4.3.3 A12 Parallelstructuur

During the interview the client highlights the focus that was paid to the technical specifications during the tender:

“The winning contractor received the highest score for quality and also had the lowest price. What we requested up front was especially technical. It was all about project management, planning, long-term maintenance, limiting traffic congestion and good spatial quality. These are all fairly technical matters and not really competencies.”- Client A12 Parallelstructuur

According to the interviewee, some parties are better able to express their ideas in the written documents because those are large contractors who also prepare tenders for Rijkswaterstaat. It is important to be specific within risk management, knowing about the weak soil in the area and the bridge near the aqueduct, instead of getting lost in general stories.

Personal characteristics should not be taken into account, as follows from this interview. In this project, it was a small criterion, which could have been left out according to the client since changes occur on the contractor's side, but also on the client's side. Asking continuity from the contractor is not fair when the clients' organization recommends to its employees to change their project each 5 years. The province authority of Zuid-Holland has used the fit of personalities as criteria in the tender once but found that difficult to score that in a transparent way. The people on the contractors' side, who are involved in the negotiation are highly educated and have the soft skills already. For this reason, the client recommends to base a tender on aspects that are easy to measure, just like technical solutions.

A competency that was underestimated was system-based contract management, and although it has been mentioned in the tender documents, more attention should have been paid to it according to the client especially because of the low price of construction submitted by Heijmans. At the same time in a competitive dialogue procedure, a real dialogue must take place, which according to the client was not the case. Since it was the first time for them to perform this procedure, they were careful and restrained in their answers and information given. They wish they had given the contractors more space through the contract and through the procedure, to be the expert and find the best solution.

According to the contractor, the procedure was well shaped where in the first round the vendors were filtered based on their plan of action. He agrees with the fact that more space could have been created during the competitive dialogue in order to utilize all chances. The procedure, however, had a long lead time, and the quantity of documents that had to be provided was a lot. When during the tendering procedure, in between the preliminary summations and the final ones, the client changed the price quality ratio from 40/60 to 60/40, the winning contractor won the tender through "determination, the flexibility and the motivation and persistence to keep the team together in that long procurement phase, with the aim of delivering the best results possible." They started looking for a way of guaranteeing the specified quality within the low price. At the end, they compromised by using the special foundation they had in mind only where really needed, which limited the costs. Next to this Heijmans had all the expertise needed to execute the project and scored well on their risk management- and traffic congestion plans. Just like the contractor of Zundert, this contractor is a proponent of presentations of the vendors in front of each other. However, he does not consider additional time for adapting the submitting but thinks the envelopes can be open right away, after which the prices are filled in and the winning vendor known. Within their tender team, Heijmans uses Human Dynamics, in order to get insights in the personal profiles of the members and discuss them. Heijmans also works together with an independent party, which in some project help the creation of a group profile for them and the client, in order to understand each other's drives and find out where potential conflicts are hiding.

4.3.4 De Haak om Leeuwarden

During the interview with the client, he explains that in total 3 quality EMAT criteria and 1 performance criterion have been used during the procedure, being respectively Less traffic hindrance with traffic management and planning of the Werpsterhoek junction as sub-criteria, Sustainability, Project control with Risk management and Interface management as sub-criteria, and Less traffic hindrance as performance criterion. The client, however, recommends the use of maximum 3 criteria, which makes reaching a unanimous decision during an expert judgement easier. In the case of de Haak om Leeuwarden, all 7 parties that made it through the selection criteria were allowed to participate in the submission phase. About the differences between the 7 participating vendors the client says:

“Limiting traffic congestion was one criterion, Sustainability, Risk- and Interface management others...With the D&C contract, we have not heavily judged on competences, but you can read in the papers that some parties understood very well which problems the client was having. Other parties still think in terms of what they’ve done in the past and try to use window dressing. Some parties really understood what the concerns of the client were on sustainability. You also have parties that make a beautiful plan but the real question is how well they will execute it.”- Client de Haak om Leeuwarden

The two parties, who has the best submissions had good scores on quality and price. According to the client, having high scores on both aspects reflects on how well the contractors have thought about the project. During project execution, the vendor who won, lived up to the promises and no problems occurred in terms of traffic flow and stakeholder management. Risk management on the other side should be shaped in a different way during a procedure according to the client. Contractors often use a RISMAN method, which does not give them the possibility to distinguish themselves from one another. They can add value, by making risks and mitigations specific to the project and not concentrating on the process of risk management itself, since that only results in general stories. Collaboration between client and contractor cannot be enforced. If people are able to work to each other’s interests and have the same mindset, they can succeed, and both make a profit. But the fit of personalities cannot be captured on paper, and for this reason, every procedure should have a competitive dialogue or alliance element, before the award phase. CVs do not say much since completely different people are part of the tender team and the execution team and relevant competencies like keep to agreements cannot be measured through CVs. Individual competencies can only be included in a tender, under the condition that the team members are fixed. But the most important thing during a tender is still the content and the solution, and not the expert behind it, because that’s where vendors have their distinctive character. The client of the Haak is a proponent of presentations since the story behind the written documents comes to life and transaction costs are decreased. Emotions and judging on subjective parties must be however limited somehow.

From the interview with the contractor, it became clear that they did not win the project based on the lowest price. The contractor had the strategy of delivering a more realistic price, and this way have a positive influence on the relationship with their client during the execution phase. Although they only scored a 6 on Interface management, they were able to distinguish as a vendor by the other EMAT criteria and the fact that they had worked out CO₂ calculations for the Sustainability criterion. The

project consisted of roads, structures and traffic systems such as traffic control, public lighting and signalling and traditionally three companies, KWS, Van Hattum & Blankenvoort and Vialis would take responsibility for their part. In order to match the interests of these companies and reduce conflicts, the whole organization was taken differently, and Volker Infra took the responsibility regarding the overarching activities, decisions and coordination of the three disciplines.

4.3.5 A50 Ewijk Valburg

The client of A50 Ewijk-Valburg pays special attention to how vendors participating in the vendor were different from one another. According to the interviewee from Rijkswaterstaat the difference in scores on quality and price, both expressed in the monetary unit was a lot, which could be traced back to the material choices made by the vendors, which also influence the maintenance (costs) of the construction.

“Partly we selected on knowledge, but there were also very clear differences in approach. The EMAT criteria that we used were Planning, Design, Maintenance and Limiting traffic congestion. When looking at design of the bridge in particular, we noticed very quickly that one of the parties was engaged with one solution, while others still had 10 000 variants. I found it quite remarkable that they had a different strategy of how they will approach the tender. The vendor who from day one was working on one variant, continuously engaged the ratio of one criteria to the rest so he would be able to improve the entire offer integrally. That vendor took all the possibilities together and hence always considered what to do. The winning vendor had the best scores on the four EMAT criteria and also had the lowest price, so that was all positive” - Client A50 Ewijk-Valburg

In the course of the procedure, one vendor received a warning, because they were too concentrated on the price, and did not leave any room for the architect. The client made it really clear that they would not make it through this round if they didn't score a sufficient grade on landscaping. That vendor turned everything around and then concentrated too much on the design of the bridge, not paying attention to the price aspect. That vendor did clearly not have a strategy of how to approach the client's problem.

During the tender of A50 Ewijk-Valburg, the client did not ask the vendors for a project plan but did that as a selection criteria for filtering the vendors participating in the next big tender of A28/A1 project Hoevelaken. The essence of a project plan is, in particular, the integral approach, how the vendors are able to translate the clients' interests into a specific solution, not how will deal with risk management on its own. Contractors should not just concentrate on the solution, but should respond property to the clients' interests. Knowing that RWS is a process oriented authority, they should focus on providing a good overview of the critical processes instead of fragmented units. That's why instead of concentrating on the competencies of individual team members, who will probably change during the course of the project, the client wants to know how vendors will organize the project and its processes. During the interview, the client once again involves the recent tender of Hoevelaken where planning study, design and execution of a single contract. For Rijkswaterstaat, this is an innovative project, where public law and the people involved there who want to take well-thought decisions, can be in

conflict with the ones involved in private law during project execution. Who want to concentrate on the progress. In that case, the client needs a contractor who understands the existing dilemmas.

The interview of the client is a proponent of assigning vendors through expert judgement, where experts per EMAT criteria come together and gather about the submissions. Client's team is then available to review the consistency, without judging the vendors in terms of value. This is a method, which they have used in the tender of A50 Ewijk-Valburg. During the tender also, special attention was paid to the collaboration between client and contractor. Vendors were allowed to question what the client wanted, which improves the project itself and the final submissions of the vendors. It also creates incentives for working in one's another interests and decreases frustration and discussion from both parties during project execution. If anything was unclear, the client prefers people to talk to each other, than to take ambiguities within written documents and cause different interpretations. The client is also a proponent of having a dialogue in all kinds of projects, except traditional contracts. According to the client, not involving lawyers in the procedure also contributed to a success, since layers cause a cramped attitude from both client and contractor. In retrospect, the client looks back at a successful procurement procedure and is happy with the choice of contractor.

During the interview with the contractor of A50 Ewijk-Valburg he explains that in order to meet the minimum requirements of the project, they had to find partners who had sufficient experience with steel and concrete bridges. To get high scores on the different EMAT criteria, Mobilis also looked for architects and other specialists per criterion. A team of people from different parties with different knowledge fields was assembled, after which the first draft idea was made. As a contractor, it is important to know what is technically feasible and constantly attempt to objectify your decisions towards the EMAT criteria. So you need to give space to creativity in the beginning and quite quickly make trade-offs and take hard decisions:

“Actually from the beginning we made trade-offs around the bridge. With steel you can make a lot more wild forms, so the architects get more freedom and you might score better on the landscaping criterion. We distinguished ourselves by making a concrete bridge with a large span. Others couldn't do that. The costs were low too, due to the choice of concrete.”- Contrator A50 Ewijk- Valburg.

Experience is according to the contractor a suitable selection criteria, for the client to find a contractor who certainly knows how to execute the project. It's good to have the right people on the wheel, and useful to consider how skills play a role. On performance measures, the same company might get a high score once and a low score for another project. This has to do with the team composition and conditions. But it is tricky how team member skills are assessed. An interview can be performed with project team members, with checking their CVs and references, but that criterion should have a weight if 10% and not more than that. Performing group role tests, and monitoring the team is also a possibility, but still should not be used as the decisive criteria for choosing the vendor according to this contractor. The EMAT criteria must be project-specific. The contractor says that vendors must give their team members the space to be creative and generate ideas, after which decisions are made, and the price is determined critically. In the execution phase, three main competencies are important, the cooperation with the client to get the right things done in a short period of time, process orientation: realize the importance of the process and the right capturing of it and having all documentation in

order: be able to transfer the project without any problems to the client. Especially in a D&C contract, collaboration remains important, since it's not the companies who work together, but the people. The contractor reflected positively on all three aspects and was able to live up to everything that was promised. Design stayed the same, but Mobilis succeeded in causing even less traffic hindrance and less maintenance costs at the end.

The most important recommendations given by the contractor is a culture change in the construction industry. To limit conflicts and disappointments from both sides, contracts need to be awarded on more realistic value. The same recommendation was also given by the contractor of de Haak om Leeuwarden. Next to this, if the contractor knows what the client wants, but that has not been described in the contract or has been described unclearly, you need to get the chance to speak that out before taking a risk and having the risk of discussions later on.

4.3.6 A2 Maastricht

Since the contractor of A2 Maastricht did not participate in the interviews, individual report of this case study only presents the results from the client. Within the innovative tender method to that time, based on the integrated UAV-GC contract, vendors received a set of requirements and a fixed price. On top of this, there were wishes. The requirements must be met within the set budget, but the party who succeeds in filling the most wishes next to this becomes the winner. According to the client the winning contractor lived up to the expectations on limiting traffic congestion:

“Traffic flow was a top requirement. Through dealing smart with changes in the traffic system, Avenue2 managed to limit the inconvenience to road users to an absolute minimum. The increase in the traffic jams during project execution was minimal and the additional delays were acceptable for the road users.” – Client A2 Maastricht.

This client from the Municipality of Maastricht suggests to involve contractors in the process of determining the weights of the criteria, which decreases the subjectivity, gives vendors the feeling of getting involved which improves the relationship and contributes to a better projects. When selecting a project, this client says that technical knowledge must be the core competence and can easily be measured through past performance on other projects. The experience does not have to be on a project with similar financial scale, but a project with equal complexity.

4.3.7 Competencies on which the vendor was selected

Competencies on which the vendor was selected	Noordwestelijke Randweg Zundert		Noordoosttangent Tilburg		A12 Parallelstructuur		De Haak om Leeuwarden		A50 Ewijk-Valburg		A2 Maastricht
	Client	Contractor	Client	Contractor	Client	Contractor	Client	Contractor	Client	Contractor	Client
Landscaping	✓	✓							✓	✓	
Recognize the interests of the client	✓		✓		✓		✓	✓	✓		✓
Design project specific solutions	✓	✓			✓		✓	✓			✓
Limit traffic congestion	✓				✓	✓	✓		✓	✓	✓
Integral approach		✓		✓	✓		✓	✓	✓	✓	✓
Expertise		✓	✓	✓		✓		✓	✓	✓	
Technical feasibility		✓			✓			✓		✓	
Planning		✓		✓	✓			✓	✓	✓	
Flexibility				✓		✓					

Risk management					✓	✓		✓			
Habitat corridor	✓										
Sustainability	✓							✓			
Problem solving			✓								
Result oriented			✓			✓					
Creativity			✓			✓					
Fit of personalities			✓	✓							
Maintenance costs									✓		
Spatial Quality					✓						
(Written) Communication skills		✓			✓						
Quality control				✓							
Motivation/ Determination						✓					
Process oriented						✓					
Interface management								✓			

Table 3 Competencies on which vendor was selected

4.4 CROSS-CASE ANALYSIS

This section presents the cross-case analysis of the cases. In the first paragraph, the main clusters of competencies are determined and supported by quotes. In sections 4.4.2 and 4.4.3, the two main clusters are further specified within sub-clusters.

4.4.1 Findings on competency clusters

Two main types of competencies have been distinguished within the case studies. The first one 'Technical competencies' includes all competencies or factors that are covered by expertise and experience level of the vendors participating in the tender. More supportive quotations on the formation of the technical cluster can be found in Appendix C.1

"It always starts with knowing what you can do with the different products, materials and techniques.. Technically, everything must be in order, otherwise nothing is going to be built. When you really know what the project is about, then it's a matter of trying to explore the boundaries of what is technically possible. "- A50 Contractor

Next to this another main cluster based on more soft-competencies or behaviour has been created. The reason is that during the interviews a lot of non-technical factors have been mentioned, which also shape the selection procedures. More supportive quotations on the formation of the behavioural cluster can be found in Appendix C.3

"For me the fit of personalities is very important, not only between colleagues but also between our employees and our customer. Also having a problem solving approach. You have to give the customer the feeling that things will go well and that we will deliver the results we agreed on. However, the relationship between our team and the client is what really matters."- Noordoosttangent Tilburg Client

4.4.2 Findings on technical sub-clusters from case studies

Based on the answers given during the interviews, two sub-categories of competencies have been identified within the technical cluster. The first one 'Process oriented' includes different project management fields like Risk management and Quality control, where the winning vendor is expected to have experience with. Those processes are essential for the completion of the project within the requirements set by the client. More supportive quotations on the formation of the technical sub-clusters can be found in Appendix C.2

“Quality control it’s a very important competence in my eyes”- Contractor A12 Parallelstructuur; “Contractors need to know about the processes of the project.”- Client Noordwestelijke Randweg Zundert; “The importance of process-based working is increasing too”. – Contractor Noordwestelijke Randweg Zundert; “A client should ask the contractor how he will be dealing with changes and how he will be preventing them”- Contractor de Haak om Leeuwarden

Next to this another sub-category set is Project specific. Clients and contractors have expressed the importance of designing specific solutions for the specific situation set. Within Sustainability or Traffic congestion, for example, vendors are expected to find solutions that best fit the requirements of the client and the stakeholders involved. Those project specific technical competencies were in some cases EMAT criteria since they have their focus on the final product.

“We have set out two questions: create an overall traffic management plan and create a planning for Werspsterhoek junction. Those are two very specific questions and they have been given answers. Risk management will always keep a place, but you have to make it specific because otherwise you get standard stories from all contractors.” - Client de Haak om Leeuwarden

The specific technical competencies based on which the vendor must be selected during a procedure, according to the interviews with client and contractor, are given in the following overview.

	Competencies on which the vendor must be selected	Noordwestelijke Randweg Zundert		Noordoosttangent Tilburg		A12 Parallelstructuur		De Haak om Leeuwarden		A50 Ewijk-Valburg		A2 Maastricht
		Client	Contractor	Client	Contractor	Client	Contractor	Client	Contractor	Client	Contractor	Client
Technical cluster												
Process oriented sub-cluster	Process oriented	✓	✓				✓		✓		✓	
	Planning	✓										
	Quality control	✓					✓					
	Stakeholder management	✓										
	Experience (with integrated contracts)	✓		✓								
Project specific sub-cluster	Design project specific solutions		✓					✓				✓
	Expertise		✓	✓	✓	✓			✓	✓		

Table 4 Technical competencies on which vendor must be selected

4.4.3 Findings on behavioural sub-clusters from case studies

Within the behavioural competencies, two sub-categories have been set, based on the answers given during the interviews. The Strategic & Analytical subcategory describes the approach which the vendor has when taking part within the tender. It also includes some attitude aspects like result orientation and determination and some analytical aspects like the ability to take decisions with uncertainties or certain problem-solving skills. More supportive quotations on the formation of the behavioural sub-clusters can be found in Appendix C.4

“I found it quite remarkable that each vendor had a different strategy of how they will approach the vendor. The vendor who from day one worked on one variant, was continuously engaged in the ratio of one criterion to the others and was able to improve the entire offer. While others were following a fragmented progress, where at the end it had to come all together”- Client A50 Ewijk-Valburg

The ‘Relational’ sub-category within behavioural competencies describes the relation between client and contractor. Its main focus is based on the understanding of ones’ another interests.

“Competence is also the personal skills of your team and the extent to which you can simply cooperate. Although those soft skills are difficult to catch, I am convinced that this really is a success factor: the extent to which you say are able to work together, the degree to which you are able to delve into the interests of the people on the other side of the table and what they worry about. This relational aspect is applicable not only to the project manager, but for all members of the team.” – Contractor A12 Parallelstructuur

The specific behavioural competencies based on which the vendor must be selected during a procedure, according to the interviews with client and contractor, are given in the following overview.

	Competencies on which the vendor must be selected	Noordwestelijke Randweg Zundert		Noordoosttangent Tilburg		A12 Parallelstructuur		De Haak om Leeuwarden		A50 Ewijk-Valburg		A2 Maastricht
		Client	Contractor	Client	Contractor	Client	Contractor	Client	Contractor	Client	Contractor	Client
Strategic & Analytical sub-cluster	Problem solving				✓							
	Result oriented		✓		✓		✓					
	Creativity			✓							✓	
	Integral approach	✓	✓								✓	
	Critical									✓		
	Recognize the interests of the client		✓	✓				✓	✓			
	Distinguish important information						✓					

Relational sub-cluster	Collaboration		✓				✓	✓		✓	✓	✓
	Trust											✓
	Project organization	✓								✓		
	Have empathy						✓					
	Fit of personalities		✓	✓	✓							
	Communication skills	✓	✓					✓			✓	
	Teamwork		✓									

Table 5 Behavioural competencies on which vendor must be selected

4.4.4 Findings on competency (sub)clusters

During the interviews clients and contractors have mentioned that the selection of a vendor is mostly on technical aspects, where also the strategy of the contractor plays a role. Clients find it important for vendors to show how they will use their expertise to design project specific solutions and how they deal with the integral character of the project.

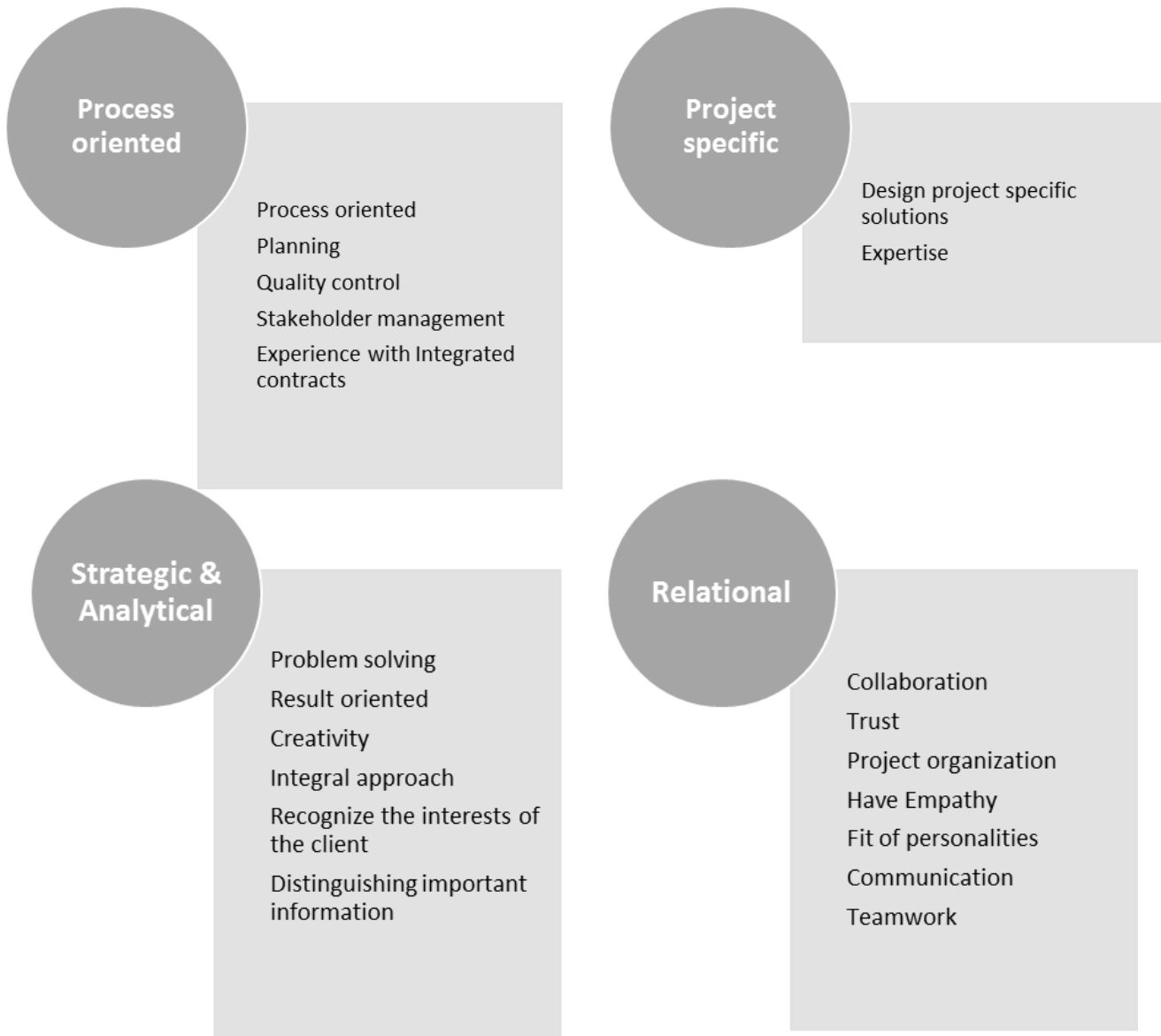


Figure 11 Competency sub-clusters

The aspects that are important during the tender procedure and on which somehow vendors should be assessed are not only about the solution and the strategy but also involve the relationship between client and contractor. Not only in competitive dialogue procedures like A12 Parallelstructuur, A50 Ewijk-Valburg and A2 Maastricht, but also in other restricted procedures answers have been given on

involving the relational aspect in the tender procedure. This results in the sub-clusters on which vendors must be selected according to the case studies, shown in Figure 12.

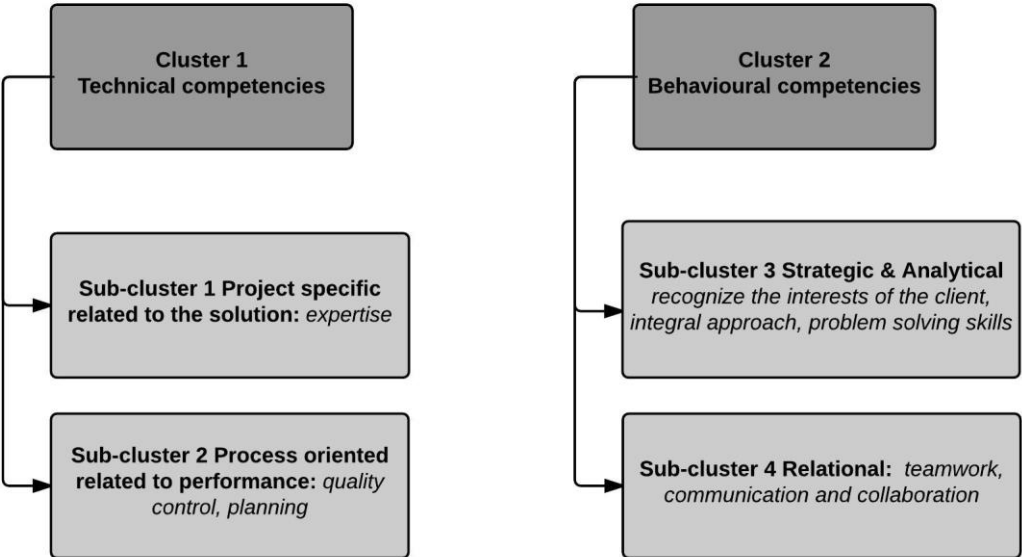


Figure 12 Competency clusters and sub-clusters

4.4.5 Findings on competency based approach

Next to the questions on competencies that have been taken into account in the cases and competencies that must be taken into account when selecting a vendor, Interviewees were also asked to give general opinion and recommendations on competence based selection procedures. Although the ideas given were not too specific, they have been summarized into recommendations, presented in this section and furtherly used in Chapter 6 as input for answering the third research question.

Be proactive as a client, have more interest for the contractor. Clients must let go of the solution space they have in mind. Organize a pre-team building between client and contractor to speak out issues and improve collaboration and subscriptions. Create room for real open dialogue between client and contractor. – In order to give room for these recommendations in the tendering procedure, the cluster measuring ‘Relational’ competencies should be used in an early phase of the tender. The most suitable completion of these recommendations in the procedure is not through a passive method like an assessment, because it does not create the room for an open dialogue. If the client wants to elaborate the recommendations in his procedure, then it is advisable to organize a joint activity, where the relational skills of the vendors are assessed, but also the fit of personalities with the client.

It is important to know what the competencies of the team are, but it is extremely difficult to assess that during a tender. Do not make competencies of the contractor and his team the decisive award criterion. - For this reason in the designed procedure, competencies of the team or individuals are taking the place of selection criteria and not of award criteria. Competencies of the team or team members are used as a filter in order to pre-select the party, which most fits the client. After the use of assessment, interview or another method, at least three vendors are asked to work on their tender subscription, focussing on the solution. Based on another recommendation, clients should limit the amount of vendors entering the award phase to a maximum of five.

Award criteria should be based on the solution. Create incentives for shared risks.- This recommendation follows up some explanation given about project plans within the previous paragraph already. Optimizing the client's initial requirements can be used as a selection criterion or as an award criteria. A disadvantage, however, is that when used as award criteria, the optimization is performed quite late in the tender, where the expectations from the vendor are even higher. However, being in line with current European law on tendering, clients and contractors agree on the fact that award criteria should be project specific and should not involve any personal characteristics of team members. The recommended amount of criteria used is between three and five, which is a reasonable amount of criteria for the client to assess, but also gives vendors a chance of distinguishing himself.

4.5 REFLECTION ON THE COMPETENCIES BASED ON WHICH VENDORS WERE SELECTED AND THE COMPETENCIES ON WHICH THEY MUST BE SELECTED

Through the interviews with client and contractors questions are asked on the competencies that they selected the vendor on and the ones on which the vendor must be selected. The competencies on which the vendor was selected were are mainly used in section 4.3 to evaluate the opinion the client and contractor on the specific tender procedure per case. The answers on the competencies based on which the vendor must be selected are mainly used in section 4.4 on the cross-case analysis based on which the competency (sub)clusters are created. It is useful to, however, reflect on the differences between what competencies are currently used and what must be used according to the interviewees.

Comparing Table 3 with Table 4 and 5 shows that there are three types of differences being:

- Competencies that **have been used in the cases** and **were mentioned** to be of general importance when selecting a vendor.
- Competencies that **have been used in the cases**, but **were not mentioned** to be of general importance when selecting a vendor.
- Competencies that **have not been used in the cases**, but **are mentioned** to be of general importance when selecting a vendor.

The first category includes competencies that have been used in the cases and were also mentioned to be of general importance when selecting a vendor. Those competencies are: *Recognize the interests of the client, Design project specific solutions, Integral approach, Expertise, Planning, Problem solving, Result oriented, Creativity, Fit of personalities, (Written) Communication skills, Quality control and Process oriented*. Expertise seems to be the most often mentioned competency for a vendor to be selected on. In the case analysis Recognize the interests of the client and Integral approach were more often mentioned to have been used (mentioned by respectively 7 and eight interviewees in Table 3), than to be suggested as important competencies (both were mentioned only four times in Table 5). This might have to do with the relation between the Strategic & Analytical cluster with the 'Project Specific' one further explained in section 6.3 Implications for measuring competency (sub)clusters.

The second category is made of competencies that were used in the cases but were not mentioned to be of general importance. Those competencies are *Landscaping, Limit traffic congestion, Technical feasibility, Flexibility, Risk management, Habitat corridor, Sustainability, Maintenance costs, Spatial Quality, Motivation/Determination and Interface management*. Excluding 'Flexibility' and 'Motivation and determination' all others are aspects that have directly been used as EMAT criteria in the tender. Since those aspects were not mentioned to be important, they have not been assigned a cluster or sub-cluster. Having a closer look, however, shows that most of them like Landscaping, Limit traffic congestion and Technical feasibility can be assigned to the Project specific technical cluster. The fact that they have not been mentioned to be important when doing the selection does not mean that they

are not. During the interviews, client and contractor did explicitly mention how important the solution of the vendor is. Those competencies have not been mentioned probably because they are too project specific and dependent on the unique character of the project.

The third category is represented by competencies that have not been used in the cases but are mentioned to be of general importance when selecting a vendor. Those competencies are: *Stakeholder management, Experience (with integrated contracts), Critical, Distinguish important information, Collaboration, Trust, Project organization, Have empathy and Teamwork*. The first two competencies are from the Strategic & Analytical cluster, the following two from the Process oriented, and the last five from the Relational cluster, where the collaboration competency is mentioned to be important by more than half of the interviewees. The competencies described in this section are the ones which are most relevant for this research since their absence in competencies on which vendors were selected and their presence in the list of competencies based on which the vendor must be selected, indicate a gap between current and recommended practices of selection. This finding gives the impression that in general competencies from the cluster of Process oriented, Strategic & Analytical and Relational are underestimated or neglected in current practices for the reason of their difficult integration in a procedure according to the interviewees.

5. RESULTS

This chapter presents the results on the competency clusters based on which the vendor must be selected. First of all the findings on competencies from literature and case studies are compared in section 5.1. After that the final (sub)clusters of competencies based on which the vendor must be selected are presented in section 5.2. Section 5.3 provides an evaluation of the (sub)clusters by Arcadis Nederland BV experts and a few implications that came across the meeting with those experts.

5.1 COMPARISON OF COMPETENCY (SUB)CLUSTERS FROM LITERATURE AND CASE STUDIES

In this section, the comparison of competency clusters found in literature and case studies is performed. In the first section of this chapter the comparison is first performed for the technical cluster and in the second section, it is done for the behavioural cluster and its competencies.

5.1.1 Technical competencies

Within the literature study of paragraph 3.2.2, Clustering of Technical competencies, two sub-clusters based on knowledge and project performance were determined. Within the case studies and 5.1 Technical competencies from case studies, the clusters focussing on the solution and the processes came out. While the sub-cluster of knowledge from literature describes the basic technical knowledge needed to achieve project success, that exact knowledge is what is needed for the vendor to design project specific solutions. In order to deal with sustainability, traffic congestion or maintenance the vendor must have certain knowledge of what is possible and how different design aspects like material influence the whole project. The skills described in literature needed for project performance at the same time are quite similar to what in the case studies has been described as process oriented. Management aspects like risk, quality, costs and planning present in both sub-clusters are essential for the project success of a project.

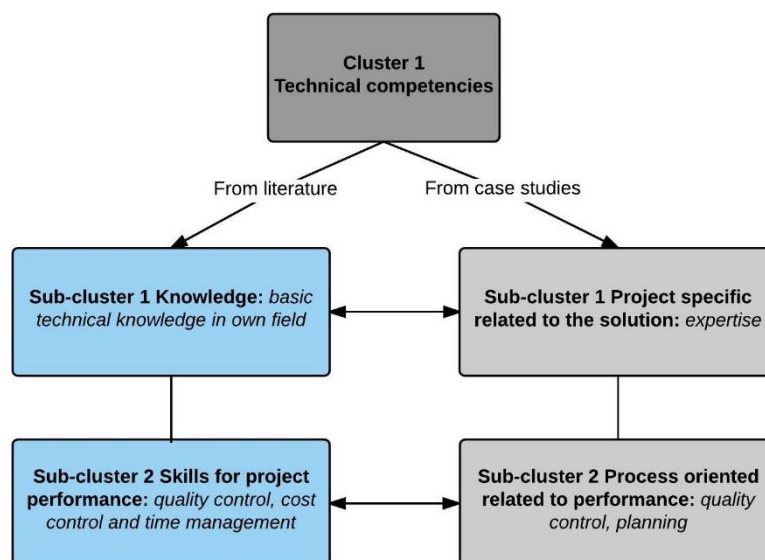


Figure 13 Technical sub-clusters from literature and case studies

5.1.2 Behavioural competencies

Within the literature study, four sub-clusters were determined, the Individual one, Analytical one, Organizational and Relational. Comparing this with the results of the case studies it can be stated that the Analytical and Relational are available once again. In both cases, the Analytical includes competencies like 'Result orientation', 'Creativity', 'Problem Solving' and 'Decision making'. Within the Relational one communication and collaboration, are elements seen in both sub-clusters. However, the Individual and Organizational cluster cannot be found back in the case studies. The reason, therefore, can be the fact that literature study is mostly based on the selection of the project manager which explains the missing link of individual competencies in the case studies. In a few interviews, it is even said that personal characteristics should not be taken into account during the tender.

"If you are talking about personal characteristics, I hesitate a little bit if you should put that on focus during tendering procedures. If you look at our team, the former project manager was a whole different personality than me. There has been another stakeholder manager and there is also another contract manager. This is an example on our side, but it also happens at the side of the contractor. If you want to base a project on projecting the personalities from the client on the personalities from the contractor you're doing the wrong thing. What you actually want is work with a contractor, who gives you the confidence of him doing the right thing."- Client A12 Parallelstructuur

Although not used in the case studies analysed in this research, personal characteristics are sometimes seen in tenders as selection criteria or award criteria. CVs of key experts including criteria as qualifications or professional experience can be taken into account in the tender. Since the main object of this research is to find out how important clusters can be measured, it is up to the client himself to judge whether to take or not to take the sub-cluster with individual competencies into account. The following sections are meant to find out whether there are any dependencies between the sub-clusters, how they can be measured and whether certain recommendations can be given on where to use the individual competencies and where not.

The reason why organizational competencies are not seen in case studies is probably because they are on a high level and not exactly project specific. Organizational competencies are vital to the company's effectiveness and efficiency. Identifying potential and developing new talent are part of it. Next to this all of the company's practices must be applied professionally and according to the codes of ethics.

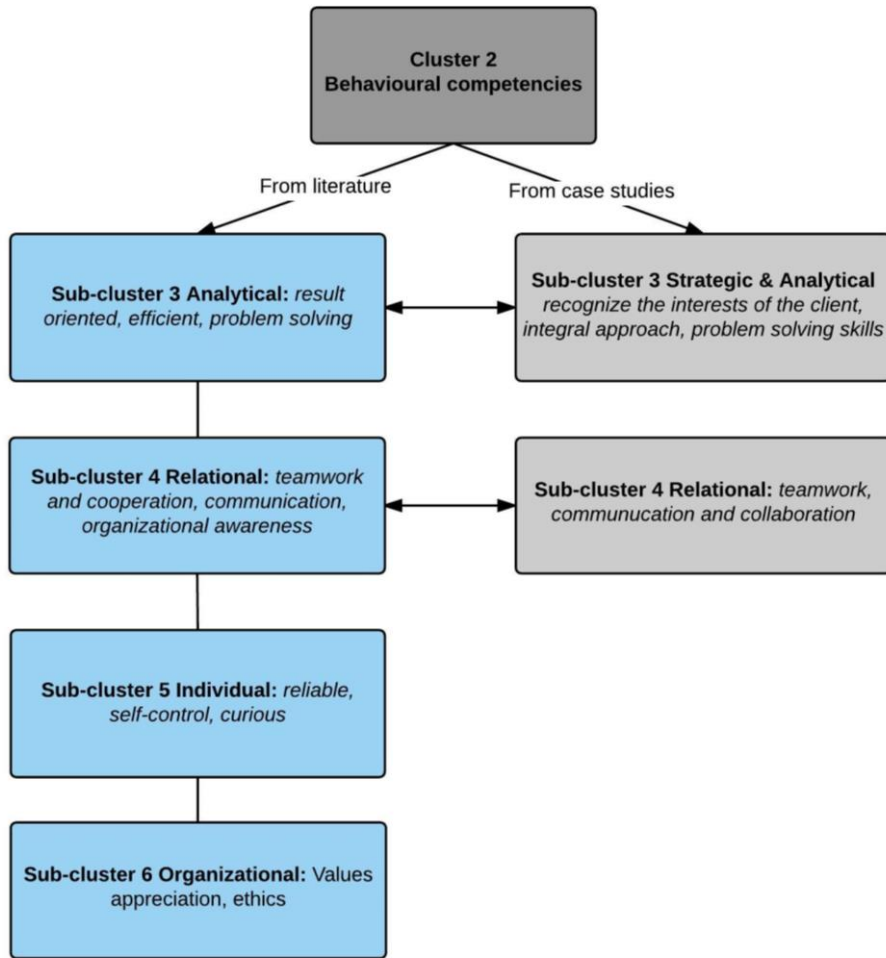


Figure 14 Behavioural competencies from literature and case studies

5.2 DEFINING FINAL (SUB-)CLUSTERS OF COMPETENCIES

The final sub-clusters of competencies are shaped by both the 'Project specific' and 'Process oriented' technical competencies. Within the behavioural cluster, the 'Strategic & Analytical' and 'Relational' both seen in literature and case studies, together with 'Individual' and 'Organizational' only mentioned in literature are taken into account.

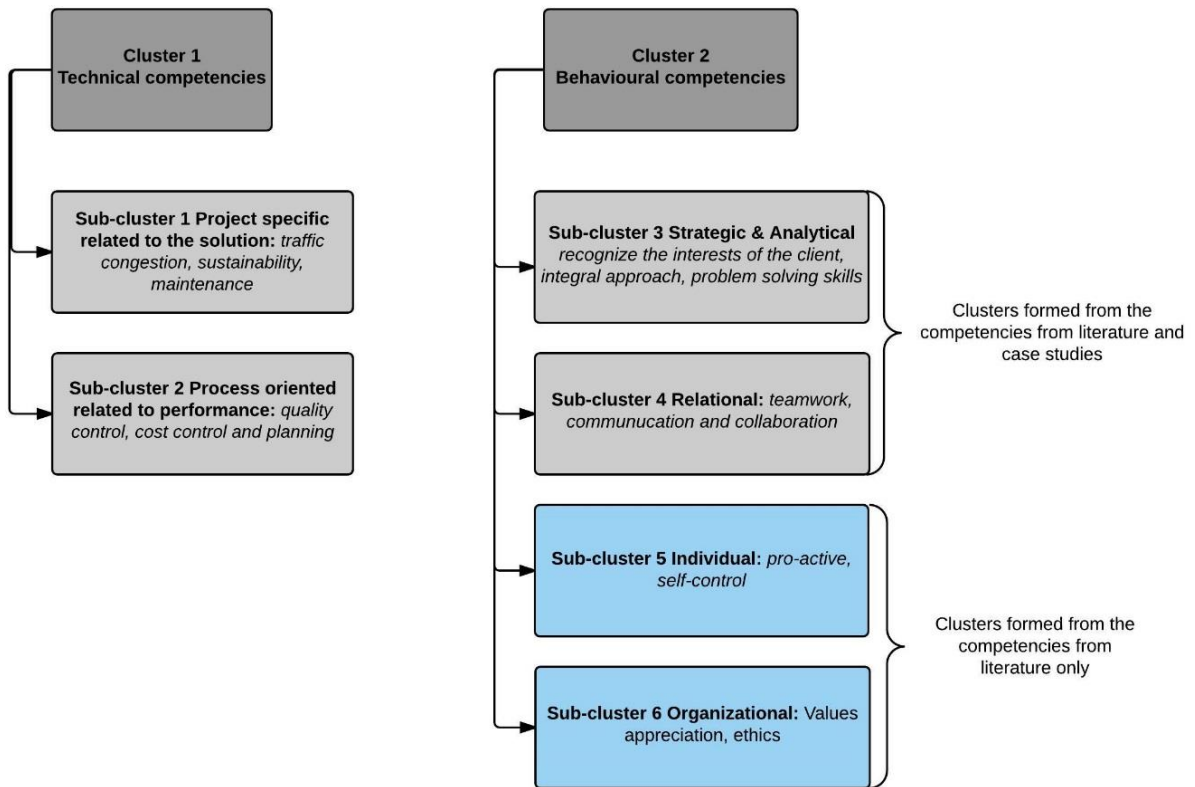


Figure 15 Final clusters of competencies

Since interviewees were sceptical on including individual characteristics in a tendering procedure, and since organizational competencies are relevant only on a higher strategic level, including sub-clusters 5 and 6 in a tendering procedure is optional for the client.

5.3 EVALUATION OF COMPETENCY (SUB)CLUSTERS

The final (sub)clusters of competencies have been presented and evaluated by four Arcadis Nederland BV experts. During this meeting, the experts unanimously agreed on the importance of sub-clusters 1 to 4 in a tendering procedure. Just as most interviewees from the case studies, they were sceptical about the use of sub-clusters 5 Individual and 6 Organizational in the tender. During the meeting, however, also two other subjects have been discussed, which are further explained in the following sections.

5.3.1 The use of competency (sub)clusters in contractual context

Knowing the preliminary results of the research in the form of sub-clusters of competencies defined, during the meeting the experts were asked to give recommendations on competence based tendering. According to them, the first step of implementation is to prioritize the clusters within different contexts. The context which the Arcadis Nederland BV employees were thinking about was within different kind of contracts, although it was clear to them that the scope of this research involved procurement procedures and not contracts. As followed the four employees ranked each cluster within three different types of contracts being Engineering & Contracting, D&C and DBFM. The results from this ranking are presented in Appendix D Evaluation of sub-cluster importance by Arcadis Nederland BV.

Sub-cluster 5 Individual and 6 Organizational are ranked as least important in almost all cases. Within the E&C contract, the experts ranked sub-cluster 1 Project oriented and 4 Relational as the most important ones. The results are followed by 2 Process oriented, 3 Strategic & Analytical, 5 Individual and 6 Organizational. An E&C contract has limited design freedom, which explains why sub-cluster 3 Strategic & Analytical is not as important as sub-cluster 2 Process oriented. Project control and quality control under NEN-EN-ISO 9001 certificate are important aspects of an E&C contract (Rijkswaterstaat, 2015), which explains the high ranking of the process oriented sub-cluster.

For a D&C contract sub-cluster 3 Strategic & Analytical is ranked as the most important one. This can be explained by the fact that within a D&C contract, there is still design freedom, for which the contractor is responsible. At the same time, the contractor must make trade-offs and this way limit costs, maintenance or other aspects. After that sub-cluster 4 Relational and 2 Process oriented seem to appear most often in the highest ranking. The collaboration between client and contractor is important since the contractor is making a design based on requirements and scope set by the client. It is remarkable however also to see that sub-cluster 1 Project specific does not appear in the top 3 ranked sub-clusters while sub-cluster 3 Strategic & Analytical does. According to the experts, it is more important to have a certain strategy in mind of how to solve the client's problem in an efficient and effective way than the solution itself.

Just as for the D&C contract, similar results can also be seen for a DBFM contract. However, the long-term collaboration between client and contractor makes sub-cluster 4 Relational more important than in D&C. In decreasing importance sub-clusters 2 Process oriented, 1 Project specific, 5 Individual and 6 Organizational have taken their spot in the ranking.

Although no firm conclusions have been taken based on the results of the expert meeting, there are a few relations that are noticed and used for the discussion chapter. The more design freedom and responsibility given to the contractor, the more important sub-cluster 3 Strategic & Analytical seem to be. When a long-term collaboration between client and contractor is expected, the more sub-cluster 4 Relational becomes important. In almost all cases sub-clusters 5 Individual and sub-cluster 6

Organizational are ranked as the least important ones. That seem to be in line with the results of the case studies, where clients and contractors all recommended not to use individual characteristics of the team members as decisive criteria for awarding the project.

5.3.2 Measuring of competency (sub)clusters

Another subject discussed during the meeting is the specific translation of the sub-clusters in selection- and award criteria. In order to implement the clusters within a tendering procedure, it is necessary to find suitable methods for measuring them. During the meeting methods for measuring the sub-clusters like *Project plans*, *Past performance*, *Satisfactory explanation*, *Interview and Assessment* were mentioned. A project plan is a specific plan, which explains where the potential contractors see risks, how they will deal with them and how they plan to organize the project. It concentrates on the specific project of the tender, in contrast to past performance, where contractors show their achievements on other projects. Satisfactory explanations are based on third parties judgement on the past performance of the vendor and do not concentrate on building up the current relationship between client and contractor. An assessment could be a suitable method for measuring the relational cluster and is currently used in Australian construction procedures according to the experts.

Although some difficulties with competency measurement were mentioned in Chapter 1, finding suitable methods for measurement and evaluating them is outside the scope of this research. It is important however to link the findings of the sub-clusters to the methods of measurement that have been mentioned through the interviews and expert meeting. Although not extensively supported by data or literature the implications of competency measurement are further explained in section 6.3.

6. DISCUSSION AND RECOMMENDATIONS FOR COMPETENCE BASED TENDERING

This chapter presents the discussion of this research and gives recommendations for competence based procedures, which is the answer of the third research question.

6.1 COMPARISON OF RESULTS FROM LITERATURE AND CASE STUDIES

To answer the first two research questions, competencies based on which vendors must be selected according to literature and case studies have been investigated. There are two types of differences between the results: differences on the level of the sub-clusters found from literature and case studies and differences on the level of the specific competencies within the sub-clusters. While the last ones should not be forgotten, only the first ones are discussed in this section since that is the level chosen for the research. There are a few possible explanations of the *'Individual'* and *'Organizational'* sub-clusters from literature to not be mentioned through the case studies.

The first one concerns the Individual sub-cluster and has already been mentioned in section 4.3.4. It is about the fact that the team members preparing the tender are in most cases different than the ones executing the project. Two other reasons are further explained in section 6.3, but briefly presented here. Competencies are difficult to measure while clients and contractors want to shape the procedure around specific measurement criteria. Individual competencies can be measured through CVs or group role tests, but there is no benchmark, and certain competencies cannot be measured on paper. Sub-clusters are not completely independent, and either are competencies. As long as there is no clear idea about the best measuring methods and competencies stay dependent, including *'Individual'* characteristics in the tender, will be critical.

The *'Organizational'* sub-cluster also has some dependencies with other sub-clusters. The fact that it is not mentioned in the case studies does not mean that it is not considered to be important for the clients. From all sub-clusters defined, this one and its competencies are considered the vaguest ones and raise the question whether they are relevant to a tendering procedure. While the literature mentioned competencies like Value appreciation and Ethics, which have been combined into the *'Organizational'* sub-cluster, competencies like Sustainability, Corporate Social Responsibility and Innovation might also be part of this sub-cluster. The reason why they have not been mentioned is maybe because clients and contractors see them as a part of some other sub-cluster.

6.2 IMPLICATIONS FOR DIFFERENT CONTRACTS AND TENDERING PROCEDURES

6.2.1 Relating results from expert meeting to research findings

As part of this research, an evaluation meeting of the clusters of competencies has been performed with Arcadis Nederland BV experts. As explained in section 5.3 during this meeting the clusters and sub-clusters of competencies have been presented, after which the employees had the chance to brainstorm about the possible integration of the clusters into a tendering procedure. An important finding during this meeting is the fact that the experts started thinking in terms of different contracts when appointing selection procedures. Although the cases taken into account during the analysis were executed under different integrated contacts, the relation between competencies and contracts was in the first place outside the scope of this research. However, both experts and interviewees agree on the fact that individual and organizational competencies are the least relevant when selecting a vendor for an infrastructure project. According to the experts, the importance of sub-cluster 4 Relational

increases when a long-term relationship between client and contractor is expected in a DBFM contract. However none of the projects taken into account has been executed under a DBFM contract, for which the suggested relation cannot be compared to the results from the interviews.

The evaluation with Arcadis Nederland BV experts also shows that the more design freedom and responsibility given to the contractor, the more important sub-cluster 3 'Strategic & Analytical' seem to be. Since in the only DBFM case, sub-cluster 3 'Strategic & Analytical' was not mentioned, this statement is related to the only case with a DBM contract being the A12 Parallelstructuur. While the client interviewed for this case did not mention any strategic or analytical skills to be of importance when selecting the vendor, he did select his vendor on the recognition of the client's interests and the integral approach. This might mean that especially the competencies from the behavioural cluster are not directly measured in a tendering procedure but unconsciously influence the choice that the client makes. This once again reveals the difficulties involved with competency measurement.

6.2.2 Relating research findings to Best Value Procurement

While this research took only value based procedures into account, in this section it is important to make a review on how the results of this research reflect on competency-based procedures like BVP. As explained in section 1.2 the idea behind BVP is to deliver the best value for the lowest price, where for vendors it is important to translate their knowledge according to the corresponding BVP philosophy. BVP does include a few elements that are in line with the results of this research. During the procedure, vendors are asked to show their competencies related to the process based on projects plans and their analytical skills through selecting the dominant information they want to show. The relational aspect is not present since during interviews questions are one-sided (from client to contractor), and there is no room for dialogue as a recommendation from this research. The project specific competencies emerge clearly later on in the clarification phase of BVP, where the project is already awarded. In BVP procedures, individual characteristics of key players are also assessed while according to this research this should not be the case because of the flexibility to change team members. The interview setting in current BVP procedures is used as 30% of the quality criteria, while based on the insights given by the interviewees, an interview is considered to be a more suitable method for clarifying the ideas of the vendor, than for the better distinction of vendors from one another. For this reason, it is suggested to decrease the weight of the interview, change its setting with one with more open dialogue and combine the interview with a more defined and specific method for measuring like expert judgement.

6.3 IMPLICATIONS FOR MEASURING COMPETENCY (SUB)CLUSTERS

Next to the methods for competency measurement already mentioned in section 5.3.2 Measuring of competency (sub)clusters, a few methods were also mentioned during the interviews. Those methods are *Expert judgement*, *Presentation and Group role test*. An expert judgement was used during the tenders of Noordwestelijke Randweg Zundert, de Haak om Leeuwarden and A50 Ewijk-Valburg and includes the assessment of the potential solutions not by the client, but by external experts on the different EMAT criteria. According to the clients who have used this method, it is an objective method of measuring since the client himself has a controlling role and is not participating in the scoring. As explained in the case study analysis the contractors of Noordwestelijke Randweg Zundert and A12 Parallelstructuur, and the client of de Haak om Leeuwarden have expressed their recommendations on involving a presentation in the tendering procedure. A group role test is suggested by the client of A50 Ewijk-Valburg with the marginal note of not making it a decisive criterion of awarding the project. The methods of measurement mentioned in the expert meeting and through the case studies, however, are limited and do not provide a full scale of possibilities.

This paragraph explains why the found sub-clusters of competencies in this research are difficult to relate to the measurement aspect mentioned in the interviews and the expert meeting. There are a few reasons:

- **Each sub-cluster consists of more competencies**

The sub-clusters of competencies defined through the literature study and the case studies have different separate competencies within them. In this research, it has been chosen to work at the level of the sub-clusters, while the fact that each cluster consists of more than one competency should not be forgotten. Within the ‘Strategic & Analytical’ sub-cluster for example, problem-solving and decision-making skills can focus on experience in the past, but can also be assessed for the specific project of the procedure.

- **Not all competencies mentioned are actual competencies**

The competencies found through both literature and case studies are very often not formulated as competencies. For example, Cost control is not a competency but a project management aspect, which could be translated into a competence by saying it is “the ability of the contractor to deal with cost control.” Through the interviews, the fit of personalities between client and contractor has been mentioned, which also is not considered to be a competence but a relational aspect. According to some of the interviewees this aspect is either there or not. According to the author of this research, however, this aspect can be developed in case client, and contractor have an open attitude and create shared incentives. In all cases, these aspects become clear during project execution and are difficult to assess in the selection- and award phase.

- **Sub-clusters are dependent**

The cluster competencies determined from literature and case studies are not completely independent. The solution, which the vendor is asked to make should always fit the interests of the client. The submission of the vendor should be an integral approach between project-specific aspects. The strategy of the vendor is, in this case, determinative for the solution that is going to be created.

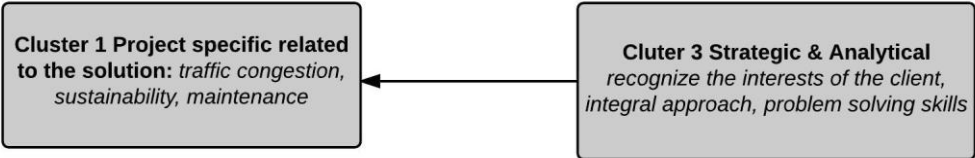


Figure 16 Cluster dependencies (1)

Next to this, the personal characteristics of the individuals are not self-contained but contribute a lot to the relational cluster. Being pro-active or self-confident does not have an influence on the project on the individual level, but on the team level. Self-control is also not relevant when not applied in the context of the team. The organizational values must also be pursued by all individuals, where a professional attitude of the contractor will always contribute to a better relation with the client.

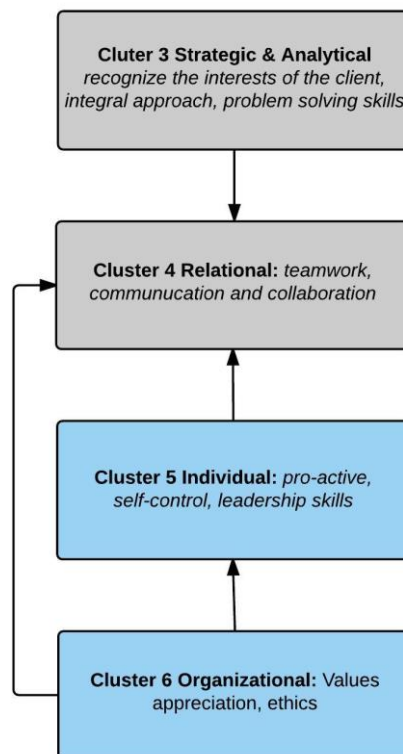


Figure 17 Cluster dependencies (2)

- **Each method might be suitable for the measurement of more competencies**

The limited methods of measurement mentioned through this research might be suitable for the measurement of more than one competency or more than one competency cluster. What is assessed during a presentations or interview depends on what the client wants and the specific configuration of the method. During an interview, the client can concentrate on the key players and their communication skills or ask questions about the solution.

Although not supported by any data or literature, the following table is based on the own interpretation of the author on which methods are suitable to measure certain competency clusters. The interpretation is based on all findings from the research, insights from the interviews and expert meeting and common sense.

When selecting suitable methods of measurement for the competency clusters, the client is advised to think about what he wants to achieve through the measurement: 1) Clarify the ideas which the vendor presented in the selection phase, or find out if some competencies are still missing, 2) Validate what he has already measured or 3) Distinguish the vendors in detail from one another. For example, if in the award phase, the client wants to validate the potential solutions, it is recommended to do that by expert judgement. If the client wants to clarify what is missing, he should use presentation or interview. If vendors' scores are quite similar, and the client wants to distinguish them better from one another, he should use an assessment of an independent party. Interview and presentation are not suitable for this function since it is difficult for the client to guarantee the objectivity of the evaluation.

	Expert judgement	Project plans	Past performance	Satisfactory explanation	Interview	Presentation	Assessment	Group role test
Cluster 1 Project specific	✓	✓	✓		✓	✓		
Cluster 2 Process oriented		✓	✓		✓	✓		
Cluster 3 Strategic & Analytical		✓	✓		✓	✓	✓	
Cluster 4 Relational		✓		✓	✓	✓	✓	✓
Cluster 5 Individual				✓	✓	✓	✓	✓
Cluster 6 Organizational				✓	✓	✓	✓	

Table 6 Possible methods of measuring the sub-clusters of competencies

Sub-cluster 1 Project specific

Expert judgement is one of the methods listed in Table 6 for measuring the project specific ideas of the vendors. During an expert judgement, the potential solutions are not assessed by the client but by external experts on the different subjects, part of the EMAT criteria. This method is mostly objective since the client himself has a controlling role and is not participating in the scoring. Project plans are also project-specific but provide only a brief overview of the idea. During an interview or presentation, vendors get the chance to explain their plans. Those are suitable methods for clarifying certain information, but not for validation.

Sub-cluster 2 Process oriented

A project plan is a specific plan, which explains where the potential contractors see risks, how they will deal with them and how they plan to organize the project. It concentrates on this specific project, in contrast to past performance, where contractors show their achievements on other projects. Past performance is, for this reason, less effective and can be used but always before the project plan. Measuring sub-cluster 2 is possible through an interview and presentation because the client is able to ask in-depth questions about the vendor's approach.

Sub-cluster 3 Strategic & Analytical

The strategy based on which the vendor wants to solve the client's solution is indirectly shown by documents, part of the project specific sub-cluster as explained in section 6.3. This means that project plans already give a brief idea of the strategy. Past performance gives information on the results achieved in previous projects, but just like an assessment concentrates more on the analytical aspect of this sub-cluster than the strategic one. An important aspect that is missing in assessments and past performance in order to measure sub-cluster 3 more effectively is the translation of certain analytical skills into practical problem resolutions. All three methods, project plans, past performance and assessment concentrate only on one aspect and do not provide a comprehensive method for

measuring the sub-cluster. Within an interview or presentation ideas come to life and vendors receive more room for explaining how they came to certain choices and how that will benefit the client. What was meant to be clear in written documents, receives room to be explained and is less of a subject to misinterpretations.

Sub-cluster 4 Relational

Group role tests can be used for measuring the relation between client and contractor, but there is once again no benchmark. The client might have an idea of kind of personalities he wants to work it, but he certainly should not only work with people who just agree with everything. So it is not clear how real expert's skills should exactly differ from the non-experts and to what extend the non-experts can have some of those competencies too. A test for good communication or collaboration skills does not exist, and even if it did, it should be normalized for the different types of team members participating in the tender (Shanteau, Weiss, Thomas, & Pounds, 2002). The second recommendation of paragraph 4.4.5 shows that according to interviewees, an assessment is not a suitable method to measure the relationship between client and contractor because it does not create a real open dialogue. The same counts for describing the collaboration incentives in a project plan. In some situations, it can be a good method when the results from the assessment are discussed during a meeting with client and contractor.

Sub-cluster 5 Individual

Interviews and assessments are commonly used methods in human resource management based on which people get hired. Competencies like assertiveness, reliability, curiosity and flexibility, being part of the individual sub-cluster, can be measured to a certain extend in an interview. Group role tests and assessments are more of situational judgement methods that concentrate on measuring individual characteristics like self-control, open-mind and reactivity in different situations. Presentations are only suitable for measuring a limited amount of competencies like communication skills and self-control. They miss the interaction aspects, which is necessary for the other competencies from the individual sub-cluster.

Sub-cluster 6 Organizational

During an interview, presentation or assessment, a vendor can be assessed on his professionalism. During an interview or presentation, he can explain the corporate values of the company and give examples of how that fits into the collaboration with the client for this specific project. During an assessment, different situations can be given, based on which the vendor must provide a reaction. Just as the satisfactory explanation, this is a passive method and does not guarantee certain positive and professional attitude further during project execution.

6.4 RECOMMENDATIONS FOR COMPETENCE BASED TENDERING

This section combines all findings from the literature study, case studies, expert meeting and discussion in order to provide a few recommendations on competence based tendering and answer the third research question.

1. It is the people and the solution that matter

While the title competence based tendering gives the impression that it concentrates on the selection of a vendor based on only its team members and their characteristics, the opposite is true. In a competence based tendering there should be room for the people and the solution. Whether the team that is preparing the tender actually recognizes the interests of the client and how it is able to translate expertise into a solution that fits the client's requirements is an essential competence.

2. An open dialogue between client and contractor is needed

Not only in competence based tendering but in all other procedures and tenders, it is recommended to create more room for open dialogue between client and contractor. In a competence based tendering the dialogue can be about the solution, about the relation between client and contractor or about results from assessments, interviews and past performance.

3. The client must determine what competencies matter to him

This research shows that selecting the vendor based on his competencies is not an easy task. Competencies are dependent, difficult to measure, and there is no benchmark for comparison. Not all competencies mentioned in this research are actual competencies but are factors that do have an influence on the selection- and award process. For the client to select the vendor expert, he must determine the competencies that matter to him.

4. Relate competencies to the contractual context

The evaluation meeting with experts shows that competencies can be prioritized in the context of the contract. The more design freedom and responsibility are given to the contractor, the more important the strategy of the contractor when developing a concept solution seem to be. When a long-term collaboration between client and contractor is expected, communication and teamwork play an important role. However, more research is needed on this subject before different contracts can be related to competence based tendering.

5. Competency-based tendering should be based on clear measurements

The whole tendering process should be based on clear and transparent criteria. However when including competencies measuring the right ones and measuring them effectively is extremely difficult, since some competencies cannot be measured on paper or are dependent. At the same time, there are restrictions on time, costs and law which shape the tendering process and the possibilities for selection or award criteria. Before entering into a competence based procedure, a client should determine the competencies he wants to measure, the best suitable methods and how to integrate this within the selection- and award criteria of a tender.

7. CONCLUSION, LIMITATIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

The first section of this chapter presents the main findings of this research by answering the three research questions and the main research question. Next to this, the limitations of the research and the recommendations for further research are presented.

7.1 CONCLUSION

This section presents the answers to the sub-questions and the main research question.

Q1: What are the key competencies on which parties should be selected according to literature?

The literature study of this research shows that parties should be selected on their Technical and Behavioural competencies. The first type of competencies concentrates on skills and knowledge, which during tendering procedures should be properly used and translated by the contractor into a feasible solution that fits the client's requirements. Next to this vendor's must be selected based on his skills for project performance and how to deal with risks and prevent cost overruns, also being part of the technical competencies. Parties should also be selected based on more soft competencies, being related to the 'Behavioural' competencies. Team members are expected to have analytical and problem-solving skills, which contribute to the selected strategy, based on which they prepare the tender. Vendors are also expected to have good relational skills, where good collaboration is expected within the team, but almost important with the client himself. According to literature, parties should also be selected based on individual characteristics of the team members and the professionalism of the company.

Q2: What are the key competencies on which parties should be selected according to case studies?

Through the case study analysis of this research, the 'Technical' and 'Behavioural' competencies are seen as well. Related to the technical competencies, contractors must have certain expertise level, which is essential for solving the client's solution. Competencies like experience with integrated contracts, or the ability to deal with quality control and stakeholder management are also process-oriented aspects being of importance when selecting the vendor. The ability of the contractor to recognize the interests of the client and deliver an integral solution, where all parts are aligned are considered important competencies related to behaviour. Next to this, just like in the literature study, according to the case study analysis parties should also be selected based on their collaboration and communication skills, among others being related to the relation between client and contractor.

Q3: What recommendations can be given when considering the use of competence-based selection?

When considering a competence based tendering it is not just important to pay attention to the competencies of the team members, but, even more, important to pay attention to how the team uses their skills to develop a solution which best first the client and his requirements. Next to this in a competence based selection, there must be enough room for dialogue between client and contractor. Relating competencies to the contract type used can help clients to determine better the competencies they want to select the vendor on. However in order to integrate competencies into a tendering procedure, more research is needed on the measurement methods of competencies.

Combining the answers from the sub-questions gives input for answering the main research question of this research being:

Based on what competencies should the vendor expert be selected during tendering procedures of infrastructure projects?

There are two main types of competencies based on which the vendor of infrastructure projects should be selected. The first type of technical competencies includes the expertise level of the vendor, his ability to translate his knowledge into a solution which fits the client's requirements and the specific situation and his ability to manage the process of project execution on quality, budget, planning, risks and others. The second type of competencies is related to the vendor's behaviour, and his underlying values and soft skills. Important competencies of the vendor are to recognize the interests of the client and to translate that into a strategy to deliver a suitable solution. The ability of the vendor to communicate and collaborate with the client is considered important as well. The findings from this research do not provide a unanimous answer on whether individual characteristics of the team members and organizational competencies should be taken into account when selecting the vendor during tendering procedures of infrastructure projects. Since more research is needed on this subject, for now, clients are advised to choose themselves on whether to include these competencies in a competence based procedure.

7.2 LIMITATIONS

This section provides a few limitations, based on the performed research and its results.

- **The literature study is based on the competencies of the project manager.**
The literature study is based on competencies of the project manager, assuming that they are valid for the whole team. However the literature should have taken into account more theoretical frameworks for example psychological factors that can influence the decision of a vendor and the client-contractor relationship.
- **The competencies from literature have not been validated through the case studies**
The literature study and the case study analysis were approached independently, for which the competencies from literature have not been tested in practice. Because of the explorative character of the research, only open questions were asked during the interviews and no questions that actually validated the literature findings.
- **The cases chosen for the analysis did not have their focus on selection on competencies.**
In order to simplify the data collection and the approach of interviewees only Arcadis Nederland BV cases have been taken into account. It was not of primary importance to select only competence based procedure like BVP since this research is meant to provide a general view of the measurement of competencies in tendering procedures. As a result of including only value based procedures clients and contractors very often talked literally about the selection- and award criteria used in the tender. In practice, it seems difficult to bring out the competencies that have been measured. Analysing project alliances like A2 Hooggelegen, where team members were selected based on their competencies for collaboration, or others from abroad like Lielähti-Kokemäki renovation project, Tampere Onshore Road – "Rantaväylä" and the Tunnel of Rantaväylä in Finland or Australia, could have been more suitable for this research.
- **The use of semi-structured interviews creates gaps in the data analysis**
Although in this research the use of semi-structured interviews is the most suitable method, because it gives the interviewees a chance of clearly explaining what competencies they measured, it also has its drawbacks. Asking different questions and going with the flow of the

conversation, causes gaps within the data and makes a comparison of answers sometimes not possible. For example, only a few times questions were asked on the selection- and award criteria that have been under- or overestimated. For this reason, some results have not been used in the cross-case analysis but only shown in the case study analysis per project.

- **Competence measurement remains complicated**

This research recognizes the difficulties concerning competence measurement, which has also been explained in the introduction part of this research. However not enough attention has been paid to this measurement aspect and how it can be improved. For this reason, the research does not provide a defined solution on how to measure competencies in a tendering procedure.

- **Competencies were compared on the level of the sub-clusters**

Competency clusters are not prioritized during the research and only the ranking of competency clusters for different contracts from the expert meeting with Arcadis Nederland BV provide a link of how the results of this research can be used in practice. Although the Project specific, Process oriented, Strategic & Analytical and Relational sub-clusters defined from the case studies were considered quite equal to the Knowledge, Skills for project performance, Analytical and Relational sub-clusters from the literature study, it is the sub-clusters that were compared and not the specific competencies within the sub-clusters, which is considered a limitation of this research.

7.3 RECOMMENDATIONS FOR FURTHER RESEARCH

The term competencies is about what the vendor is capable of doing while within the context of construction projects more attention must be paid to the vendor actually delivering his promises during project execution. In further research, it is recommended to find out how the competencies of selection- and award reflect on project execution since this research did not pay enough attention to this aspect.

This research's literature study concentrated on the project manager while in the future it is recommended to take all team members into account. Since the team members preparing the tender are different than the ones executing the project, it is recommended to examine further if and how the competencies needed for both teams are different from one another or whether there are general competencies valid.

The competencies and the competency clusters developed in this research are validated only through the expert meeting with Arcadis Nederland BV, but in future research, it is recommended to have a critical view on the results and perform a better validation. Next to this more attention must be paid to the specific competencies or aspects mentioned in this research since most of the analysis in this case is performed on the level of the sub-clusters.

More research on the specific translation of the strategy of the vendor and the relation between client and contractor in a tendering procedure is needed. The case studies taken into account concentrated on technical aspects, but the interviewees did recognize the importance of the strategy and the relation. However, the interviewees did not have a clear idea of how those competencies can be measured and implemented within tendering procedures as selection or award criteria, also to be in line with the tendering law.

In future research, it is also recommended to include more competency measuring methods and provide a more reasoned view on their effectiveness. This way a clear overview of the advantages and

disadvantages of each method is given, which helps the client to choose the best method and measure the competencies needed.

An important finding from this research is the fact that the strategy which the vendor has when participating in the tender is related to the type of contract involved in the project. Design freedom and responsibility for the contractor stimulate the use of analytical skills and the choice of a certain strategy. A long-term relation between client and contractor like in a DBFM contract stimulates the use of collaboration and communication skills. In further research is it recommended to find out how exactly competencies are related to the contractual context of the project.

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APPENDICES

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APPENDIX A COMPETENCIES OF THE PROJECT MANAGER

Technical competencies	Shahhosseini & Sebt (2011)	Edum Fotwe & McCaffer (2000)	Arendse (2013)	Cheng, Dainty & Moore (2005)	Crawford (2005)	PMI (2008)	Brill, Bishop & Walker (2006)	ECITB (2010)
1 Time management	1	1	1		1	1		1
2 Cost control		1	1	1		1		
3 Establishing budgets	1	1				1		
4 Stakeholder management	1			1	1	1		1
5 Teamwork	1			1				
6 Resource management	1		1				1	
7 Procurement & contract	1	1		1		1		1
8 Problem resolution	1							
9 Information & documentation	1					1		1
10 Monitoring & Controlling risk					1	1		1
11 Control & reports	1	1	1		1			1
12 Basic technical knowledge in own field		1						
13 Construction management activities		1						
14 Health, Safety & Environment				1				1
15 Defining project scope			1		1	1	1	1
16 Communicate effectively	1		1	1	1	1	1	
17 Develop project requirements			1	1	1	1	1	1
18 Develop project objectives			1				1	1
19 Facilitate project management processes			1			1		
20 Manage project meetings and correspondence			1	1				
21 Plan project economy			1			1		
22 Forecasting techniques		1						
23 Quality control		1	1			1		1
24 Employ co-operation of supply chain partners				1				
25 To champion company standards and approaches				1				
26 Responsibility awareness				1				
27 Team selection					1	1		
28 Organizational support					1			
29 Know how project success is measured			1				1	
30 To promote and share knowledge				1				
Ranked as important								

Contextual competencies		Shahhosseini & Sebt (2011)	Arendse (2013)	Similarity
1	Personnel management (team development)	1		#29 Team selection in Technical
2	Health, safety & environment (regulations)	1		#14 Health, safety & environment by Cheng et. Al (2006)
3	Limiting legal exposure	1		
4	Relation between temporary team and permanent organization	1		
5	Project orientation	1		Similar to Portfolio orientation
6	Systems, products & technology	1		
7	Finance	1		#2 Cost Control and #3 Establishing budgets in Technical
8	Portfolio orientation	1		
9	PPP implementation	1		Higher level than Portfolio Implementation
10	Business	1		Similar to permanent organization
11	Plan project economy		1	#21 Plan project economy
12	Develop PM professionalism		1	#15 Ethics in Behavioural
13	Plan project quality control		1	#23 Quality
14	Perform procurement and enter into contracts		1	#7 Procurement & contract in technical
15	Promote personnel competencies and learning		1	#32 To promote and share knowledge in Technical
16	Handle management of a programme		1	Unexplained
17	Involve participants		1	#2 Engagement & Motivation in Behavioural
18	Characterize corporate project processes		1	Unexplained
19	Support handling of project execution tasks		1	Unexplained
20	Provide staffing to the project organization		1	Unexplained
	Ranked as important			

APPENDIX B INTERVIEW QUESTIONS

Questions for specific interviewees

1. What is your background and how are you involved in this project?

Questions for the individual case

2. Which tendering procedure was chosen for this specific project and why? Can you describe the process of the tender?

Questions of the pattern of findings across multiple cases

3. Based on which competencies was the winning vendor selected in this project? Why? How did he distinguish himself from the others?
4. Can you one by one relate the following selection criteria used for this project to certain competencies expected from (you as) the contractor? (selection criteria used from tender documents)
5. Can you do the same for the award criteria? (award criteria used from tender documents)
6. Do you think the competencies were measured and compared well during the tendering procedure? If not, how can this be improved?
7. Can you reflect on the choice of competencies on which Avenue2 was selected and the process of cooperation after the tender? Can you give specific examples of how specific competencies worked out well during project execution?
8. Which competencies are still relevant and which not? Were certain competencies under- or overestimated during the tender?
9. What would you have done differently during the tender procedure?

Questions about the entire study

10. Which competencies are essential and should be used in the selection of a vendor in general?
11. If you would be able to design a competence-based tender, how would you compose the selection process?
12. Do you have any general recommendations for the selection or award criteria currently used during a tender, scoring or the weight factors given?

APPENDIX C SUPPORTIVE QUOTATIONS

C.1 TECHNICAL CLUSTER FROM CASE STUDIES

“When we talk about competencies I think working with people who earned their place in the market, people who know how projects are built and know how to keep projects running. That comes with experience, which in retrospect is traceable.”- Noordoosttangent Tilburg Client

“A lot has to do with technical quality, the trust in the company and many personal qualities because each project is unique in itself. That is the only thing the client can rely on, what we have done in the past. That gives the client the confidence that we will deliver again in the future”- Noordwestelijke Randweg Zundert Contractor

“It always starts with knowing what you can do with the different products, materials and techniques. Technically, everything must be in order. Otherwise, nothing is going to be built. When you really know what the project is about, then it's a matter of trying to explore the boundaries of what is technically possible. ”- A50 Contractor

C.2 TECHNICAL SUB-CLUSTERS FROM CASE STUDIES

PROCESS ORIENTED

“Quality control it’s a very important competence in my eyes”- Contractor A12 Parallelstructuur; “Contractors need to know about the processes of the project.”- Client Noordwestelijke Randweg Zundert; “The importance of process-based working is increasing too”. – Contractor Noordwestelijke Randweg Zundert; “A client should ask the contractor how he will be dealing with changes and how he will be preventing them”- Contractor de Haak om Leeuwarden

PROJECT SPECIFIC

“Some contractors have a lot of experience with RWS tenders, and they know what the client wants to hear. They already have a certain strategy for writing the tender, while others make it easier for themselves with general stories. What we want to see is how the contractor is going to deal with this project in particular.”- Client A12 Parallelstructuur

“We have set out two questions: create an overall traffic management plan and create a planning for Werspsterhoek junction. Those are two very specific questions, and they have been given answers. Risk management will always keep a place, but you have to make it specific because otherwise you get standard stories from all contractors. ” - Client de Haak om Leeuwarden

C.3 BEHAVIOURAL CLUSTER FROM CASE STUDIES

“There must be an open collaboration with giving and taking from both sides and enough space to discuss any issues between both parties. To achieve the above, there must be trust between the parties. The client must realize that the contractor is not a philanthropic institution.”- A2 Maastricht

“For me, the fit of personalities is very important, not only between colleagues but also between our employees and our customer. Having a problem-solving approach as well. You have to give the customer the feeling that things will go well and that we will deliver the results we agreed on. However, the relationship between our team and the client is what really matters.”- Noordoosttangent Tilburg Client

C.4 BEHAVIOURAL SUB-CLUSTERS FROM CASE STUDIES

STRATEGIC & ANALYTICAL

“Processes like landscaping, engineering, planning, often run parallel to each other. The challenge that we face every time is to make an integral design within the short period of time given.”... “The EMAT criteria landscaping and the design of the bicycle bridge had to be attuned to each other.”- Contractor Noordwestelijke Randweg Zundert

“I found it quite remarkable that each vendor had a different strategy of how they will approach the tender. The vendor who from day one worked on one variant was continuously engaged in the ratio of one criterion to the others and was able to improve the entire offer. While others were following a fragmented progress, where at the end it had to come all together”- Client A50 Ewijk-Valburg

“Someone who is creative, has good ideas and good arguments for those ideas. Two is a person who is close to you; everyone has different people preference. Three is perhaps the most important one, don’t talk about the tender and selection criteria themselves which happens quite often, only talk about what needs to happen, what are the challenges, what is the problem”- Client Tilburg

RELATIONAL

“Competence is also the personal skills of your team and the extent to which you can simply cooperate. Although those soft skills are difficult to catch, I am convinced that this really is a success factor: the extent to which you can work together, the degree to which you can delve into the interests of the people on the other side of the table and what they worry about. This relational aspect is applicable not only to the project manager but for all members of the team.” – Contractor A12 Parallelstructuur

“In Design & Construct contracts with freedom for the design, the good collaboration between client and contractor should be more pronounced. If you as a client know what you want, you should use traditional contracting” . - A50 Client

“If people cannot get along with each other, then nothing will happen. The kind of approach, the fit of personalities and the willingness to bring a successful project are very important.”- Noordoosttangent Tilburg Contractor

“Speaking of skills, it is important for the contractor to learn to communicate with the end user. Contractors often want to put a note in the mailbox and start working on the street the next morning. That's not building communication” – Client Noordwestelijke Randweg Zundert

“A contractor and certainly a project manager must be able to bridge the gap between client and contractor, but also with the environment. Communication is one of the main qualities he must have. Internally, he must have technical knowledge, but also be able to communicate with the different parties as subcontractors and end users involved in the project” - Contractor Noordwestelijke Randweg Zundert

APPENDIX D EVALUATION OF SUB-CLUSTER IMPORTANCE BY ARCADIS NEDERLAND BV EXPERTS

The tables present the results from ranking three different types of contracts (in each column) for four Arcadis Nederland BV employees, based on the six sub-clusters of Project specific, Process oriented, Strategic & Analytical, Relational, Individual and Organizational. The first column of each table stands for the importance of each cluster while the rest of the numbers in the rest of the table stand for the sub-clusters.

Employee 1	E&C contract	D&C contract	DBFM contract
Most important	1	3	4
	4	4	6
↓	2	2	2
	5	1	5
	3	6	3
	6	5	1
Least important			

Employee 2	E&C contract	D&C contract	DBFM contract
Most important	2	3	4
	1	2	3
↓	4	1	2
	3	4	1
	5	5	5
	6	6	6
Least important			

Employee 3	E&C contract	D&C contract	DBFM contract
Most important	2	3	3
	1	4	4
↓	3	2	2
	4	1	1
	5	5	5
	6	6	6
Least important			

Employee 4	E&C contract	D&C contract	DBFM contract
Most important	3	1	1
	4	3	3
↓	1	2	2
	2	4	4
	5	5	5
	6	6	6
Least important			

